FACULTY OF TECHNOLOGY

DEVELOPING A BUSINESS MODEL FOR THE IOT PLATFORM ECOSYSTEM

Mehrdad Mirzaei

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ABSTRACT

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<tr><td colspan="2">Author: Mirzaei, Mehrdad</td><td colspan="2">Thesis Supervisor:
Janne Harkonen, Erno Mustonen</td></tr>
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<tr><td colspan="4">Abstract:

The focus of this study is to analyze the present business model for different companies around a common project. Different kinds of products and what is productization is explained. This is followed by a brief explanation on what is IoT and the most important building blocks of business models in a service dominant company. The current state of case studies presents the analysis of important elements in the business model and platform governance context. The results discuss the weaknesses and strengths of each company with regards to different elements. The chosen business model for case studies is discussed in different elements in details and the most important elements of them is how to increase customer interaction by offering complex solution.</td></tr>
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FOREWORD

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LIST OF ABBREVIATIONS

A2A	Application to Application
API	Application Programming Interface
B2B	Business to Business
GDP	Gross Domestic Product
H2H	Human to Human
H2M	Human to Machine
IoT	Internet of things
IR	infrared
M2M	Machine to Machine
MSP	multi-sided platforms
NPD	New product Development
NFC	near field communication
PSS	Product-service System
RFID	radio frequency identification
S-D	Service-Dominant
SDK	Software Development Kit

1 INTRODUCTION

1.1 Background

The Internet of Things (IoT) made a new revolution in the internet area by connecting different devices and sensors together (Mishra *et al.*, 2016). Nowadays, IoT has impacts on everyday life in different aspects. However, there is not enough literature about the IoT business model and how it can be implemented in different area of IoT (Gubbi *et al.*, 2013). This is one the main reasons that why every service dominant company should pay more attention to the business model in this area.

The service-based business model is based on six building blocks; but, other business models frameworks rely on less elements and in general definition (Kindström, 2010). Because of this reason, the service-base business model is used as the theoretical framework in this study. This thesis focuses on the service-based business models related to IoT platforms.

1.2 Research scope and objectives

The Internet of Things (IoT) platform ecosystem and its business model are in the main focus of this master's thesis. The aim of this study is to develop a service model for the IoT platform business ecosystem. The objective of the study is approached through the following three research questions:

RQ1- How to construct a business model for IoT ecosystem?

The aim of this research question is to understand what important factors are to build a service model for IoT business ecosystem. Business models are like a roadmap for every kind of businesses so, the first step is to understand it well. Furthermore, building blocks of IoT ecosystem have been investigated. This research question has been answered by reviewing the existing literatures.

RQ2- What are the case companies' current business models in IoT?

To address this research question, empirical data about current case companies have been gathered through interviews with responsible people to business model. Also, different source of information from companies' website have been collected for this goal.

RQ3- What kind of business model would fit the case companies' IoT ecosystem?

This research question aims to achieve a well-defined service model for case companies. Based on the literature review and also the interviews from companies, the best service model is suggested to the case companies.

1.3 Research process

At first the thesis begins with background and why this topic has been decided. Three research question have been asked and this study aims to answer these questions.

The literature review covers a short description about what is product and productization, relevant literature on IoT and IoT platforms. The IoT platform has been discussed from different points of view in the variety of papers and books. Then has been tried to explain business model related to IoT concept and discuss about revenue model in IoT ecosystem. Finally, it covers organizational buying behavior to help in constructing a suitable service model for different companies.

Then, introducing companies that have been interviewed for the thesis and a short description about each company and their product or services. The aim of this section is to explain how data is collected from different companies.

At the fourth part, related elements to service business model are chosen based on Kindström (2010). Each case company is analyzed in different elements. The case companies are divided in two groups. The first group are producers or those companies that provide services and the second group are those companies that buy service and product from the first group. In this part, tries to answer second research question.

Finally, tries to discuss weakness and strength point of all companies and explain what should do to have a better performance for whole ecosystem. The research process is shown in fig 1.

Figure 1. Research process

2 LITERATURE REVIEW

Since long time ago the word called product has been using. However, today the meaning of product is different from what it was long time ago. One of the most important factors before entering each market is knowing the true meaning of product in that field. Product and productization is going to be explained briefly in this section.

Due to different meaning of the word "product" from the producers' perspective, the Internet of Things bring different meaning by itself and has been growing fast during the past few years, while absorbing attention among manufacturers. Therefore, first of all, any company who wants to enter this field needs a clear vision about what is IoT and how to manage the business model and platform ecosystem related to this topic.

2.1 Productization

Managing products can be challenging for companies when the understanding over what is a product is not clarified. Therefore, it is essential to get familiarized with literature on productization.

2.1.1 Product

Many researchers have been trying to define what a product is, and they have come up with some definitions from different aspects. According to Ulrich (2003), anything that can be sold, for instance as a good, service, or knowledge to a customer or an enterprise can be considered as a product. Product can be software, hardware, service, or a combination of these elements (Kropsu-Vehkapera, 2012).

Products can be tangible (physical goods), services, or intangible (non-physical) ones that are not services, for example, a piece of software or an algorithm (Saaksvuori and Immonen, 2008). Software-based offering like computer programs and anything related to processing information refers to intangible products (Fricker, 2012). In this content all the physical products can be count as the tangible products (Harkonen, *et al* , 2015). Products can be defined as the appropriate combination of tangible and intangible

elements that can be sold to customers to satisfy their needs (Harkonen, Haapasalo and Hanninen, 2015).

Customer value has been defined as a price which is paid by the customer, also the customer value of a product depends on how the customer perceives it (Kortge and Okonkwo, 1993). Customer value is affected by the whole buying process such as time spent and distance traveled (Pitta and Laric, 2004). Customer value can be defined as understanding customer expectations and meeting them, creating and delivering customer experiences, and managing the customer evaluation (Paananen and Seppänen, 2013).

2.1.2 Product-service systems

Companies typically try to increase production, however, in recent years, the effects of this effort have demonstrated that providing tangible products alone is insufficient in terms of remaining competitive (Yu, *et al*, 2008). As a result, companies have begun to offer different types of solutions to increase market share as well as customer satisfaction (Sundin, 2009). One potential method for this challenge is to include services with the physical products through alternative product uses and provide customers with a solution which is known as a product-service system (PSS) *(*Beuren *et al*., 2013). There are two objectives for PSS (Beuren, *et al*., 2013): first, increase the company's competitiveness and profitability, and second, to reduce the consumption for products through alternative scenarios of product use instead of their acquirement. The PSS can re-orient the current standards of consumption and production, thus enabling a move towards a more sustainable society (Manzini and Vezzoli, 2002). Therefore, the key elements of PSS are: (i) the product, (ii) the service, and (iii) the combination of product, service, and their relationship (Goedkoop *et al.*, 1999).

Based on the economy and environmental characters, the PSS can be divided into different groups (Tukker, 2004):

- Product-oriented services: in this category, providers focus on selling physical product with small service for using that product. This service could be an advice for the product to use in the most efficient use.

- Use-oriented service: the product still plays the main role; however, the main focus of business model is not just selling product. Provider has the ownership of product and depends on the situation, might be share with different users.
- Result-oriented service: here, the seller and customer try to make an agreement on the results and there is not any pre-determined product to meet the needs.

PSS can benefit business, customers, and the environment, however, the main benefit of PSS is that it can improve business processes during the product life cycle (Krucken and Meroni, 2006). A company using PSS tries to implement alternative ways for introducing its products to customers and also uses different ways of consuming materials. In this regards, PSS opens new doors to the market and competition (Mont, 2002).

2.1.3 Productization

There have been many definitions for productization during past decades and most of them are based on the nature of different products. For instance, productization is seen as a process of finding a need and combining suitable elements, tangible or intangible, into a product-like object, for which it covers the whole process from the idea to commercial readiness. (Harkonen *ey al*, 2015). In other words, it is the process to have a product to sell in the market, enable producing, delivering, selling, purchasing, and using or consuming. Overall, productization is a process and adds value to the products and services (Suominen *et al*, 2009).

Product structure represent the relationship and properties between different parts and component of a product (Saaksvuori *et al*, 2008). In general, the product stricture can be divided into two main category: the commercial side and the technical side (Tolonen, *et al*, 2014). The commercial side is what customers can see and choose between different product of a company and the technical side can be defined as different elements of a product (Tolonen *et al*, 2014)

During product development, productization can speed up innovation and product development itself (Suominen *et al*, 2009). The innovation process as a standard process can be divided in three main groups: basic research, productization, and exploitation (Nelson *et al*, 2005). Therefore, the productization does not form the whole innovation

process but it has direct impact on innovation (Suominen *et al*, 2009). The value of productization in innovation is shown in fig 2.

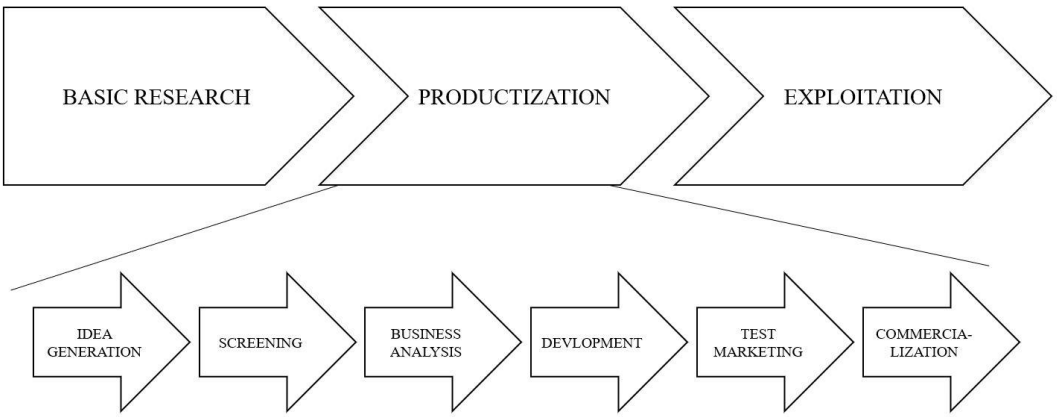

Figure 2. Productization in the innovation process in the context of NPD

Productization can be classified in different fields based on the existence of different products. Table 1 shows the roles and activities of productization for different kinds of products (Harkonen *et al*, 2015).

Table 1. Different product context and the roles of productization

Content	**Role**
Product	In the context of physical product with both tangible and intangible elements, productization has an impact on engineering aspect, development of product and introducing to market.
Service	In the context of service, productization has an impact on service offering, creating repeatability and enhancing understanding of the offering.

Software	In the context of software, productization has an impact on interface of development and market with standardization that refers to repeatability and scalability.
Technology	In the context of technology, productization has an impact on creating balance between engineering and marketing-oriented views.

2.2 The Internet of Things (IoT)

Nowadays, usage of the internet dramatically grows to compare with the last decades. Many people use the internet for their own business, hobbies and also to communicate and socializing with others (Mishra *et al.*, 2016). It is obvious that this usage needs a powerful platform to connect all the machines and smart objectives to each other (Miorandi *et al.*, 2012). In 1999, Kevin Ashton proposed the term 'internet of things' (IoT) for the first time to define a globally emerging internet-based information service structure (Ashton, 2009). There are many definitions for the internet of things in different references, the main point being about connecting different devices through a network. Sensors have a key role in IoT, and they have a big portion in devices that are related to IoT (Borgia, 2014, Dlodlo *et al*., 2012). Sensors are devices that can sense many parameters like temperature, light, pressure, sound, motion, etc. (Thibodeau, 2014). There are more than 10 billion connected devices all over the world and they are increasing rapidly (Columbus, 2016).

Internet of things is a network of worldwide interconnected objects which are uniquely addressable based on different protocols, and it can connect objects through wireless or wired networks (Bassi *et al*, 2008). As mentioned before, the term 'things' in IoT refers to smart or intelligent objects (Andersson *et al*, 2015). The smartness of objects can be defined by the ability of identification, sensing, networking and processing to items and objectives (Kortuem *et al*, 2010).

The main impact of IoT is the influence which it has on the everyday life of its users, involving aspects such as assisted living, smart homes and offices, e-health, and learning (Atzori *et al*, 2010). IoT has a direct impact on environment, society and business with the creation of new intelligent applications and services (Garcia-Morchon *et al.*, 2013). The portion of gross domestic product (GDP) that comes from primarily physical industries is still more than GDP from industries working on digital area. IoT will close primarily physical industries to cyber world and change their business. For instance IoT can decrease the labor cost and also speed up the industrial process (Borgia, 2014).

Figure 3 shows the main point of view of technologies and standards from three perspectives: physical objects, networking between objects, and cooperative processing. In this figure, the main elements of IoT are illustrated such as: things-oriented vision like smart items, Internet oriented vision like web of devices and semantic oriented vision like semantic technologies. These three building blocks together can make IoT (Bandyopadhyay *et al*, 2011).

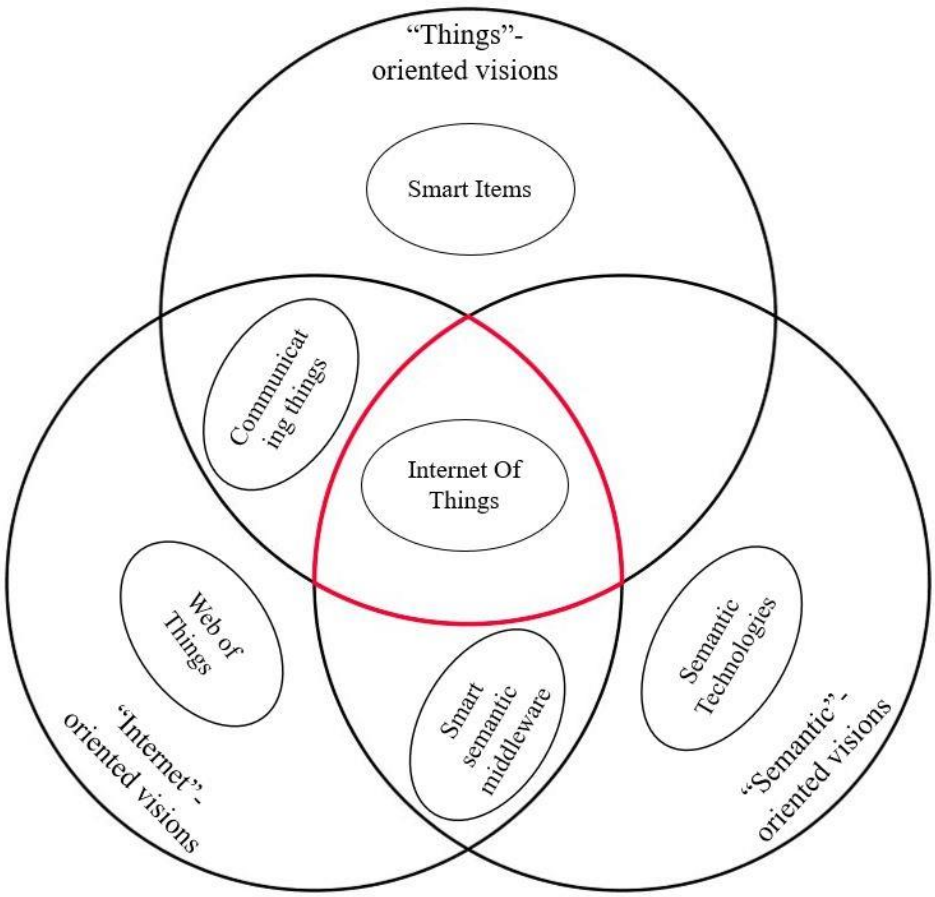

Figure 3. Convergence of different visions of IoT

There are more than 10 billion connected devices all over the world, and their numbers are increasing rapidly (Columbus, 2016). Also, the economic aspects of IoT have been growing due to the high usage of IoT during recent years. Sensors have a key role in IoT as they link to devices that are related to IoT (Borgia, 2014, Dlodlo *et al.*, 2012). Sensors are devices that can sense many parameters like temperature, light, pressure, sound, and motion (Thibodeau, 2014).

2.2.1 IoT platform economy

The current situation of the market is known as the revolution in technological adoption which refers to forming a huge range of connected devices and smart tools (Yang, 2014). Towards technological advancement, the adoption of IoT has been increasing during

recent years. Fig 4 shows the economic prospect of IoT based on six main factors (Alrabea *et al*, 2019). The productivity-based aspects is at the demand side; while, the GDP contribution is located at the supply side. Depends on the situation IoT can have direct or indirect impact on employment and supply side. All in all, IoT can have impacts in all aspect of business (Alrabea *et al*, 2019)

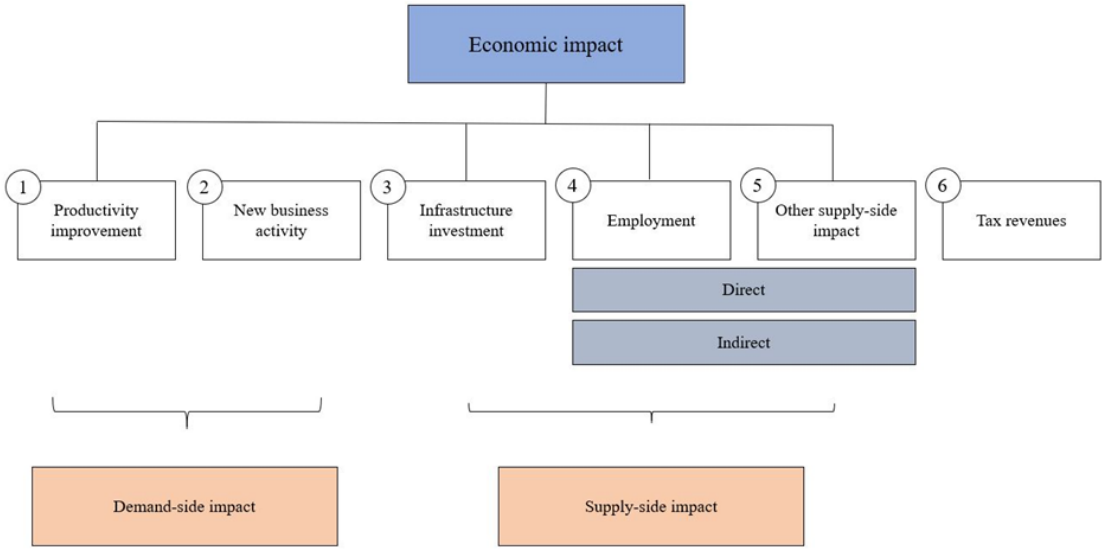

Figure 4. Economic prospects of IoT

2.2.2 IoT platforms

Using IoT has been started already years ago by connecting devices to each other. Therefore, platforms were built to connect smart devices together. In the beginning, different producers tried to make the suitable platforms for their own products, but this kind of thinking cost too much for the company. Therefore, eventually, all the manufacturers tried to use common platforms for their devices (Nakhuva *et al*, 2015). IoT platforms have received lots of attention recently because of the dramatical increase of smart objects in human life. Many companies have started to develop a suitable platform and all of them was with a common purpose: to interconnect smart objects. For instance, Amazon has the "AWS IoT Platform" and IBM has Watson IoT headquarter in Munich (Scully *et al*, 2016).

Platforms are often known as the main core of business ecosystems which are built by the ecosystem owners or vendors (Gawer *et al*, 2014). In the context of complementary products or services, all producers are known as "complementors" and all the stakeholders that are interacting in the platform referred to as sides (Teece, 2007, Toivanen *et al* , 2015). Therefore, multi-sided platforms (MSPs) that create value by connecting more than one party who want to exchange products, services, and information (Tiwana, 2013). IoT platforms make the number of generic, i.e. application independent functionalities that can be used to build IoT applications (Köhler *et al*, 2014).

Table 2 shows two common IoT platforms (Nakhuva and Champaneria, 2015).

Table 2. Various Internet of things Platforms

Name	Key Features
Google Cloud Platform	- Run on Google's infrastructure - Scalability - Compute, storage, and services - Higher performance - Provided support if required - Assurance of Google Grade security and compliance for your applications - Environment safe cloud
IBM BlueMix	- Powerful web dashboard - Device Registration - Scalable connectivity - Security of communication - Storage of data - Provided support if required

Platforms play a significant role in information technology-driven businesses. Many big companies like Microsoft and Apple make hardware and software products around platforms. From this sight of view, platform can be defined as a set of elements that supports variety and evolvability in a system by constraining the linkages among the other components (Eisenmann *et al*, 2006, Baldwin *et al*, 2009). After defining the platform, platform governance is another important part and the goal of all platform governance is

to organize communication between different actors (Boudreau, 2010). Governance has been defined as what keeps the ecosystem together (Manner *et al.*, 2013). Table 3 shows the platform governance concepts based on the different references (Schreieck *et al.*, 2017).

Table 3. The platform governance concepts.

Concept	Aspects
Roles	• Number and order of sides • Distribution of power • Ownership • Relationship to stakeholders
Pricing and Revenue Sharing	• Achieving network effects • Barriers to market entry • Subsidizing of one or more sides
Boundary Resources	• Software tools (API, SDK) • Documentation • Data
Openness	• Granting access to technology • Giving up control over technology
Control	• Informal control mechanisms • Formal control mechanisms
Technical Design	• Modularity • Interfaces • Compatibility
Competitive Strategy	• Competition • Co-opetition, collaboration • Absorption & Envelopment • Public Relations
Trust	• Relationship complementor platform owner • Relationship end user platform

The analysis of the governance mechanisms of IoT platforms is presented according to Table 3 (Schreieck *et al.*, 2017). One thing that is common between almost all platforms is the end-user or customer side. However, all platforms should not just deal with customers, also with the intermediary sales partners on the demand side. Devices and device partners can be added to the platforms as an additional feature. Most of the platform vendors try to focus on the demand side before developers. Therefore, these platforms are user base and less attention on the supply side. Finally, depending on the situation, the state of the ownership of a platform is different from case to case (Schreieck *et al.*, 2017).

Most of the platforms offer APIs and SDKs also use starter kits for the users to enable a fast and smooth integration for their devices. Most documents also have step-by-step tutorial code samples to help developers to connect their device to the platform. All the platforms offer a help center to assist customers in emergency situations. As the final note, all the platforms offer forums for exchanging information among their customers and also to answer their questions in the forum (Schreieck *et al.*, 2017).

All the platforms offer a free trial to strengthen trust among their potential customers. The price of the platforms depends on the different features that it has for instance hosting option, the number of devices that are connected, and subscribers. The governance of revenue sharing almost depends on the platforms which offer a white-labelling or that have a dedicated application marketplace (Schreieck *et al.*, 2017).

The openness of platforms can be discussed in two different dimensions: towards their users and towards third-party developers. Most of the platforms have the ability of self-registration for new customers to directly start using the platform. However, some platforms are not open for third-party developers (Schreieck *et al.*, 2017).

2.2.3 IoT platform ecosystem

The creation of the economic value has been changed from individual contributions by single firms to the integration of user's knowledge to the creation of value in complex service ecosystems (Edvardsson *et al.*, 2012). The IoT platform ecosystem consist of a platform owner that applies governance mechanisms to make value creating mechanisms

on a digital platform between the platform owner and an ecosystem of independent complementors and consumers (Hein, Schreieck, *et al.*, 2019). Nowadays, the speed of IoT growth rapidly increases and the emergence of IoT ecosystem with common standards, domain, platforms, and interfaces feels more than before. Without these common infrastructures, the cost of using IoT would be more than what is expected and impossible to be used with many products (Mazhelis, Luoma and Warma, 2012). Furthermore, based on some studies, service platforms have emerged as a dominant model (Lusch and Nambisan, 2015, Hein *et al.*, 2019). Service platforms are known as the center of an ecosystem with different elements and take advantage of network externalities (McIntyre and Srinivasan, 2017, Lusch and Nambisan, 2015). The business ecosystem is a network of producers of products or services, suppliers, and buyers (Moore, 1997). Figure 5 shows the different actors in a business ecosystem.

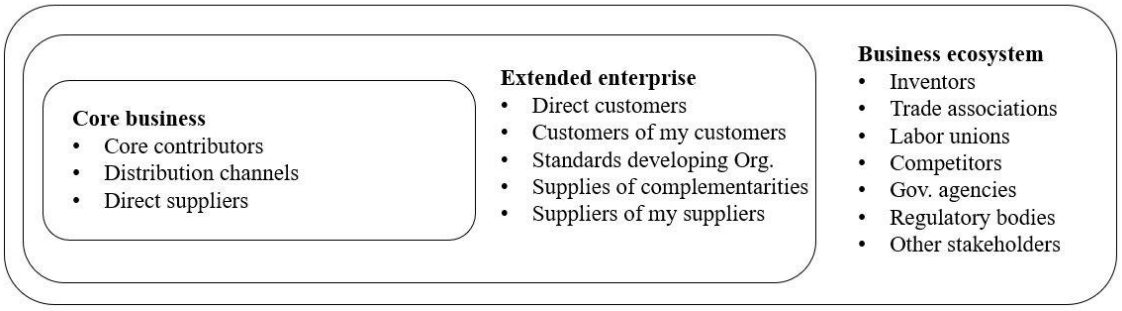

Figure 5. Generic actors in business ecosystem

There are three different building blocks for digital platform ecosystems (Hein, Schreieck, *et al.*, 2019):

1- **Platform ownership**: it is a critical factor for designing and governance of digital platforms (Bakos *et al*, 2008). Platform ownership is not just about who owns the platform, but also about the distribution of power and relationship among actors in the ecosystem. Based on this definition there are three different kinds of ownership in digital platforms. First, centralized digital platform ecosystems which are controlled by a single owner like Facebook (Hein, Schreieck, *et al.*, 2019). Second, a group of actors owns the digital platform and governance

mechanism (Bazarhanova *et al*, 2019). One of the examples for this kind of ownership is the Cloud Foundry. It is an open-source, multi-cloud application platform-as-a-service governed by the Cloud Foundry Foundation. Here, the power is distributed among stakeholders (Hein, Schreieck, *et al.*, 2019). Third, decentralized digital platform ecosystems are governed by peer-to-peer communities such as Ethereum can be governed by the community (Riasanow *et al.*, 2018).

2- **Platform value creation mechanism in the ecosystem**: successful platform are the platforms which use value creation mechanism in platform ecosystem and it has to be built on efficient and convenient facilitation of transactions (Tiwana, 2013). Digital platforms help complementors and customers to interact and exchange value in a mutually beneficial manner (Evans, 2012). Another value creation for digital platforms is the capability for innovation by giving this opportunity to complementors (Tiwana, 2013).
3- **Complementor autonomy**: the complementor of autonomy shows the degree of freedom among the complementors when they are creating value in digital platforms (Ye *et al*, 2018). Complementors with a high autonomy are loosely coupled to the digital platform and contribute to the variety and amount of complements and complementors with a low autonomy are tightly coupled to a digital platform (Boudreau, 2012, Danneels, 2003).

When it comes to service platform ecosystems, based on different references there are three main requirements (Lusch *et al*, 2015, Hein *et al.*, 2019):

1- **Ecosystems need to provide flexibility and integrity in their structure**: flexibility in structure means that how easily actors can work together inside the ecosystem. Integrity in structure means the relationship between actors in A2A network (Lewicki *et al*, 2009, Tilson *et al*, 2010).
2- **Shared ecosystems need to offer a solution for the cognitive distance between all the actors:** the common view in the form of standards or institutional logic guarantee that actors as a group interpret the integration of resources and that they align more quickly on resource exchange (Hendriks-Jansen, 1996).

3- **Service ecosystems should provide the architecture of participation and make a sure contribution of all actors** (Hein, Weking, *et al.*, 2019).

To make the best value co-creation, the platform should establish transparency about the ecosystems' actors, what they know and what they can do (Schreieck and Wiesche, 2017).

All ecosystems need a core that represent the common asset for all the ecosystem members. For IoT, this core can be defined as software, hardware, and standards which are used for interconnection between the devices. IoT business ecosystem is one kind of business ecosystem, which helps individuals and companies to have a contraction between themselves while the companies are competing with each other by utilizing a common set of core assets related to the interconnection of the physical products on the Internet. These assets may be in the form of hardware and software products, platforms, or standards that focus on the connected devices, on the connectivity thereof, on the application services built on top of this connectivity, or on the supporting services needed for the provisioning, assurance, and billing of the application services (Hein, Schreieck, *et al.*, 2019).

Each IoT ecosystem has two separate parts, first one is the device part, which includes the smart products, and the second one is the application part inside the ecosystem. The product manufacturers offer a physical product as solutions that are equipped with embedded systems and gateways. Furthermore, the application platform should provide a suitable environment for the application development. Consequently, an IoT application should provide an open platform architecture for the ease of access and development (Papert and Pflaum, 2017).

Most of the business to business (B2B) platforms have three main challenges to co-create value in their ecosystems (Hein, Weking, *et al.*, 2019):

1- **Unclear ownership of product and services**: it means that the ownership right for data, applications, and services are not clear from partners' point of view.
2- **B2B customers account for special usage**: it means that the rules and restriction in different areas are different.

3- **B2B customers have an inhomogeneous and highly specialized variety of machines, processes, and systems**. Because of that, the producers need to pay more attention to customer's department, machines, and processes.

The central elements of IoT are the ecosystem, the ecosystem core, and the business model. These build a framework that connect different types of business models with the underlying ecosystems (Leminen *et al.*, 2012).

2.2.4 Service business models in IoT

The business model can show how a company creates, delivers, and captures value (Osterwalder and Pigneur, 2010) also it is a blueprint that shows how a company does business (Osterwalder, Pigneur and Tucci, 2005). Business model is like a plan for a company to generate revenue and make the profit from operations, and a company without this plan will not be successful (Chan, 2015). Fleisch et al. (2015) have defined the business model with four main elements:

1- Who are the customers?
2- What is being sold?
3- How is it produced?
4- How is the revenue earned?

The business model can be reviewed in many different ways, however, some studies show that all the business models have the same basic elements (Shafer, Smith and Linder, 2005). The business model canvas is one of the most popular business models that shows how to create a new business model or analyzing an existing business model (Osterwalder and Pigneur, 2010). The business model canvas has the following nine components which also called building blocks (Osterwalder and Pigneur, 2010):

1- Key partners - Who are the partners of the company and what is required for the partners?
2- Key activities - What activities are needed to deliver the value propositions?
3- Key resources - What resources are required to create value for the customer?
4- Value propositions - What value does the company deliver to its customers?

5- Customer relationships - What kinds of relationships between customers does the company create?
6- Channels - How does the company reach its customers?
7- Customer segments - Who does the company create value for and target?
8- Cost structure - What are the costs of the business model?
9- Revenue streams - How is income generated from the customer segments?

Traditional business models have been generated on a firm-centric basis, but the ecosystem is different around the IoT because sometimes companies need to collaborate with competitors and across industries. That is why traditional business models are not effective for the IoT ecosystem (Chan, 2015). Many opportunities have been created in the IoT area because it has many different applications areas (Manyika *et al.*, 2015). One of the most important reasons for using the business model is that they are effective ways for analyzing, implementing, and communicating business strategic choices (Shafer, Smith and Linder, 2005). Many producers use different types of business models for their products which can be physical products, services, or a mixture of both. The purpose of using business models in IoT is to create value for their production, or to make solutions (Leminen *et al.*, 2015). Figure 5 shows the basic principles for designing an IoT business model (modified from Lai, Jackson and Jiang, 2018).

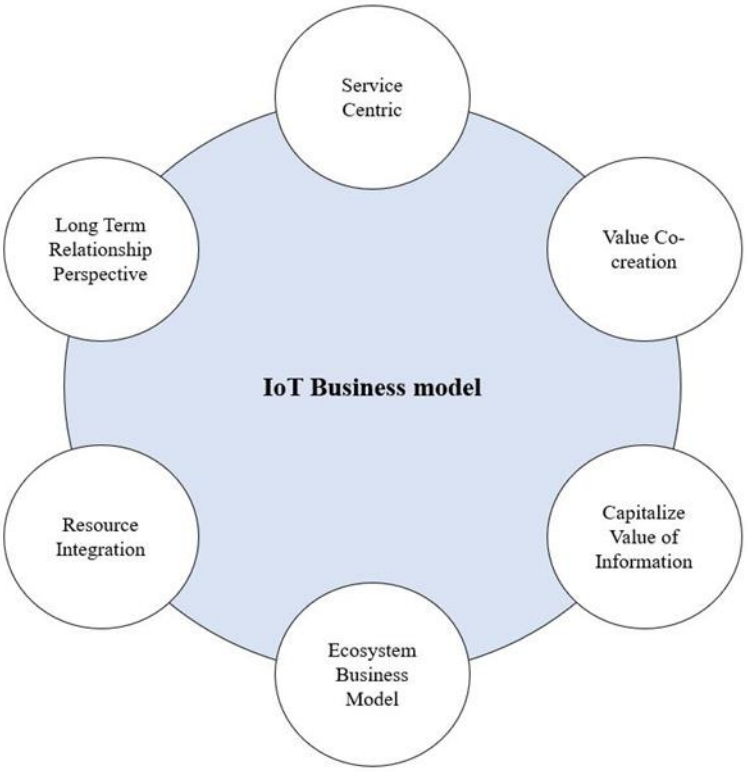

Figure 6. Guiding principles for designing business models for IoT

Value creation in IoT can be divided into three layers: manufacturing, supporting, and value creation (Chan, 2015). The manufacturing layer refers to manufactures and retailers which are providing items like sensors and terminal devices. The supporting layer collects data that is useful in the value creation process. The third layer uses IoT as a co-creative partner because the network of things is able to think for itself (Chan, 2015). Nowadays, products can connect to each other and most of them have lots of features to track the customers' behavior (Hui, 2014). Therefore, it is better to use Service-Dominant (S-D) logic to make a business model for IoT (Turber *et al.*, 2014). In S-D logic, the duty of firms is not just selling the product to customers but also acting as a platform for customers and competitors. In S-D logic, the traditional firm-centric view is replaced with the network-centric view. Table 4 shows the key aspects and main issues of a service-based business model (Kindström, 2010).

Table 4. Key aspects and main issues of service-based business model.

Business model parameter	**Key issues**
Value proposition	- Articulated offering - Visualization - Closer customer interaction - A dynamic offering portfolio
Revenue mechanisms	- New revenue model
Value chain	- Dedicated roles for service development - A structured service development process - A new reward system - Extending the resource base
Value network	- Finding partners that can add value to the new offerings
Competitive strategy	- Branding - Differentiation
Target market	- New customer segmentation

There are four layers of opportunity to adding value in the business model by collaboration. These four layers are: device, connectivity, service, and content layer (Yoo *et al.*, 2010). The device layer involves hardware and operating system. The connectivity layer involves transmission through network and physical transport. The service layer involves direct interaction with users through applications and the content layer has all the data (Chan, 2015).

Six types of general business models have been defined for IoT (Fleisch, Weinberger and Wortmann, 2015):

1- **Physical Freemium**: this means the physical asset and free digital service that are sold to customers without any additional charge.
2- **Digital Add-on**: physical products can be sold to the customers very cheaply and customers can activate other feathers at any time with a higher margin.
3- **Digital lock-in**: This refers to a sensor-based, digital handshake which are used for limited compatibility, prevents counterfeits, and ensures warranties.
4- **Product as Point of Sales**: the customers receive services directly at the product or via smart devices and identification technology.
5- **Object Self-Service**: this is related to the ability of devices to place orders on the Internet.
6- **Remote Usage and Condition Monitoring**: smart objects can send data about their situation and their own status in real-time. This can be helpful for detecting errors and monitoring usage.

In addition, IoT business models can be divided into four categories based on their main value propositions (Suppatvech, Godsell and Day, 2019).

Add-on business model: one that uses IoT for enabling extra features, functions, or services to existing products or maybe a personalized service for specific customers. In order to access additional IoT-enabled services, customers need to purchase a good or service first.

Sharing business model: users or customers pay for certain time of using the product or service which allows customers to use the product or service when it is available.

Usage-based business model: IoT is used to measure the amount of product usage and allow the customer to pay for their needs.

Solution-oriented business model: IoT is used to make a solution for their customers. In other words, providers use IoT to offer solutions for customer needs.

2.2.5 Revenue models in IoT

The revenue model is one of the most important elements of business model (Chesbrough *et al*., 2002; Gassmann *et al*., 2014). Based on Fleisch *et al.* (2016), there are two different kinds of revenue models in IoT. The direct revenue model and the indirect revenue model. In the direct revenue model vendors make revenue by selling product or service directly to customers, so there is just one source of revenue. In the indirect revenue model the selling item is a mixture of physical product and service, and maybe more than two vendors are working together (Fleisch *et al.*, 2016).

2.2.6 Benefits and challenges of IoT

The usage of IoT in human life is increasing every day in many fields, including the industry and agriculture. The wireless sensor networks have been developed for agriculture usage to help machines to do their work more precisely (Wang, Zhang and Wang, 2006). IoT can also reduce the promote services by using the common data storage, sharing data and information. IoT can prevent fraud, and also ensure safety for a variety of industries. Because of the suitable monitoring of resource and usage of product, IoT can eliminate waste, and also help companies to reduce their cost and be competitive in the market. It is much easier when a company use IoT for monitoring operational efficiency, which can help producers to use their maximum ability to produce a product (Wang, Zhang and Wang, 2006).

On the other hand, there are some challenges in using IoT which makes it sometimes expensive for industries. The initial cost for using IoT is high, and all the companies are not able to use it widely. In some cases, the business model is not compatible with the company business model. For little amount of industries lack of knowledge about how to utilize IoT has been made some difficulties before. Therefore, before using IoT to make products, companies must have enough knowledge about it (Wang, Zhang and Wang, 2006).

2.3 Organizational buying behavior

IoT has a lot of impact on all kind of industries and it has been growing rather fast in the last decade. Many companies try to invest in the field to use its advantages in their products (Porter and Heppelmann, 2014). The industrial buying process has been defined as complex series of interdependent actions which include understanding of a need, technical specification, supplier evaluation and final purchase decision (Robinson, Faris and Wind, 1967). There are two basic aspect for a purchasing process (Osmonbekov and Johnston, 2018): 1) *communication aspects*: obtaining, retrieving, analyzing, and distributing information relevant to a purchasing decision. 2) *transaction aspects*: activities related directly to the consummation of the actual purchase.

In business to business marketing three main buying situations have been identified by researchers including: straight rebuy, modified rebuy and a new task (Robinson, Faris and Wind, 1967). In straight rebuy situations, both communicational and transactional aspects of buying will become more M2M, because firms will use their technological capabilities to make these transactions more efficient (Osmonbekov and Johnston, 2018). In the modified rebuy and new task situations, the amount of M2M communications will increase, but H2H and H2M will still be important because building trust via H2H and obtaining information via H2M will reduce uncertainty of these type of transactions (Osmonbekov and Johnston, 2018).

2.4 Literature synthesis

The key points of literature review include clarifying the key terminology:

- Product-service system: a combination of physical product, service, and supporting network to satisfy more customers' need.
- Internet of things: a network of connected devices which are uniquely addressable based on different protocols.
- IoT platform ecosystem: it consists of a platform owner that applies governance mechanisms to make value creating mechanisms on a digital platform between

the platform owner and an ecosystem of independent complementors and consumers.

- Service business model: it is a plan for the company to generate revenue and make the profit from operations, and a company without this plan will not be successful.

The business model around IoT area is different from other kinds of business. IoT is a mixture of service and physical goods. Based on different references the best business model for IoT area is a service business model. Figure 7 illustrates the main elements of service business model.

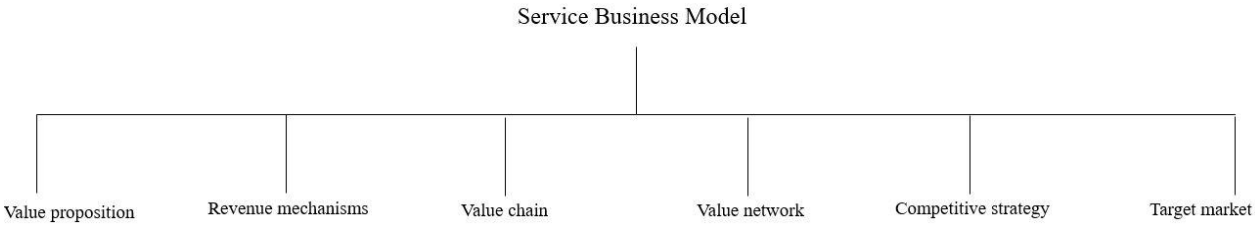

Figure 7. Main building blocks of service business model in IoT

3 CURRENT STATE ANALYSIS

This chapter discussed the current state of the analyzed case companies in terms of their current productization and business models.

3.1 Research method

The research methods **about service-based business models** are not too much**,** therefore a **case study approach was chosen as the best-suited research method** (Miles *et al*, 1994). Also, multiple case studies has been used for the same approach in the research method field (Eisenhardt *et al*, 2007; Yin, 2003). The current state of productization and business model practice have been analyzed through the collection of empirical data in the form of structured interviews in seven case companies: six are seller companies and one is a buyer company. The interviews have been held with the key people that are responsible for business and product portfolio management. Key people have been interviewed and each interview lasted near one hours. Table 5 shows the interviewee roles in the analyzed companies.

The current state analysis aims to answer research question one. What are the case companies' current business models in IoT? The most important components of a service-based business model are value proposition, revenue mechanisms, value chain, value network, competitive strategy, and target market. So, they are utilized to support structuring the analysis. The analyze of the platform governance another important factor. The main building blocks of IoT platforms in the case companies is discussed in this section.

Table 5. Interviewed participants and their roles.

Case Companies and field of their business	Roles of interviewee	Nature of business
A: Solution for metallurgical industries	Co-founder, chairman of the board, chief metallurgist	B2B
B: Condition monitoring of industrial devices	Chief Operating Officer	B2B
C: Controlling of casting process	CEO Head of the research	B2B
D: Smart trackers	Project manager	B2B
E: In process water analyses for metallurgy companies	CTO	B2B
F: Metallurgical modeling for casting	CEO	B2B
G (buyer company): Metallurgy	Process development manager	B2B

Most of the interviews have been done virtually through the Microsoft teams or Zoom and two cases through filing out the questionnaire. At the beginning of each session a brief introduction about the subject was given to the interviewed person to have a good understanding about the context. Then, questions were asked based on the pre-defined questionnaire. All the interviews have been recorded through recording devices and

important notes have been taken during the sessions. Furthermore, all the company's web pages and materials were utilized to have a better understanding about the situation. The overall results are presented in this chapter.

3.2 The case companies

Case company A:

The case company is a B2B metallurgical company which provides unique solutions to monitor the production of metals at any temperature. For this goal, high speed imaging and laser illumination technologies are being used. The main customers are metallurgical factories which need surface inspection. The main offerings of company A are 1) solution for visualizing, monitoring, and assessing the quality of flat, long, round and rolled products. It can be applied from high to low temperature processes. 2) solution for monitoring tapping of molten metal and slag in a multitude of process phases. 3) complete solution for monitoring inner surfaces of ladles, converters, and furnaces in high temperature conditions. 4) core part of all company A products, it is a complete IoT platform for the metallurgical industries. By using this solution, users can make immediate decisions during the production process and use this information later on to enhance the process control.

Case company B :

This case is a B2B company that collects raw data from different hardware in the industry and convert it to useful data. Company B uses edge-computing and IoT platform for its work and transfer gathered data from sensors to platform for analyzing the information. The main solutions that Company B offer are: 1) pump condition monitoring: vibration of the pump, temperature of the motor and pressure of inlet and outlet of the pump can be continuously measured and monitored during the operation. 2) condition monitoring of gearboxes: vibration levels of the gearbox bearings, oil temperature and the gearbox rotation speed can be measured 3) Blower condition and usage monitoring: Company B sensors are useful for balancing the fan blades and measuring the air pressure produced by them.

Case company C:

Company C is a B2B company that helps metallurgical industries to optimize their process at high temperature. The way of controlling process during melting at arc furnace has been invented by company C for the first time. The main offers of company C can be divided into two groups: Product A and Product B. Product A: during the melting process, all component such as slag, flame and arc emit light. These light sources are analyzed during the process by optical emission spectroscopy. Then analyzed information sends to control system of furnace. Product B: it is a real time temperature measurement for high temperature metallurgical process. It can be used for measuring the temperature of slags, hot gases and mold.

Case company D:

Company D is a B2B company that works with large variety of industries based on tracking devices. Company D IoT platform is designed to integrate business intelligence in organizations. Company D has been working co-operating with big companies such as: Finnair, Microsoft, and Outokumpu. In the steel industry company D uses sensors to make the casting process visible for metallurgical companies. Its sensors can collect data from melting pot and this data is analyzed by the system. Outcome of this process can be situation of metal and pot also the best time for casting or stop heating.

Case company E:

Company E is a B2B company that analyses the water during the industrial process. Its technology can detect multi-metal at real-time from aqueous samples. During the measurement, the molecular analytes of the sample breaks into atoms and then these atoms to their higher electronic states. Upon returning to their ground states atoms release their excess energy by emitting optical radiation. Analysis of the emission spectrum reveals the sample's elemental composition and the respective concentrations in real-time. Company E can analyze the samples at maximum 5 bar and 50 degrees centigrade. The typical limit of detection is 1ppm for solved metals in water. Some features of their

solution include sampling until reporting results just takes 5 minutes, automatic calibration and automatic cling up sensors and machines.

Case company F:

Company F is a B2B company that offers solutions for metallurgical companies. Company F is a small company that offers modeling for casting. This modeling helps metallurgical companies to understand the chemical composition of melt and is it the good time for casting or not. Another service is about control the speed of continues casting just with online models. By these solutions, the need of analyses the sample each time before casting decrease. Company F do not use any sensor or camera and offer their solution just based on mathematical models.

Case company G:

Company G as the buyer is a B2B company that makes the high-strength steels and provides services for better performance and sustainability. It has the cost-efficient system for producing near 9 million tons steel per year. This case company has a large variety of customers from all over the world. For the case company G, utilizing the IoT improves the production rate and reduce the cost by easier and faster way to analyze the data. Furthermore, sensors by doing measurements at high temperature have solved some problems in production line.

3.3 Current State of Business Models:

3.3.1 Value proposition

The products presented to customers vary from company to company as mentioned in the research process. Company A offers solution for metallurgical companies and support their customers in the long term, as long as customers use their products. This contract guarantees availability of spare parts and 24/7 hours support during the usage. This is one of the biggest points of their work. Company A has ability to create new services for customers depending on what customers need but services can also be more expensive. Company A uses the normal way of advertisement like brochures and internet webpages.

Company A tries to list advantages of their product for customer to convince them for using their service. Company A's solutions can monitor the products and detect defects in all temperatures in the production process. This means that firms can analyze the product in each step and if a product is not qualified for the next step, producers can push that one to another stage and prevent wasting money and time. Hence, they can reduce the operational time and expenses.

Company B offers solution for industrial companies that use pumps, blowers, and gearboxes. Based on what company B offers, the category of its customer is too big. Company B has a long-term relationship with its customers. In the contract, basic parameters include such as: availability of spare part during contract and the availability of support. Depends on what customer wants, there is a monthly meeting or each two weeks. Company B tries to visualize its service via advertising throw internet, articles in relevant magazines, attend in different seminars, and brochures. The customers have a suitable interaction with service provider, and it is helpful to customize the offer for them. All the solutions that Company B provides help customers to use their tools for longer time by better efficiency so, it causes money saving during a certain period.

Company C solutions are useful for any metallurgical industries that use arc furnace or need to measure high temperature around melted metal. The main point of value proposition in this company is increase operation efficiency and cost reduction. By Product A technology, working atmosphere of electrodes can be controlled and it means that the electrodes lifetime will increase. Furthermore, reaching the melting point is faster and it means less energy with more efficiency. Product B solution also cause more efficiency and cost reduction by accurate the casting process. Company C guaranteed the return of investment less than four month. This could be spectacular point for customer companies. During the contract customer companies do not have any concern about availability of hardware, repair, and software support. The relationship with customers is the long term, because of the regular meetings and the lifetime support. Visualizing the offers is reached through advertising on webpages and social media, using agents to introduce solutions to customers, and attending in related seminars to identify potential customers in this field. However, customers do not have any choice to change the offering

solution. In other words, the solutions are fixed, so customer interaction in this field is narrow.

The variety of services in Company D are more other companies in this study. However, this case is going to be analyzed on common features. Like every other company, Company D tries to reduce operation cost. By using their services, the price of data transfer for tracking devices is decreased. Other features like bi-directional, always online, secure and battery optimized communication can be guaranteed at the beginning. The most important part of value proposition is indoor tracking that offers by Company D and this one makes them different from thousands of companies doing the same work. Visualizing the services are reach by advertising, seminars, and meeting with potential customers. Company D is able to optimize the service for each different customer. They have large variety of customers from Finnair to Microsoft and Company A that each one is in the different field. Therefore, they want to increase interaction with their customers. Company D has a long-term relationship with customers.

For the first and most important element that is cost reduction, Company E offers a novel solution for steel industries that can analyze the water in less than five minutes. By using this solution, factories do not need to spend a lot of money and time to take a sample and give it to a laboratory for analyze and wait for the test result. Due to this fast analyze, the maintenance cost also decreases on the production line. Based on the contract, repair and replacement of the spare parts can be guaranteed by the Company E. Therefore, the relationship with customers is long-term as far as they use the service. Visualizing this service is reached through partners, advertisement and retailers. The interaction with customers are just about customers' feedback about the service and based on what Company E offers, the service cannot be changed totally form an organization to another organization.

The main element in value proposition for Company F is also cost reduction. Their solutions reduce the need of analyzing melt each time before casting. Furthermore, they can also speed up the casting process. The relationship with customers is depends on customers and it can be short-term or long-term relationship. Some customers like the alpha company wants to pay step by step and develop the service during the usage but

others just pay one for the service and use it. The visualizing the service is just through partners. Company F does not have any website or advertisement. The contraction with customers is also narrow and the services can be changed a little bit based on what customers want.

Table 6. Value proposition in case studies.

Case companies	Value proposition
A	Reduce the operational time and cost, online support, advertising through magazines and webpages, long-term relationship
B	Increase the working hours of mechanical devices, reduce the cost, advertising through magazines and webpages, long-term relationship
C	Increase operation efficiency, cost reduction, return of investment in a short period, advertising through magazines, seminars, and webpages, long-term relationship, online support
D	Reduce operational cost, advertising through magazines and webpages, long-term relationship
E	Reduce the operational time and cost, advertising through magazines and webpages, long-term relationship
F	Cost reduction, speed up the industrial process, visualizing the service through partners, Both long-term and short-term relationship

3.3.2 Revenue mechanisms

In a product bases company, the revenue mechanism depends on what they sell to customers but in a service base company other factors are included such as hourly billed work. Company A gets paid once for the hardware like cameras and sensors and then

there is another payment based on the usage of their customer. Therefore, Company A uses kind of standard contract. Company B also uses the same revenue mechanism, customers are charged for hardware like sensors and then monthly payment for cloud service and software. Company C has two kinds of revenue stream. The first one, fixed price for hardware and installation at the beginning and monthly or yearly payment for the service. The second one, just monthly or yearly payment for using service and nothing for hardware. In this case ownership of hardware belongs to Company C. Company D has fixed price at the beginning for hardware. Customers should pay per device or per service they want to use. Then there is monthly or yearly payment for the service. Also, it is cheaper if the fee is paid per year. The revenue stream for Company E is a little different and customers just should pay monthly fee for using the service and not any fixed priced at the beginning for the assets. Company F is paid just once at the beginning of work for whole service.

Table 7. Revenue mechanisms in case studies

Case companies	Revenue mechanism
A	Fixed payment for the hardware and monthly payment for the service
B	Fixed payment for the hardware and monthly payment for the service and cloud
C	1) Fixed price for hardware and installation at the beginning and monthly or yearly payment for the service, 2) monthly or yearly payment for using service and hardware belongs to service provider
D	Fixed price at the beginning for hardware and pay per device or per service that customers want to use. Then there is a monthly or yearly payment for the service
E	Monthly or yearly payment for the service

F	Just one payment at the beginning for the whole service

3.3.3 Value chain

The value chain is part of business model that its improvement sometimes is neglected by many companies. Most of the companies know how to deal with their resources and processes but they do not try to change it over a period. Most of the study cases have a clear and kind of fixed structure for their value chain. The solutions that have been offered are almost fixed with small difference from customer to customer. The key resources in these companies are human resources like developers, hardware like sensors, and data center. Company A, Company B, Company C, Company E and Company D have inbound logistics that include suppliers for hardware and all activities for receiving and storing them. Also, operation that include all activities for transforming inputs to outputs. Marketing and sales to reach potential customers for their product and service. Finally, all services that need to keep their product work efficiently. Only Company D does not use its own cloud, because of the huge amount of data and the cloud supplier is part of value chain. Situation for Company F is also different and the value chain is not clear enough and they do not have any suppliers but just develop their service by themselves.

3.3.4 Value network

The value network is an important factor in business model. In this part, has been decided to analyze value network in different elements.

1- Internal value network: Company A, Company B, Company E, Company D, and Company C have a mature internal value network because of the mature service that they offer. In these cases, the research and development section works properly. Company A and Company B can modify the service based on the customers' need and develop the service. Company D is more advanced and can specifically develop a service for customers. Solutions that are offered by Company C are fixed; however, the development team is working on innovation to extend the service. In Company E the situation is different, they just use

customers' feedback to make sure that the service is working properly or not. This service is kind of fixed service and cannot be changed a lot from customer to customer.

2- External value network: for service-based companies external value network are even more important that internal value networks, because for instance customers have to be seen as part of value network. In this case, just Company D has a proper interaction with customers that they can act as the developer. Interaction with customers in Company A is also good but not as Company D.

- Market channel: almost every company mentioned that the most important channel is the partner channel. The potential customers can be reached through partners and this is even more important when all companies are doing the same project. In this study, the partner is a company that offers a solution and use other companies' solutions to strengthen its service. For example, Company A uses Company F solutions. The second place belongs to direct sales for those companies that knows their customers to sell their service directly to them. The third channel is internet marketing, almost every company uses this channel to sell their service and internet marketing is between five top costs of each firm. Five companies also mentioned that seminars and conferences are count as their main channels to reach their customers.
- Customers: companies are being aware of role of customers in their value network. Customers can be seen as valuable player by shifting activities to them. These activities can be control and ownership of devices or services. Every company in this study let customers to have the ownership of devices but not to control the process.
- Suppliers: this part of value network is kind of neglected by all firms. Suppliers do not have any impact in the value network. They are seen just as part of work to buy hardware from them and that is the end of relationship with suppliers.

The value network of Company A is simple. They do everything by themselves and use suppliers just for the hardware. In this case value network is narrow because Company A mainly works with its customer not suppliers. Situation for Company B is similar, and the main suppliers are those who provides hardware. It is also the same for rest of companies

except Company F. The value network of Company F is made based on staff to develop service.

3.3.5 Competitive strategy

Competitive strategy is a long-term action in a business model to gain advantages against other competitors. The competitive strategy can be reviewed from different points of view and it depends on the industry and its field. In this study is decided to analyze it based on relative elements.

- Brand: most of the case studies are kind of well-known brands in their region and their field. However, they have difficulties about this outside their region or even outside Finland. Company D has a well-known brand due to its partnership with well-known companies.
- Service quality and performance: the service quality is the most important factor that all companies try to achieve and they have built the trust based on the quality of service. However, this factor can also act as a barrier to innovate new services. Most of the companies concern about launching new service that can hurt reputation and they try to act careful.
- History: some of case companies like company F are new but others are working more than couple of years and in IoT field with this history they can be count as an old company. This factor can be seen like brand in competitive strategies.

Company A is offering a unique solution to its customers, so the differentiation leadership strategy has been chosen for its business model. This kind of strategy is not easy to implement in any business, however, Company A uses its innovation to take the most advantages from that. Company B also uses kind of new solution in its field and also tries to reduce the cost for customers. furthermore, it has a close relationship with customers that can be count as an advantage in competitive strategy. Company C has different advantage in competitive strategy, they can grantee the return of cost typically after two or three months. By this approach, they are building trust and also competitive advantage at the same time. Company D use trust for this part of business model. They guarantee the security of information because big and famous companies are their customers. Company E approach is offering the innovative solution for steel industry. It is a good

way in the competitive strategy to offer a new solution; however, it has some difficulties at the begging.

3.3.6 Target market

The last factor of this business model framework is target market, which refers to potential customers that a company can focus on them. For service companies this element is also more important because service producers need to understand total operation of customer companies to reach deeper into customer's operation. Therefore, producers must know customer's operation to have a greater impact on their functional needs. All the companies focus on customer segments based on customer production process.

Company A tries to focus on metallurgical industries that need fast detection and analyze for their products. The target market for Company B is quite big and many industries included in their field. but just based on their operation, every company that uses pumps, gears, and blowers. The situation for Company C is the same, the customer segment is based on the customer process. Therefore, segmentation includes all the metallurgical companies which use arc furnace. This segmentation is huge for Company D because they can service any company that needs to track a device or vehicle. Company E focuses on steel industry and tries to reach customers based on their process. Company F is offering service for metallurgy companies and also universities that need this service for their work. So, the segmentation in Company F is also based on customers' process.

3.4 Current State of Platform Governance:

Governance is the main part of platforms that holds all other parts. In this part, is tried to explain and analyze the governance of this ecosystem in general. The main building blocks of IoT platforms all the interviewed companies have them. Therefore, platform governance framework has been applied to analyze the platform. Because some points of governance framework are similar to business model, they are briefly explained in this part.

Roles: the number of sides were different from company to company; however, the customer side was common between all of them. Each company tries to explain how their platform generates value for customers. Almost in all platforms, the supply side can offer more services to the customer, but the new offer should be close to main service. All the platforms that have been using are standard platforms without a marketplace inside the platforms. It means the two side of platforms are users and devices; therefore, there is no space for other developers. Almost every company has their own platforms except Company D technologies. Company A has the most interaction with different partners, but their relationship in the platform is little.

Boundary Resources: in order to co-create value all the companies focus on APIs and SDKs for further development. Most case studies have been using online documentation that includes guides and code samples to help developers. All platforms have help centers to support customers if there is any problem.

Pricing and revenue sharing: in this case study all companies need to install hardware like sensors and cameras, so they cannot offer free trial of platform to their customers. The price of the platform depends on different factors and also different from seller to seller; however, the number of devices connected, usage of space in cloud and the amount of data traffic is same between near all companies. In one case, because of the history of firm with their customers the price of platform is not fix and it is different from customer to customer.

Openness: openness can be analyzed by two dimensions: for its users or for third-party developers. In this study, because of the situations the platforms were not open for either users or third-party developers. Is means all the users need to sign the contract first or install hardware to access the platform. None of the platforms is open for third-party developers to add their features or extensions to the platform.

Control: as many other platforms, in all the platforms that have been using by case study companies, IS plays the key role. Data stream is the only input and output of the platforms, so all the platforms can be count as formal platforms.

Technical design: most of the platforms have been designed based on the primary needs and usually designed to do everything by itself instead of using other extension to increase functionality.

Competitive strategy: in this study, most cases have kind of unique solutions for customers and competitive strategy is not just through advertisements. All companies are flexible to offer solutions to the customers. The main point is collaboration with other companies instead of fighting to just sell more.

Trust: in this point of view, relationship with complementors and platforms owner are based on the customers goals. All the stakeholders are working on the same field, so trust is built on the main goals. In the other side, because all the companies are well known in their field the security of data is guaranteed before starting the project.

3.5 Buyer company:

The buyer company prefers the ownership of devices and others and then monthly or yearly payment for the services. Furthermore, the payment based on the production of company is the best model that they want to choose. The most important elements of a service from customers view are platform security, compliance with regulations, price, service stability, and service quality.

4 DEVELOPING A BUSINESS MODEL FOR THE IOT PLATFORM ECOSYSTEM

This chapter presents the improvement recommendations for the case companies. The third research question that was asked in the research plan is: what kind of service model would fit the case companies' IoT business ecosystem? Based on the previous researches, has been tried to compare elements of service dominant business model with what is said in literatures. This chapter aims to reach the best business model that would fit the case studies. For this goal, is tried to understand which elements are the most important building blocks for a service dominant business model.

4.1 Platform as a service in business model:

Companies can sell product to customers as a service and charge them based on how much the product is used. Except Company D, none of the interviewed companies use this to charge their customer based on their usage. This method can increase the relationship with customer also. For instance, if customer company wants to decrease the production of one line, they have this feeling that they are not going to pay any extra money when they do not use it. On the other hand, if a customer wants to increase the devices such as sensors or cameras, more money needs to be paid. All these points help to build a close relationship with customers that is hard to break with other competitors.

Moreover, usage of platform is not the same for all customers. For example, in steel industry, two companies might need the same amount of hardware like sensors and cameras; however, one might need to use the platform more than others. In this situation the company that are using less, is paying more and it will increase the cost of production. The payment can be also different for usage of the service as well.

Most of the case companies mentioned that partners are one the important factors also in value chain and market channels. It means that partners have two different roles that each one is critical. One of the interviewed companies said that it is impossible to develop a solution in IoT area without using partners. However, it can act like a barrier sometimes. For example, if a service provider wants to develop an IoT solution, but it cannot find a

good partner to handle some aspect of the work. All the case companies that are working together are from the same geographic area. It could be somehow dangerous if they just rely on each other. In the other point of view, all the interviewed companies were looking forward to selling their solutions all over the world. If they use other companies from other countries, they also can use partner channels to reach new customers in different places. For example, if they use an Italian company as a partner of their work, they can reach Italian steel manufacturers easier and also the trust can be built in a shorter time for those companies that do not know you. For instance, Company A has been offering a novel solution for steel industries that can increase the speed of production and decrease the cost but as the interviewed person said, it is hard for them to reach the customers.

4.2 Important building blocks of service-based business model:

For going forward in the service-business model, companies need to do changes in all elements of the business model. It is not enough to change just one or two elements; nevertheless, the whole ecosystem should change to create value. The focus of all companies in this study is to create value proposition and develop the process which is good but not enough. Understanding what elements need to be changed in business model can help the companies to be more effective in their field. Managers need to have a perfect vision about existing business model to outline those factors that need to be improved. Most of the case studies in this research have an innovating solution in their value proposition which is perfect. However, other factors are also important as innovation and should get attention.

4.2.1 Designing a new value proposition:

Increase the customers' interaction is one important element in service offering that gives an advantage to offering more complex solutions than launching a new service. So, companies need to develop the interaction with customers to meet their expectations. In this study, most of the case studies said that we are just asking about feedback from our customers; however, we are not able to change the service too much or offer new context for further development. Company D said that we always ask from our customers about what they exactly want and then if it is possible, we can change the service to it. In this

field, companies do not put lots of effort and energy to convince the customer about a fixed service that is offering to every other company. Instead, they can focus on what exactly customer need and try to offer a complex solution that meet their expectations. Content of services can be increased to expand the value proposition. In this way, service producers can meet more customers' needs. For instance, Company A reveal cast solution can be applied from high to low temperature to examine the quality of wide range of products. If Company A uses the company C and Company E solutions for the arc furnace and water analyze, they can offer a more complex service that meets customers' need from melting metal to a product.

All the companies in this study list the features and benefits of their service to convince the customer to buy the solution. This way is a basic way but not enough for the visualizing a service. By doing this method customers might see producers just a physical product seller. Because all the case companies in this study are offering different solutions, it is better to also mention how fast they can implement the solution, do customer should stop production during the installation phase, is gathered data safe and secure. Therefore, service delivery and also post service delivery are important and companies should emphasis on them for visualizing a service. One way for visualizing can be producing a video in form of story from starting the project to implementing a service.

On the other hand, with more complex offering the range of customer will drop. So, companies need to keep a basic service to offer a wide range of customer and after that try to develop the service for different customers. In this situation, the duty of development team is more important. The result is more interaction and close relationship with customer. For instance, Company D has a basic service as tracking devices; nevertheless, they can customize this service for large variety of customers.

In general, companies need to build their value proposition and expand the portfolio around customers' business. Companies should try to expand advanced services for their value proposition. This value should be different from the basic service offering and more creative to meet different customers' desire.

4.2.2 Developing the revenue stream:

Most of the case companies use the fixed price at the beginning and then monthly or yearly payment for using the service. This kind of revenue stream is a traditional revenue stream in IoT area that almost every company in this field use this. Another kind of revenue stream could be charge customers based on their productivity. It also can cause trust among customers. In this case you guarantee the return on money but in a different way. For instance, Company A says that they will guarantee the payback in a short period. However, this short period depends on many factors such as production rate of company. In this situation Company A can offer that the customers will pay us when they feel the changes like reduce cost and time saving after using the solution. Another benefit is that in this revenue stream, interaction with customers will increase and the first one who trust in others are the seller company. This kind of revenue stream is also considerable for partnering in a common project. In this way, companies can easier work together, because customers do not need pay anything at the begging of the contract and also customers are keener to accept complex solutions that seems expensive at first. In the field of this study customers are mature companies with the clear cost structure that understanding their needs is not difficult. Therefore, it is better to implement this kind of revenue stream for mature companies.

The question that might come up here is how to change the standard contract to a more innovating value-base contract. To answer this question, companies can use customers profitability or productivity. If they do not have access to this information, service providers can use their equipment to measure this. For instance, if Company D' customer decrease the transportation in a certain period, they do not need to pay as a fixed amount and vice versa.

Finally, mearing the productivity of customers should be discussed at the beginning. This is also improving customers interaction. To use Company F solutions, customers should just pay certain amount at the beginning and also no more payment until they use the service. In this kind of revenue stream, customers process is a little bit neglected by service provider. It is difficult for this small company to reach their customer and always find new customer to offer a service. Another problem in this kind of contract is building

trust. If a small company offer a solution with just one payment at the beginning, customers might find it difficult to trust and use the service. Also, by continues payment, customers are more confident about the service support during their usage.

To sum up, creating a new revenue stream based on the customers structure, is not easy and can be one of the most challenging factors in business model. Because it might need to change the whole revenue stream as well as the cost structure in the service offering company. However, by implementing this method, companies can take more advantages to build a close relationship with customers.

4.2.3 Improving the value chain:

All the case companies mentioned that the key resources in their value chain are human resources, development, and sales. However, none of the case companies say that the software is also one of their key resources which it actually is. It means that the case companies should put more attention and effort on their service as a key resource.

Most of these cases misunderstood the meaning of development of a service. They hardly try to develop a service for customers based on their feedback and demands; nevertheless, service providers do not work at the developing a service in general. For instance, Company F said that we do not have enough time and human resources to think about developing our service in general. One point here is that in most companies structured service development is neglected. Almost every case company in this study has an innovative solution in their field; however, for how long they can use these innovative solutions without any structured service development.

On the other hand, every company mentioned that the biggest cost of their company is salary for staff. This can act as a barrier to add more staff for service development part. All in all, the development part needs to be added even by sharing responsibilities between staffs.

If developing the service is neglected, the process of selling service as a part of value chain could be neglected as well, because selling the service is part of developing it. The reward for sales members is unclear in most of the case companies or like a product base

company have an extra reward for selling more services. In this part of value chain sales group should be part of development team and know everything about the service and the process on the customer company. They can act like a bridge for between customers and service-based companies to understand what exactly customer wants and what they can offer to them. For example, Company A mentioned that after the they have problems in marketing and sales. Their sales are way less than what they expected during last year.

Delivering the service is another important factor in value chain. It can directly affect the customer satisfaction. This element needs to be considered in all case companies. It is even more important when more than one company are partnering up in a same project. The process of delivering service should be fast and without any confusion. Otherwise, customer get a negative point at the beginnings.

4.2.4 Increase the impact of value network:

The internal value network is doing well in most of the case studies. They know what they are doing inside the company. The same also for external value network. However, the point is to extend the value network and use dynamic value network. The customers and service partners can be used to reach this goal. Companies can use their customers and suppliers to innovate new service. Customers can act like an important resource for a new service. For instance, customers have some difficulties on a section that is somehow related to the service provider. In this situation, service providers can develop or design a new service for customers to help them.

Suppliers or business partners as part of value network can also have a negative impact on the value network. If the infrastructure of the partners is not mature, it will affect the whole project. Therefore, for main companies are necessary to choose their partner wisely as part of the value network.

Service providers also can shift some activities to their customers to increase the value of customers in value network. Most of the case companies are doing this buy letting customers to control the process themselves. This also can help service providers to focus on developing the service instead of taking care of everything. However, this duty can also go further by giving the customer their own cloud for their data. Also, it can increase

the risk for business and might could say that it depends on customers and how mature they are.

4.2.5 Improvement of competitive strategy:

The best strategy for competition in IoT area is to have an innovative value proposition. In this study most of companies have this advantage in their competitive strategy. This advantage should continue for more services and build a strong relationship with customers.

Almost every case company has a well-known brand in their region. Therefore, always launching new service concerns them to lose their reputation. It is always possible that new service does not work properly, and customers get a negative feedback about their brand. To solve this problem companies can lunch and test their new services under the name of different brand. Another way is to launch the new service gradually. Service providers can test the new service on small companies with lower price or sometimes for free to ensure that the service will work without any big problem.

4.2.6 Changing target market:

The target market is based on the customers process in all the case companies. However, the segmentation of customers can be done based on the needs and profitability of customers. If these three elements work together, service providers can improve the relationship and existing competence. All in all, seems in this project case companies do not have any problem to find the target market.

4.3 Improving platform Governance:

In this part the importance of the platform governance is discussed based on the mentioned factors in previous chapter. In this study all the case companies except the Company D have the vertical market approach. It means that the service providers, offer solution to the customer based on their process or industry. However, the Company D offers its solution based on common goal not a specific industry. If producers rely on the vertical platform, the market segment is smaller; but the service can be more mature in a

specific field. In horizontal platform, the market segment is bigger but also the competition is harder due to lots of competitors in the horizontal platform.

Degree of openness is another factor that can be reviewed for the case companies. All the case studies use closed platforms. None of the platforms in this study are open to the third-party developers. More degree of openness can help service providers to develop more mature services because more people or groups with more idea can work on the platforms. However, the opportunity of uniqueness of the service will be lost during more openness of platform.

This is also one missing part from the case companies in this research that is platform partners. Platform partners can sell the platform under their own brand. In this situation, the main platform owner can sell the platform through other company and charge the seller. This is helpful when the platform owner wants to sell the service in another country. The well-known companies in another country can use their brand to sell the service.

Platform complementors can help the platform owners to add extra features on the main platform. The platform owners in this study can let other companies to act as a complementors to develop the platform and add extra features. By using complementors, development a service can be done faster and easier. However, there is the risk of damaging the reputation of the platform owner.

4.4 Other improvements in IoT area:

One the most important concerns during interviews was the standards of connecting devices like sensors and cameras to the internet. Some service providers worried about changing protocols of connecting device over a period of time. They think that if something like this happens, service providers need to change all the hardware to new hardware. If such things happen, it means more cost and customer dissatisfaction. To prevent these concerns, all the companies that are working in IoT area can use the most common standards to at least reduce the risk.

Another concern is security of customers' information. One of the case companies mentioned that we spend a lot of money each year for this and if someone hack the customer information, it will have a direct impact on our reputation. For instance, Company D uses a third-party cloud to store the customers' information. At first it seems more expensive than having the own cloud; nevertheless, the risk of storing information will decrease. The way that company D is using for data securement can be the best option for other companies. Also, when each company partnering with a famous firm in this area, it will increase the trust among customers.

4.5 IoT ecosystem business model synthesis

For having a better value proposition, the companies can offer more complex solutions, use new methods for visualizing the service. Companies need to build their value proposition and expand the portfolio around customers' business. Companies should try to expand advanced services for their value proposition. The common value propositions between all the case studies are cost reduction and faster production rate. Therefore, these two elements can be applied for the whole ecosystem.

Creating a new revenue stream based on the customers structure and change the whole revenue stream as well as the cost structure in the service offering company. Build a new kind of revenue stream that can charge customers based on productivity of them. Most of the case companies use monthly payment for their services; however, they can change this method to production rate of the customers. It means the payment is not fixed like monthly payment; but related to the usage of the service from customers. In the fixed monthly payment if the customers increase or decrease the service usage, they have to pay a certain amount and it will reduce the customer satisfaction and also profitability of company.

All the case companies focus on human resources, development, and sales as key resources in value chain. However, the software itself has ignored as the part of value chain. Therefore, developing a service in general is also neglected. It is necessary to pay more attention in developing services in the value chain. Developing the services should has a certain structure. The development part needs to be added even by sharing

responsibilities between staffs to reduce the labor cost for developing service. The companies can select one or two people in each section to share their ideas about improving services and then implement these to their service. Therefore, there is no need for extra people who just work on development section.

The internal and external value network is working properly in all the case studies. However, to extend the value network the customers and service partners should be used as part of value network. For example, service providers can develop or design a specific service for a customer to solve a certain problem. Also, the performance of the partners can affect the whole project. Therefore, for main companies are necessary to choose their partner wisely as part of the value network. Companies can use their partners to improve their business model in many different aspects in value network. Furthermore, customers need more attention as part of value network to increase the interaction.

For the competitive strategy, having an innovative idea in the business is one of the best strategies. In this study, all the case companies have a novel solution that makes advantages in their field. however, companies need to develop their service continuously and always consider new services. Because in long term their services will not be new anymore and they will lose this advantage. The companies can offer new services under the name of another brand or can test the new service on small companies with lower price or sometimes for free to ensure that the service will work without any big problem. It can help them to examine the new service without risking the main brand.

Most of the case companies segment their customers based on what customers produce. However, the segmentation of customers can be done also to the other companies with similar process. For example, if there is a solution for casting steel, this service also can be applied for other metals or plastic as well. In this project most of the case companies work around metallurgical process that can be extended to other materials as well. Table 8 some key issues and managerial goals related to the case companies.

Table 8. Key issues and managerial goals

Business model parameter	Key issues	Managerial goal
Value proposition	Jointed offering Closer customer interaction	Structuring the new offerings and making them tangible.

		Achieving an excellent understanding of customer operations and business.
Revenue mechanisms	New revenue mechanisms	New ways of selling parameters to the customers depends on what customers wants.
Value chain	Extending the resource base structured service development process	Acquiring new resources in service delivery. Creating a decision process and establishing development stages
Value network	Finding partners that can add value to the new offerings	Supplying additional services.
Competitive strategy	Branding	lunching the new solutions with extra values.
Target market	New customer segmentation	Addressing the right customers in the right way.

5 DISCUSSION

5.1 Key results

This study aimed to identify the challenges and to improve the practices of six case companies in an IoT platform-based business ecosystem. Three questions have been asked at the begging of the study and here all of them are answered briefly.

First research question was answered in chapter two by analyzing different references. In general, the business models try to answer basic questions about customers, production, revenue, and value. However, in the service business model the situation is more complex, and it needs more attention. Traditional business models are not effective for IoT area anymore. The Service-based business model for IoT consist of value proposition, revenue mechanism, value chain, value network, competitive strategy, and target market.

The second research question was about current business model in case studies. In the chapter 3, all the case companies have been reviewed in detail to answer this question. In total, all the case companies are good at most of the building blocks of the service-based business model. For example, all of them have a strong value proposition and competitive strategy.

The third research question is answered in chapter four by improving different building blocks in the service business model. All the case studies have a suitable base in service-based business model. However, most of the case companies needs to offer more complex solution for their work to increase the interaction with their customers in value chain. They need to use different ways in revenue stream that fit the customers better. Make a structural service development for their value chain. Extending their services as part of value network. Also, lunching new innovative services for their competitive strategy. Finally, find similar customer segments for their target market.

5.2 Theoretical implications

The importance of service business models in IoT area has been discussed in earlier literature. However, most of the literature findings have revealed that many companies have challenges in this area (Kindström, 2010). So, new elements in business model have been developed to provide the framework to solve these problems that companies are facing. The results of this research study that was based on the different case companies prove the findings in Kindström, (2010).

5.3 Managerial implications

The aim of this study was to discuss the present practices, identify the weakness and strengthen related to service business model in six seller companies, and then provide suitable recommendations. As an active managerial implication of the result of the study, service business model should help companies to have continuing profitability and innovation during their work. It will require to utilize every single detail in the building blocks of business model. The business model that suggested by this thesis should help companies in the IoT area to improve their business in different aspects.

5.4 Validity and reliability

The aim of this research is to improve business model of a case companies. To be able to do this, a combination of broad theoretical and empirical study was done. Lincoln and Guba, (1985) concept and framework of trustworthiness has been chosen to check the validity and reliability of this research study. Based on this framework, there are four stages as: credibility, transferability, dependability, and confirmability to proof the level of trustworthiness of a qualitative research.

The credibility of this study ensures with similar studies approach of this research area that is mentioned in literature. In the empirical study, semi-structured interviews were used to gather the data that covered all the study area. During the interview session, interviewees could discuss their opinion on the questions and also ask for more

clarifications to have a better understanding about the questions. Companies' website was utilized to obtain additional information for the empirical study.

The transferability of this research, answer the question about how the study results are applicable in other environments. Service-based business model in IoT area is applicable in other similar case companies. However, the findings of this study might be only applicable to the case companies and not to all the companies in IoT area.

The dependability of this study, represent the research about seven different company. This study has the same findings with other references. Depending on the researcher's point of view, more questions can be asked, and this may cause the final outcome to be different from one to another.

Confirmability is about the objective findings of the research. During this research has been tried to analyze given answers from different perspectives of the interviewees to obtain an objective conclusion.

5.5 Further research

This study tried to analyze the IoT business models of six companies. However, based on the limited schedule, there was not enough time to investigate everything in detail. In my opinion, another research with more case companies and in more detail would be better for future research.

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Appendix

Questionnaire:

PLATFORM/SUPPLIER COMPANY INTERVIEW
Company name:
Role(s) of the interviewee(s):
Company's offering
What is the company's offering to the steel industry?
How is income generated?
What are the main costs of the company's business?
Customers
Who are the company's customers?
Can the customer also act as a developer for the platform?
What kind of customer relationships does the company create and maintain?
What are the channels that the company uses to reach its customers?
Value creation, delivery and capture
What are the value drivers (motivational factors) of the company?
What value does the company deliver to its customers?
What is the value of the company for the whole ecosystem?
What activities are required to deliver the value propositions?
What resources are needed to create value for the customer?
Roles and partnering in the AMET ecosystem
What is the role of the company in the ecosystem? Please describe.
- Platform owner?
- Developer/supplier?
- Customer?
- Something else? What?

Who is the company partnering up with in the ecosystem? How?
What is required of the partners?
What roles can you identify in the ecosystem?
How does/would the IoT platform facilitate interaction in the ecosystem?

CUSTOMER COMPANY INTERVIEWS
Company name:
Role(s) of the interviewee(s):
Role(s) of the interviewee(s) in relation to the platform:

What would be the value of the IoT platform for your company?
What would be the optimal service model of the IoT platform? How would the customer company want to buy the services? Why?
- Subscription (monthly or yearly fee), ownership of the devices
- Subscription (monthly or yearly fee), no ownership of the devices
- Pay-per-use (tons, meters, connected devices, amount of data…), ownership of the devices
- Pay-per-use (tons, meters, connected devices, amount of data…), no ownership of the devices

- Pay-per-results (analyses, # of detections, process optimization), ownership of the devices
- Pay-per-results (analyses, # of detections, process optimization), no ownership of the devices
- Some other?

How important are the following aspects to the interviewee on a scale of 1-5 (1. Unimportant – 2. Slightly important – 3. Important – 4. Very important – 5. Vital / Obligatory). Please describe:

- Service stability
- Price
- Platform security
- Compliance with regulations
- Quality standards
- Earlier customer references of the platform / reputation of the platform company
- Earlier customer references of the applications / reputation of the device suppliers
- Service provider's familiarity with the customer's operations
- Current selection of the applications and services of the platform
- Future selection/ease of adding new applications and services to the platform
- Ease of installation/deployment
- Ease of use
- Platform information quality
- Platform quality
- Service quality
- Customization possibilities
- Response speed to customer demands and orders
- Platform services' trustiness
- Responsible behavior of the platform and the provider
- Possibility to choose between cloud, local and hybrid installation