Aalto University
School of Business

Value Creation and Strategy in the Hyperconnected World

the Current Wave of Digitalization Explained Through the Study of Finnish Forerunner Companies

MSc Degree Programme in Creative Sustainability

Master's thesis

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THE NAKED APPROACH

A Nordic perspective to gadget-free hyperconnected environments

DEMOS HELSINKI

Aalto University
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Abstract of master's thesis

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Abstract

The topic of this study is the key characteristics of value creation among Finnish forerunner companies looking to gain competitive advantage from the use of smart, connected processes, products and services i.e. smart solutions. Smart solutions are technological tools of value creation that are allowed through the rise of Hyperconnectivity (i.e. Hyperconnected World, Internet of Things, Industrial Internet, Internet of Everything). For companies, technological development allows new ways to create value, make strategic choices and innovate in their business models. To understand these choices and the development at large, macro-level systemic approach is taken to look at complex field of technological development and related possibilities that it offers.

Six value creation models and underlying technology stack required for successful integration of Hyperconnectivity were identified through the study with distinctive characteristics. The value creation models are the parts that companies adopt in their business models to deliver value to their stakeholders – from strategic perspective value creation represents the strategic choices that companies use to develop their business.

Besides the extensive literature review of existing knowledge, the study uses quantitative research methods by collecting and analysing primary data (online-survey) and secondary data (existing data on a sample). The analysis was done through descriptive statistics, the usage of distributions, frequencies and means.

In addition to practical and theoretical contributions related to the definitions of the field, value creation models and strategy, the thesis delivers a framework to understand the development at large. This is useful especially in understanding the relations between megatrends, the new environment of digitalization and Hyperconnectivity, strategy, value creation, and business models to create a new perspective to approach the whole development – not from just companies' perspective, but for anyone trying to understand the technological development shaping our world.

Keywords digitalization, Hyperconnected World, Hyperconnectivity, strategy, value creation, business models, Internet of Things, IoT, Industrial Internet, II, megatrends

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Tiivistelmä

Tämän maisterintutkinnon tutkielman aihe on arvontuotannon tärkeimmät ominaisuudet suomalaisissa edelläkävijäyrityksissä, jotka hyödyntävät älykkäitä, toisiinsa kytkettyjä prosesseja, tuotteita ja palveluita – toisin sanoen älykkäitä ratkaisuja liiketoimintansa osana. Älykkäät ratkaisut ovat arvontuotannon teknologisia tapoja, jotka mahdollistaa hyperkytkeytyneisyys (ts. Hyperkytkeytynyt Maailma, Asioiden ja Esineiden Internet, Teollinen Internet, Kaiken Internet). Yrityksille teknologinen kehitys avaa uudenlaisia tapoja tuottaa arvoa, mahdollistaen uusia strategisia valintoja ja mahdollisuuksia liiketoimintamalli-innovaatioihin. Näiden valintojen ja kehityksen ymmärtämiseksi kokonaisvaltaisesti, monimutkaiseen teknologiseen kehitykseen on tutkielmassa otettu laaja-alainen systeeminen näkökulma, joka kuvaa kehitystä ja siitä avautuvia mahdollisuuksia arvontuotannon näkökulmasta.

Tutkielman kirjallisuuskatsaus tunnistaa kuusi arvontuotannon mallia, niiden käytön mahdollistavan teknologiapinon sekä kuvailee näiden ominaisuuksia. Arvontuotannonmallit ovat yritysten liiketoimintamallien osia, joilla ne tuottavat arvoa sidosryhmilleen – strategisesta näkökulmasta arvontuotannonmallit tarkoittavat tehtyjä strategisia valintoja liiketoiminnan kehittämisessä.

Kattavan kirjallisuuskatsauksen lisäksi, tutkielman osana on kvantitatiivinen tutkimus sisältäen primääri- (web-kysely) ja sekundääridatan (olemassaoleva tietokanta) tutkimuksen. Tiedon analyysi tehtiin kuvailevien tilastojen, jakaumien, ja keskiarvojen avulla.

Kehitykseen liittyvän termistön, arvontuotannonmallien ja strategiaan liittyvien käytännöllisten ja teoreettisten kontribuutioiden lisäksi tutkielma luo kaavakuvion, jonka avulla kehitystä voi ymmärtää laajassa kuvassa. Tämä on erityisen hyödyllistä, jotta pystytään ymmärtämään ja kuvaamaan megatrendien, digitalisaation luoman uuden ympäristön ja hyperkytkeytyneisyyden, strategian, arvontuotannon, ja liiketoimintamallien välisiä suhteita. Uusi näkökulma koko kehitykseen ei ole pelkästään hyödyllinen yrityksille, vaan kenelle tahansa, joka haluaa ymmärtää paremmin teknologista kehitystä ja sen vaikutuksia maailmaan.

Avainsanat digitalisaatio, Hyperkytkeytynyt Maailma, Hyperkytkeytyneisyys, strategia, arvontuotanto, liiketoimintamallit, Esineiden Internet, Asioiden Internet, Teollinen Internet, megatrendit

FOREWORDS

At its heart, the purpose of business research is to gain understanding of how and why things happen, to shed light on new perspectives and correct out wrong ones – to be able to create information that helps to make better decisions. This was the motivation of this thesis throughout its writing. As it was written for a foresight-focused think tank Demos Helsinki – a community that has grown very beloved for me in the past months – the thesis tries to explain the world on many different levels and from many perspectives without loosing its coherence. Whether I achieved this, I leave to be judged by the reader.

There are some people, who give me new perspectives and help me to make sense of the world every day. They deserve a shout-out right here – the people who keep changing the way I think, and have affected how this thesis was written by providing their time for me whenever needed. So thank you Johannes Koponen, Erkki Ormala and Aleksi Aaltonen, for your comments and feedback throughout the whole writing process. Thank you Armi Temmes, Maria Ritola, Aleksi Neuvonen, Juha Leppänen, Johanna Lampinen, Johannes Mikkonen, Roope Mokka, and Tuuli Kaskinen, for being part of it one way or another. And last, but not least, thank you everyone at Töölönkatu 11 and Demos Helsinki community, for giving me the chance to work among such excellent and admirable people.

I also want to give big ups to the one person whom won't expect this, but certainly deserves it the most: Dr. B. What effect can be achieved by just being real is remarkable – thank you for your support and mentoring when it was needed. Hope that passion never dies, that you still killing it and training the Jedi's.

Finally, I'd like to thank my close family: Miika, Anna, Maria, Tomi, Heljä, Joonas, Katri, Sampsa, Reetta, Riku, Lukas, Jon, Cherry, Max, Kyle, Brad, and Eetu – for always being there; my parents, grandparents and Emppu – for I am merely a reflection of what you have given me.

-Risto

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"'What meaning does your construction have?' he asks.

'What is the aim of a city under construction unless it is a city? Where is the plan you are following, the blueprint?'

'We will show it to you as soon as the working day is over; we cannot interrupt our work now,' they answer.

Work stops at sunset. Darkness falls over the building site. The sky is filled with stars.

'There is the blueprint,' they say."

- Italo Calvino, Invisible Cities

1. INTRODUCTION

This study aims to find out what are the key characteristics and opportunities of value creation used by Finnish Forerunner Companies in their business models to gain competitive advantage from their use of smart, connected processes, products and services (i.e. smart solutions). Often referred as the Industrial Internet, Internet of Things or Internet of Everything, these systems enable network of objects or "things" to collect and exchange data and these objects to be controlled remotely across networks (i.e. possibilities through the use of electronics, software, sensors, data and network connectivity). This development creates opportunities for new kind of operations, value creation and business models, which depend mainly on the better usage of data – estimations range between $14 trillion to $33 trillion to be the potential value of the whole field (Vermesan & Friess 2014, IIC 2015). For example, the connections between things, systems and people allow new kinds of platform business models to become commonplace; we all heard the stories of AirBnB and Über. Yet, those two are just commonly heard examples of a variety of new applications and value creation models in the field, which is just about to expand across many industries – not just consumer services, but our whole world. **Essentially, smart and connected environments reshape industry boundaries and create entirely new industries – in many businesses forcing the fundamental question, "What business am I in?"** (Porter & Heppelmann 2014).

Changes in the business environment are driving the transformation. The clear driving force for the next wave of digital disruption is the rapid technological development driven by sensors, software, processors and their connections in products and data management systems and applications (Porter & Heppelmann 2014). Other changes in the environment include globalization and urbanization, which both can be seen in the rise of new value creation and operations management models (Juhanko et al.

2015). At the same time, more negative trends can be found as well. Environmental issues such as resource scarcity and climate change affect how companies have to deal with their resource usage and emissions (Ritola et al. 2015). Simultaneously, Finnish companies, which are the focus of the study, have been forced to adapt to low-growth economy since the global economic downturn of 2008, making it more challenging for the businesses to operate – in a way supporting the change to smarter use of resources. In this rapidly changing business environment, the organizations that can implement major structural changes to design their business models to compete differently typically turn out to be the fastest growing companies (Casadesus-Masanell & Ricart 2010).

Historically, information and communications technology has been a major source of wellbeing and economic growth in Finland producing up to half of the productivity gains and forty per cent of the total production growth on national level. Yet, in the midst of decline and transformation of Nokia and current economic situation, new ways to benefit and use the technological know-how and skills is needed. **Finland is according to many sources one of the top leading countries in the world coming to preparedness as well as usage of digitalization, yet many business leaders and managers don't fully understand this possibility that is in front of them**. Interesting question thus being, how can Finnish companies create value and compete in the new environment of digitalization? (Pohjola 2014)

Thus, **this research aims to reveal what kind of key characteristics can be found in Finnish forerunner companies looking to adjust their business models by using smart solutions – hopefully to shed light on the best practices and opportunities in the field in Finland from the perspective of strategy, business models and value creation**. It also aims to identify what are the driving factors that shape the business models among the forerunner companies. In addition to this, what is also looked at is the role of sustainable business models and innovation related to this technological development – and how sustainability on larger point of view is a part of technological

development itself. At the same time, it is expected that not all companies in the sample are adopting these type of characteristics in their business models, thus the study aims to clarify how common the adoption of these solutions are, is there are a common language that can be used when discussing them and what are the main focus areas of development for companies looking to adopt them in the future.

The research is a part of Tekes strategic research opening called the "Naked Approach – Nordic perspective to gadget-free hyperconnected environments" (Naked Approach 2015), and targets to support the project in its aim in speeding up and directing the paradigm shift to smart, hyperconnected environments. The study was done as a commission for Nordic think tank Demos Helsinki, whom the author has worked since April 2015. Demos Helsinki is part of Naked Approach research project among five Finnish universities (Demos Helsinki 2016). Regarding this study, the main aim is to deepen the research especially related to the development of business environment in the context of the larger research project. What is searched for are insights to the applications around the latest wave of digitalization offered for large range of companies, but as more traditionally viewed as companies operating in the field of Industrial Internet and Internet of Things. **There seems to be clear difficulties in developing business models that use the full potential of the Internet of Things** (Vermesan & Friess 2013) and according to World Economic Forum (WEF 2015, 7), a vast majority of respondents in their Industrial Internet survey "do not fully understand its underlying business models and long-term implications to their industries". Thus, there is clear need for more research on the topic, on the best practices and ways of creating value through it to better understand the possibilities that the current wave of digitalization offers.

On a more personal note, the motivation for the study is to discuss the new ways of value creation through the use of technology, especially **how technology can help in creating sustainable well-being and help us to adjust to planetary boundaries – in other words how digitalization can help us be more smart on our use resources.**

Technology plays a significant role in shaping of our world, and also holds a promise of more efficient, transparent and hopefully more sustainable society (Linturi 2015). Information and communications technology can even be labelled as being the electricity of our time, raising the productivity and efficiency in operations among different parts of the society to a whole new, unseen level (Pohjola 2014). Smart, connected processes, products and services offer a possible way to more sustainable future for society at large – something that is quite timely topic considering for example what were the goals of the Paris conference on climate change as well as being something that should be pursued on authors' personal opinion.

1.1. Research Problem and Questions

The defined research problem is "**what are the key characteristics of value creation in Finnish forerunner companies looking to adjust their business models by using smart, connected processes, products and services?**" What are searched for are the most common ways, characteristics and key choices how companies integrate smart solutions (i.e. electronics, software, sensors, data and network connectivity) to their business models.

Due to novelty of possibilities in this sector that are arising from the rapid technological development, few knowledge gaps can be found that need to addressed before answering the actual research problem. First, result of the novelty is that there are no widely accepted definitions of terms and boundaries for them – companies do not seem to have a common language when discussing this development at large and neither does anyone else. Second, little research has been done related to the integration of different applications of the field in the business models and how they create value, especially in the Finnish context. Third, based on the background studies it is expected that not all companies in are adopting these type of characteristics in their business models, thus the study will also shed light on how common the adoption of these systems are, and what are the main focus areas for companies looking to adopt them in the future.

To fill these knowledge gaps, the following research questions arise:

1. **What are the most often used terms and definitions related to the development?**
2. **Are there any identified and existing models of value creation? How these include sustainable business model characteristics?**
3. **What are the characteristics of value creation in Finnish forerunner companies looking to adjust their business models by using smart, connected processes, products and services?**

The first research question defines the current state of the field and how it is understood at the moment. This will mainly be done by literature research, but companies are also asked about what terms do they use in their daily operations. The second research question looks into what identified and existing models of value creation can be found that are based on the use of smart solutions – identification done through reviewing different studies done on the topic as well as researching further with the empirical part of the study. The last question looks into the current strategy and applications of Finnish forerunner companies, how value is created through different ways to apply the new technological tools to business models and what part of business development their strategy focuses on. The last question will be answered through the empirical data collected and relating it to the analysis of the existing knowledge.

1.2. Context and Scope of the Study

The study is focused on **what are the drivers, trends, development paths, concrete ways and key characteristics of value creation at the present moment among the Finnish forerunner companies.** Importance of understanding the present to be able to act in the future is the reasoning behind this approach. Yet, this approach clearly has limitations that are only partly overcome by the fact that the larger trends and drivers are most likely going to be similar in the near future at least. Considering the rapid pace of

change in our world – especially technological change – it has to be admitted that this type of approach has its limitations in how long it can be relevant. Technologies around the internet and data are changing at such a pace that we do not know what and how fast will things change in just a few years. At the same time, we are not sure what kind of development path the society is taking at large in the future as these factors also have a strong impact in the direction of the development.

The theoretical scope of the study is wide, with its main focus on state-of-art literature on digitalization including Internet of Things, Industrial Internet, Internet of Everything and related concepts. Other main areas of research to existing knowledge include strategy, business models and sustainable business model –concepts. How these interact with each other is then looked upon to discuss what do we know about business and value creation models related to the current phase of digitalization, especially from the perspective of companies. **The study of existing knowledge lead to the framework that is something that the study heavily relies on and must be understood to understand the study at all.**

Research will be interesting for and directed to anyone whom is working with strategy and business model development currently with interest in the opportunities that digitalization allows. Thus, the main audience for the study are those, who are directly involved in the strategic decision-making of their company. In general, for those whom seek better understanding of how digitalization is shaping the world at the current moment, the research should provide additional information and frameworks to better grasp the wide field and its implications, not only for businesses in Finland, but globally as well.

The scope of the study is defined with its limitations in-depth in the last chapter of the thesis. However, some clear boundaries about the scope are in order to be discussed right here. First, as defined, the research is, despite the global nature of technological development, focused in its empirical part on Finnish forerunner companies. The investigation is limited to a certain group of companies and is thus only representative a

small portion of the forerunners locally – and it unfortunately can not be used to draw large conclusions about the state of Finnish companies in general related to the development. However, the study sheds light on some of the best practices and key characteristics of value creation. In addition to this, there are some exclusions made throughout the study as the field itself is vast and developing faster than any research can really stay in pace with. Thus, more of a macro-level approach is adopted throughout the study. Rather than sticking with minor details, macro-level phenomena are identified and studied, both in case of the new environment as well as the value creation characteristics themselves. This results to that many aspects of the development and its relation to different concepts are scratched from the surface rather quickly, which naturally leaves more in-depth analysis to be done in further studies.

1.3. Structure of the Thesis

The structure of the thesis is roughly the following: the thesis is divided into five chapters –introduction, existing knowledge, methodology, empirical findings and analysis, and lastly conclusions. Each chapter has different amount of sections under them, which will be introduced in the beginning of each respective chapter. In the first chapter "Introduction", the topic is introduced with the research questions, research gap, context, scope and structure of the study described. The second chapter "Existing Knowledge" consist of the literature review and the synthesis made based on that. The third chapter "Methodology" discusses the research method used as well as data collection and analysis procedures. The fourth chapter "Empirical Findings and Analysis" combines the methodology, data representation, analysis and discussion related to the chapters two and three. The last, fifth chapter "Conclusions", describes the results of the study as well as discusses what kind of new research paths this study could open in addition to discussing the validity, reliability and limitations of the research.

Each section in all chapters have some parts of the text that are bolded. This is to help the reader to pay extra attention to the most important definitions, terms, descriptions and thoughts regarding the section. These are made after the writing of

the thesis to single out the most interesting and informative bits, to help the reader grasp and understand the most important parts from each section.

1.4. Definitions

Even if most of the definitions and the reasoning for the use of them in the way they are used in this research is provided in the coming sections, to help the reader, few key terms are defined here. These can provide help in understanding the study and its context.

Digitalization = Overall term to describe the technological development spawning the past decades. Allows the use of more advanced technological tools and information technology to create efficiencies and new ways to create value in the society.

Hyperconnected World = The word to describe increasing digital interconnection of people and things, anytime, anywhere. Defined by Hyperconnectivity.

Hyperconnectivity = Internet of networks, people, things, machines, and computers enabling intelligent operations using advanced data analytics for transformational outcomes, to redefine the landscape for individuals and organizations alike. Brings together many different terms and definitions from different perspectives to define the current wave of digitalisation in the society i.e. Internet of Everything, Internet of Things, Industrial Internet and so on.

Smart solutions = Smart, connected processes, products and services allowed by the use Hyperconnectivity and related technologies. Means the possibilities that are offered by technological development such as electronics, software, sensors, data and network connectivity.

Strategy = The plan that combines organizations goals, policies and actions in a cohesive whole and through its formulation it helps organizations to direct, allocate, position, anticipate and marshal operations towards the strategic goals of the organization

Business Model = The logic of the firm, the way it operates and how it creates value for its stakeholders. Made of two elements: strategic choices and consequences of these choices. Consist usually of many value creation models.

Value Creation Model = The parts of business model, the actions that increase the worth of goods and services to create value for the firm's stakeholders. Firms can use many sources to create value.

2. EXISTING KNOWLEDGE

The literature review of this research includes four sections. In the first section 2.1, the current phase of digitalization, its background, driving trends and related concepts, definitions and terms are discussed in depth. The second section of the literature review 2.2 includes basic strategy and business model definitions, their characteristics, how value is created, what is a "sustainable business model" and how the different concepts are used in this research to understand the value creation of businesses as strategic choices through virtuous cycles. In the third section of the literature review 2.3, these two research areas are then combined, when we look into ways how value is created through the use of smart solutions as well as how these relate to the business model development and strategic choices of companies. The last section 2.4 of the literature review is a short synthesis of previous three parts – drawing a picture of what and how this development looks at large, how its different parts interact and relate with each other.

2.1. The Current Phase of Digitalization

The digitalization of society is connected with wide range of somewhat undefined terms and definitions – thus there is a clear need to clarify the topics and definitions before going deeper into the research. As a phenomenon, digitalization in terms of the use of more sophisticated electronics, software, sensors, data usage and networks connecting with each other is a novel development area. Due this, many different organizations and actors have tried to define the field and come up with their own terms to explain it. To understand what the study is about, to form the backbone for it, these terms are discussed in this section. But first, a quick look in to history is in order to understand where the development is coming from and where the development is heading into.

2.1.1. Third Wave of Disruption in IT

As described by Porter and Heppelmann (2014), information technology has radically reshaped business environment twice in the past 50 years – and now we are well on our way to the third transformation. Before 1960's and modern information technology,

products were mechanical and value chain was based on manual paper processes and verbal communications. During the 1960's and 1970's, the first wave of IT automated individual parts of the value chain, leading to rapid productivity increases due to data and analysis that was now able to develop each individual activity on its own. Standardization of processes across companies was the result of this – raising a dilemma for organizations how to have distinctive strategies and to get operational benefits with significant difference from competitors.

The second wave came with the rise of Internet, with inexpensive connectivity making it possible to coordinate and integrate among individual activities. It led to productive gains and growth in the whole economy, transforming the value chain the second time. Yet, both the first and second wave of IT left the products and services largely unaffected. (Porter & Heppelmann 2014)

Now, at the third wave of IT disruption, IT is moving in to the products itself. Porter and Heppelmann (2014) describe the third wave as the **new forms of productivity gains, improvements in product performance and functionality that are driven by sensors, software, processors and their connections in products and data management systems and applications**. In addition to improved products, the value chain will go through another disruption, where product design, marketing, manufacturing, after-sale service, data analytics and security will drive value chain based productivity improvements. Some suggestions say that the third wave of IT changes everything, and as with the Internet itself, the third wave represents yet another leap in development that will go through whole society. World Economic Forum (WEForum 2015) describes this development as the **Hyperconnected World, "the increasing digital interconnection of people – and things – anytime and anywhere"**. This new level of connectivity will affect the whole society at different levels. For companies, understanding this change is more important than ever – if they want to exist in the future. (Porter & Heppelmann 2014)

2.1.2. Megatrends as Drivers of Change

Changes in the business environment are driving the transformation. **Five megatrends shaping the world economy – and our lives – are introduced in this section**. The base of the study draws its knowledge on the work of think tank Demos Helsinki and the ten years of research related to the trends that shape our world, so little actual research has been done in the subject of megatrends on this study per se. **As a more of an introductions and to understand the big picture, the society's development at large, it is important to be aware of the trends that direct the development to form the base for the study**. These five megatrends and their effects are introduced below – especially from companies' point of view.

The clear driving force, the megatrend behind the next wave of digital disruption is the rapid **technological development** driven by sensors, software, processors and their connections in products and data management systems and applications (Porter & Heppelmann 2014). This can simply be referred as **digitalization** (e.g. Ritola et al. 2015) or as discussed in the last section, the third wave of disruption in IT (Porter & Heppelmann 2014). Digitalization in general is used to describe the technological development and how information technology can create efficiencies and new ways to create value in the society. Companies need to understand the possibilities that arise from being able to develop digital products and services to create efficiencies in their value chain – a development that for example many Finnish companies have not realized to integrate in to their strategy (Ailisto et al. 2015). Rapid technological development and how it affects companies trying to benefit from it is the focus of the research, but there are other trends that are affecting the companies, shaping their competitive environment, their business models and possibilities for value creation simultaneously with the technological development.

Besides digitalization, companies have to deal with the globalization and its effects. **Global economy** is one the major megatrends affecting companies currently. Globalisation of economy can especially be seen in the rise of new value creation and operations management models (Juhanko et al. 2015, Ritola et al. 2015). When looking at

the context of this research as in Finland and Finnish companies, the clear result of global economy is that Finnish companies have been forced to adapt to low-growth economy since the global economic downturn of 2008, making it more challenging for the businesses to operate. This in a way supports the change for companies not to aim only for Finnish markets, but also looking opportunities abroad as well as be more efficient in operations. In the new, up-and-coming markets, actors are also not tied to physical location as they have been throughout the history, but rather the global economy offers a way to supply and act globally – offering the possibilities for looking growth abroad rather than just looking it at their home-market in Finland (Ailisto et al. 2015)

From companies' perspective, one notable development path that is happening is the increased **interdependency** resulting from digitalization and global economy, which will shape our social, political and economical environment (Sitra 2015). Companies have to be more aware of their global competition, networks and often act in global markets in collaboration with other global companies and competitive environments. The further on the technological development the companies adopt in their own systems, the more their business model will be relying on dynamic, complex network and ecosystems of actors (Vermesan & Friess 2014). This interdependency is also woven into our global system when looked into the next megatrend, **resource scarcity**.

Environmental issues such as **resource scarcity and climate change** are affecting how companies have to deal with their resource usage and emissions for example. Rapid growth in the planet's population results in increased demand for resources, and according to several studies demand seems to outpace production, resulting in prices rises as well as increased competition between actors. **Scarce resources** have been identified by several risk reports as the largest global challenges humans as a species are facing. (Ritola et al. 2015)

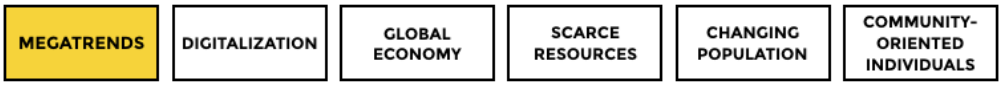
The **changes in population** is also one of the main trends that can clearly be seen in today's world: global population is turning to be more urban, wealthier and more educated. More people live in the cities than ever before and many western countries,

including Finland, are facing challenges with their aging population. (Juhanko et al. 2015, Ritola et al. 2015)

Notable social change is **the age of community-oriented individuals.** Individualism is growing to a new direction in the 21st century, where the individualistic rational consumer of the 20th century is making way for new emergency of more communal values and community-orientation. Collaborative consumption initiatives, social media, other digital platforms, neighbourhood activism and crowdfunding are examples of the shift towards acting in groups rather than as individuals. Ways of participation have changed: election turnouts have declined with approximately ten per cent from the 1950's, whereas digital community platforms have grown from zero to two billion users in just 20 years. (Ritola et al. 2015)

Digitalization is part of the larger development and how digitalization's current wave is developing is largely affected by other megatrends shaping our world today. There are clear global and local driving forces that affect Finnish companies, whether they operate in Finland or in other countries, that shape the possibilities of their business models and how they develop in the future. Understanding these trends is vital for any company especially in the times of such a rapid change that the lifespan of companies is actually getting shorter and shorter (MIT 2015). These five megatrends are together shaping our world towards being more interconnected – shaping the environment of our Hyperconnected World that will be discussed in depth in the next section.

Figure 1. Five megatrends changing the world (Ritola et al. 2015)



2.1.3. The Current Wave of Digitalization – Definitions and Characteristics

Internet of Things, Industrial Internet, Internet of Everything, Hyperconnected World – you heard the buzzwords before. But what do these terms really mean? Different names have been given to identify different viewpoints to describe same phenomenon from different perspectives. In this section, deeper look is taken into the meaning of different terms and how these terms relate to the context of the study. In general, **digitalization of the whole society means in what kind of opportunities electronics, software, sensors, data and often real-time network connectivity allows – how are processes, products and services turning smart and connected (i.e. smart solutions)** as described in our short history review on section 2.1.1. This section gives overall picture of larger concepts used to describe the development, from the point of view of larger societal change. Each concept is looked on its own as well as how it connects with other terms and definitions.

Industrial Internet (II)

When describing the point of view of companies to the development, often heard term is **Industrial Internet (II)**, which was made famous by General Electric (Evans & Annunziata 2012). GE described Industrial Internet having three main elements: 1) smart machines, 2) advanced analytics and 3) humans at work. The first part includes putting sensors to machines. The second part means analysing the output of data coming from the sensors. And the third part how people can have access and effect on these processes better than before through use of these tools. How GE describes the Industrial Internet is that it means the new operations and business models arising from the usage of smart machines, advanced analytics and connected systems (Evans & Annunziata 2012). Generally, Industrial Internet explains the digitalization process from companies' perspective and in more technical approaches (Ailisto et al. 2015). Industrial Internet is part of the digitalization wave, where connected products and services allow the better usage of the resources tied to them and gathering knowledge on their usage to optimize the process (Ailisto et al. 2015).

Leading industrial firms such as AT&T, Cisco, GE, IBM and Intel formed Industrial Internet Consortium, which defines Industrial Internet as connecting smart machines and devices in addition to people who use them in a way that decision-making can be improved due more advanced data analysis to create more flexible business (IIC 2015). According to Juhanko et al. (2015) the distinction to Internet in traditional form comes on the source of information; in Industrial Internet the information comes from sensors and machines rather than people using the network. For example, a sensor can be gathering data on how much usage a machines gearing has, connecting it to analysis service which then advices when to have maintenance before it breaks down based on historical data on how long a gearing can last. The approach of IIC (2015) does not necessarily makes this kind of straightforward distinction of source of information, but defines **Industrial Internet as "an internet of things, machines, computers, and people, enabling intelligent industrial operations using advanced data analytics for transformational business outcomes, and it is redefining the landscape for business and individuals alike**". The IIC definition includes quite largely the development as a whole, without setting too strict boundaries to what it is actually. As the leading organization around the world promoting companies' adoption for Industrial Internet, the definition of IIC is the most prevalent and also used as a basis of the definitions used in this research when talked about the development.

Industrial Internet of Things (IIoT) and Internet of Things in Industry

To describe the same development of Industrial Internet, other terms have been proposed as well. The World Economic Forum (WEF 2015) defines **the industrial or companies' viewpoint** with the label **Industrial Internet of Things (IIoT)**, whereas Vermesan and Friess (2013) define it simply by using the term **Internet of Things in Industry**. From these, IIoT have been used by IIC as well (IIC 2015). These mixed terms are the first example how there are no clear boundaries set on such novel area of development just yet – in fact, it is not sure if the boundaries even exist, and the definitions of how the phenomenon is referred as, is just shaping.

Internet of Things (IoT)

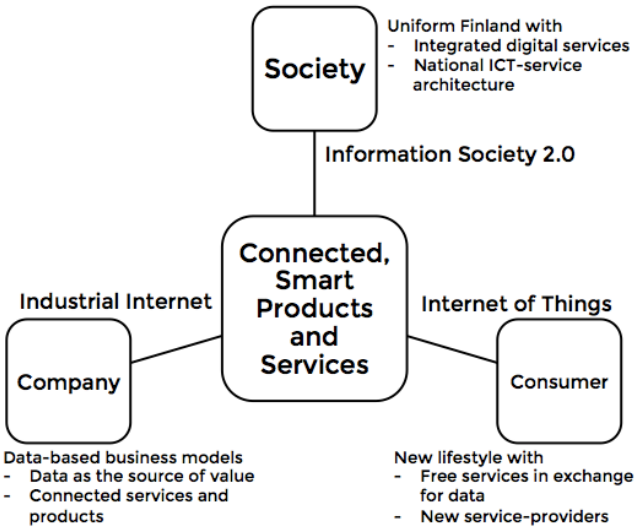
This brings us to term **Internet of Things (IoT)**, which is probably the most often heard term in the context in addition to Industrial Internet. By definition IoT enables network of objects or "things" to collect and exchange data and these objects to be controlled remotely across networks. Vermesan and Friess (2013, 8-9) describes IoT as being "a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications/services and reach common goals". As a term, **IoT has been more referred as meaning products and services directed to consumers rather than industries** (Juhanko et al. 2015). For example, different metering systems, televisions connected to the Internet, health applications to monitor individuals own health and cars connected to Internet are some applications of IoT – yet according some definitions (e.g. IIC 2015) these could be included under the definition of Industrial Internet as well.

Contrasting to that, the limited consumer approach is challenged by many definitions, where IoT is in fact used to describe the whole phenomenon at large, similarly to the definition of II. For example, Cisco and Gartner use the term IoT to describe how connecting physical things to a network that contain embedded technology to gather data as well as communicate and interact with internal and external environment to result in new ways of value creation (Cisco 2015, Gartner 2015). In similar way, Manyika et al. (2013) defines the **Internet of Things as the use of sensors, data communications technology and network connectivity, which allows the objects or "things" to be tracked, coordinated or controlled**. As Vermesan and Friess (2014, 13) quite well describe: "The Internet of Things is not a single technology, it's a concept in which most new things are connected…". In fact, organizations have included "smartness" in their products, machines, services and operations for years. Now with the development of Internet and network connectivity, this data can now be analysed further on, often in real time – and this opportunity is called the Internet of Things (IoT-Finland 2015).

Information Society and Smart, Connected Products

In Finland, one framework that is understood to be a good basis to define digitalization of the whole society can be seen through connected, smart products and services (figure 2). According to the classifications made by Juhanko et al. (2015), what is commonly understood is that Industrial Internet focuses on the viewpoint of companies to digitalization, whereas Internet of Things is the consumer perspective. The **Information Society** or **Society 2.0 means the integrated digital services provided to citizens by government and how the digitalization development will also shape the public sector** (Juhanko et al. 2015). These three come together when the different actors form a **network of smart, connected products and services**. Porter and Heppelmann (2014) describe these **smart, connected products (processes and services)** in more detail through the viewpoint of the change being that products themselves turn smart to define the new way of product functionality, service providing and process optimization. These **smart, connected processes, products and services allow organizations ways to create value through different applications that the technological development allows.** Porter and Heppelmann (2014) in fact propose that IoT as a term is not very good in describing the phenomenon or its implications. They argue that the IoT is focused too much on the technologies themselves, whereas in fact the most transformative phenomenon is the "changing nature of things".

Figure 2. Connected, smart products and the relation to different definitions (translated from Juhanko et al. 2015, 9)



Ubiquitous Computing

Another often appearing term that describes the same development is **Ubiquitous Computing** (i.e. pervasive computing). **It describes the trend towards embedding microprocessors to all objects so that they can communicate information – ubiquitous meaning "existing everywhere"**. In practice, it is especially used from the more technological point of view to describe the large-scale, small and distributed devices that are able to sense, communicate and interact real-time or through sensor networks and peer-to-peer systems. It is often used when talked about machine learning, data mining, sensor networks, grids, peer-to-peer networks, data stream mining, activity recognition, Web 2.0, privacy, user modeling and other related areas. Compared to other definitions, it is certainly much more technology focused, with the main description being in the microprocessors (i.e. sensors) and their connectivity. (May & Saitta 2010)

Internet of Everything

Another term sometimes used is the **Internet of Everything (IoE)**, which will succeed the IoT as connecting people, things, information and places together (Vermesan & Friess 2014). How IoE is defined by Cisco (Bradley et al. 2013, Cisco 2015) it means **the way people, processes, data and things come together to create systems that provide value and turn information into new opportunities, richer experiences and large business opportunities for individuals, companies and societies**. According to Juhanko et al. (2015) and the definition used by IIC (2015) this is very close to the definition of Industrial Internet, but making it larger to apply outside of not only companies, but individuals and societies as well. In a sense, this thus includes both IoT and II under the same definition, even if the focus is still from company perspective.

Hyperconnected World and Hyperconnectivity

What seems to be describing the digitalization of society the best is the term mentioned before, **Hyperconnected World,** or simply **Hyperconnectivity,** used by World Economic Forum (WEForum 2015) to describe the phenomenon at societal level.

Hyperconnected World means "**the increasing digital interconnection of people – and things – anytime and anywhere**". This connectivity will shape our social, political and economical systems. Digitalization could be used as to describe the development as societal level, yet as very generic term it might not be the most descriptive term, for example when compared to Hyperconnected World. Also, on his book "Social Physics", Pentland (2015) uses the terms of Hyperconnected World and Hyperconnectivity to describe the development of global nervous system that allows highly sophisticated usages of data to transform our society – not just in terms of companies, but for all individuals and organizations alike.

A Synthesis on the Definitions and Terms

To form a language and terms that can be used in this research based on the literature the definitions and terms are here put together according the best understanding of their uses. In the table 1 below, a summary of all used terms is provided. In figures 3 and 4, a synthesis of the digitalization of society and related terms are put together. Figure 3 depicts the new environment that companies, other individuals and other organizations have to adapt to. The best way to describe the societal level change of environment seems to be **Hyperconnectivity or Hyperconnected World.** Hyperconnectivity can be used to describe **the increasing digital interconnection of people and things, anytime and anywhere** (WEForum 2015, Pentland 2015).

Table 1. Digitalization – Summary of terms and definitions in order of appearance

TERM	ACRONYM	DEFINITION	SOURCES
Industrial Internet	II	Companies perspective to digitalization. An internet of things, machines, computers, and people, enabling intelligent industrial operations using advanced data analytics for transformational business outcomes, and it is redefining the landscape for business and individuals alike.	Evans 2012, GE 2015, Ailisto et al 2015, IIC 2015, Juhanko et al 2015
Industrial Internet of Things / Internet of Things in Industry	IIoT	Used to describe same development as Industrial Internet, definition above.	WEF 2015, Vermesan & Friess 2013, IIC 2015
Internet of Things	IoT	The use of sensors, data communications technology and network connectivity, which allows the objects or "things" to be tracked, coordinated or controlled. More consumer-centric approach to digitalization.	McKinsey 2013, Cisco 2014, Gartner 2015, Juhanko et al 2015, Vermesan & Friess 2013, IIC 2015, IoT-Finland 2015
Information Society / Society 2.0		Public sector / societal development perspective. The integrated digital services provided to citizens by government and how the digitalization development will also shape the public sector.	Juhanko et al 2015, Ailisto et al 2015
Smart, connected processes, products, and services (i.e. smart solutions)		Opportunities that organizations have through the use of new ways to create value through applications that II, IoT and Information Society allow.	Porter & Heppelmann 2014, Juhanko et al 2015
Ubiquitous Computing		The trend towards embedding microprocessors to all objects so that they can communicate information – ubiquitous meaning "existing everywhere". Especially used to describe the technological point of view of the large-scale, small and distributed devices able to sense, communicate and interact real-time or through sensor networks and peer-to-peer systems.	May & Saitta 2010
Internet of Everything	IoE	Close to the definitions of Industrial Internet, but tries to account for larger development of also individuals and the whole society as well. The way people, processes, data and things come together to create systems that provide value and turn information into new opportunities, richer experiences and large business opportunities for individuals, companies and societies.	Vermesan & Friess 2014, CiscoBradley, Juhanko et al 2015, IIC 2015
Hyperconnected World / Hyperconnectivity		Similar to the definition IoE, trying to account for larger societal development. The increasing digital interconnection of people – and things – anytime and anywhere.	WEForum 2015, Pentland 2014

Hyperconnectivity happens is through the use of **the Internet of networks, people, things, machines, and computers enabling intelligent operations using advanced data analytics for transformational outcomes, to redefine the landscape for individuals and organizations alike** (edited from the definitions of Industrial Internet by IIC 2015 to account for the phenomenon at societal level). The **Industrial Internet** describes the companies' perspective to this phenomenon, whereas **Internet of Things** mainly refers to the smartness of products and services from consumers' point of view and **Information Society** to the development of public sector. From the practical point of view, in figure 5 we see how the new environment means new ways to create value through **smart, connected processes, products, and services, i.e. smart solutions** (e.g. Juhanko et al. 2015, Porter & Heppelmann 2014). As discussed earlier, these smart

solutions tap into the potential provided by **electronics, software, sensors, data and network connectivity to individuals and organizations**.

Figure 3. Digitalization of society – a definition of the new environment

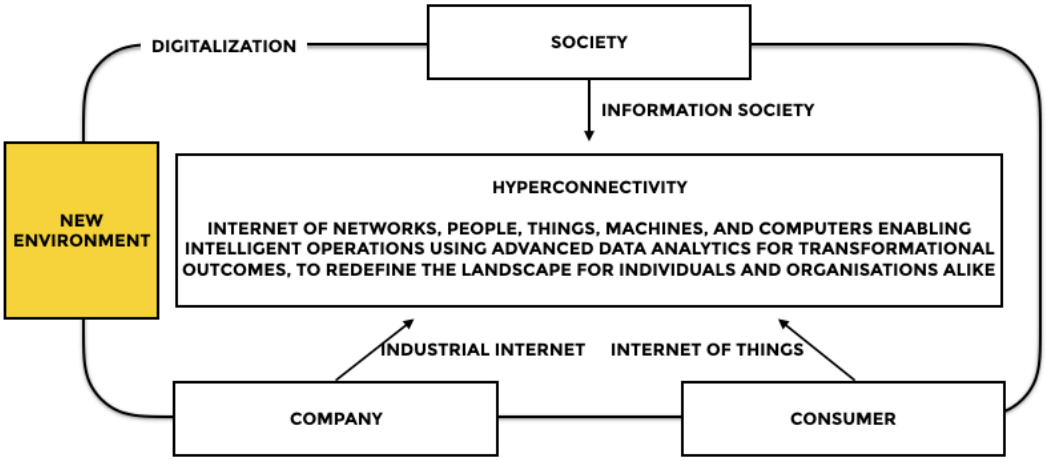
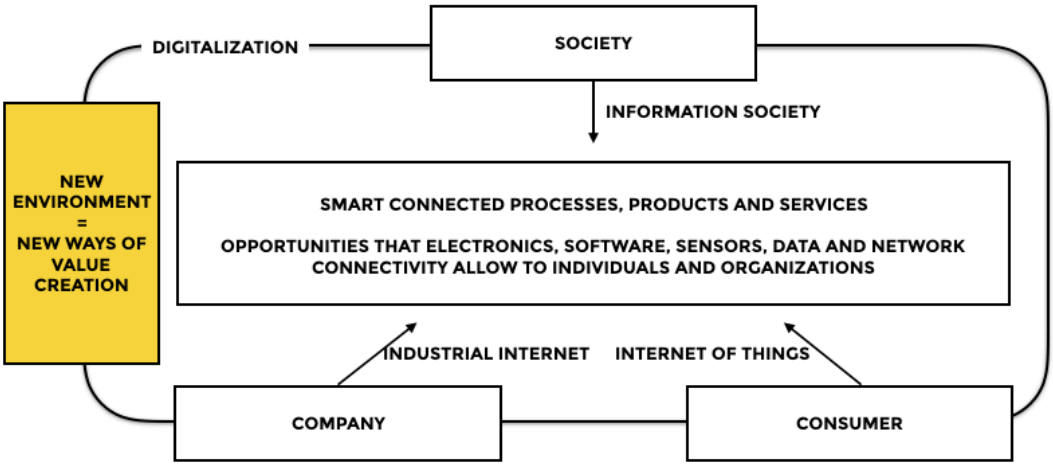


Figure 4. Digitalization of society – opportunities for companies



The practical level, the opportunities that businesses have through smart solutions and related value creation possibilities are looked more in detail in section 2.3. To form a background to be able to look into that, strategy, business models and value creation are discussed in the next section.

2.2. Strategy and Business Models

In this section, basics of strategy and strategic decision making as well as business model definitions, characteristics, value creation, sustainable business models and concepts overall usefulness in related to strategic decision-making are discussed. In addition, the meaning of these constructs for this research and the way they are applied is described. Before heading deeper into business models, basics of strategy are looked first as the viewpoint and framework to understand business development and value creation.

2.2.1. Basics of Strategy and Strategic Frameworks

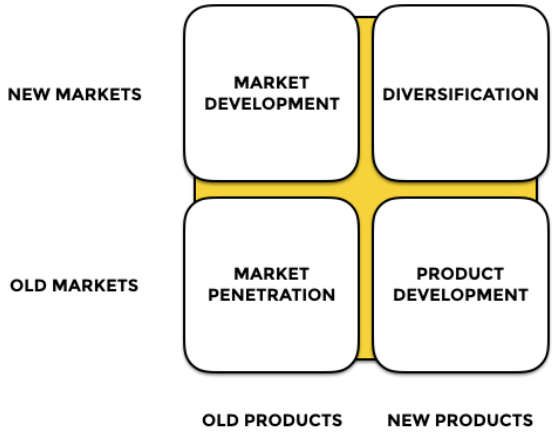
In very simple definition, business strategy implies by which means the firm is using to achieve its goals (Porter 1980). A strategy exists for all firms and it can be either explicitly or implicitly made through organizations operations, even if most companies tend to formulate some kind of strategies for themselves (Porter 1980, Mintzberg & Quinn 1998). In general, a **strategy is the plan that combines organizations goals, policies and actions in a cohesive whole and through its formulation it helps organizations to direct, allocate, position, anticipate and marshal operations towards the strategic goals of the organization** (Mintzberg & Quinn 1998). Ansoff (1965) understands strategy from a decision theory point of view, where there are three classes of decision-making areas (strategic, administrative and operating), on which companies need to make decisions on. In other words, strategy is an action plan designed to achieve a goal or a long-term aim. According to Ansoff (1965, 17), the strategic problem to be solved by firms is to "configure and direct the resource-conversion process in such a way as to optimize the attainment of objectives".

To put strategy into the context of the research, first notion to be stated is that the new wave of **digitalization doesn't necessarily change the basic understanding of strategy: to gain competitive advantage, a company has to be able to differentiate itself to command a price premium, operate at a lower cost than its rivals, or both** (Porter & Heppelmann 2014). Companies have to make (either explicit or implicit) strategic choices, and these choices – if successful – lead to competitive advantage that allows superior profitability compared to the industry average (Porter & Heppelmann 2014). Naturally, companies operate with limited resources, resulting in strategic choices often involve trade-offs as only some of them are feasible and possible for a company to adopt. Certain strategic choices are available depending on, for example the technological development of the company and the investment capital owned. These strategic choices can reinforce one another and define a coherent and distinctive strategic positioning of the company (Porter & Heppelmann 2014, Casadesus-Masanell & Ricart 2010).

In general, strategy is directed to grow the company's business and help it to pinpoint the needed choices to be made. When companies are looking to grow their business, one useful framework to understand the development of different business areas is Growth Vector Components matrix (also referred as the Ansoff Matrix; Ansoff 1965, 99). This matrix shown on figure 5 distinguishes between the old (i.e. current or existing) and new markets and products, to distinguish four categories of growth sources for companies. These categories are **market penetration**, which means to increase the market share of old markets with old products by operational efficiencies; **market development**, which means to create new missions for the firms' current offering; **product development** meaning creation of new products to old markets; and lastly **diversification**, which means to create new products for new markets (Ansoff 1965). The Growth Vector matrix is used as the basic framework of strategic focus on this study, as it fits categories distinguished for value creation through Industrial Internet by Juhanko et al. (2015) which will be discussed later on. On the other hand, similar traditional categorisation

could have been used such as Porter's Three Generic Strategies of overall cost leadership, differentiation and focus (1980), yet the categorisation for growth markets by Ansoff for the emerging field of Hyperconnectivity were chosen as the most representative compared to sources discussing the division of value creation in certain categories (Juhanko et al. 2015). In general, these types of normative or prescriptive categorisations can be helpful in different contexts to distinguish company's strategic development directions (Mintzberg & Quinn 1998).

Figure 5. The Growth Vector Components matrix (based on Ansoff 1965, 99)



Considering the emergent nature of the technological development, companies do need to realize that in strategic point of view, there are huge risk and uncertainties in play (Porter 1980). For companies trying to compete in an emerging field, where most value creation and business models are new, one way to look at strategic development is through understanding so called Blue Ocean Strategy (Kim & Mauborgne 2005). What is proposed by Kim and Mauborgne is that companies should pursue of both differentiation and low cost (operational efficiencies) at the same time rather than looking into dividing them as separate strategic actions. This is done to find markets on the uncontested places and create own markets rather than try to compete on the existing ones. The reasoning is to not compete on the fields that are highly contested, rather making the competition irrelevant by reconstructing industry boundaries (Kim & Mauborgne 2005). Certainly, smart solutions are defining new operational effectiveness and every company has to

know where to look in its strategy somehow – not dependent on the strategic framework and way to look at the strategic decision-making is taken (Porter & Heppelmann 2014).

When it comes to strategy and business models, often they seem to be understood as relatively the same especially in simple competitive situations, making it difficult to distinguish between the two concepts (Casadesus-Masanell & Ricart 2010). However, there are clear differences that should be noted. Business model can be defined as to be a reflection of firm's realized strategy, and on the other hand it can serve as a tool to help in the strategic decision-making process (Casadesus-Masanell & Ricart 2010). What are looked in the next sections are business model definitions and characteristics as well as how the concept relates to strategy.

2.2.2. Business Model – Definitions and Characteristics

The appearance of the term business model into mainstream is relatively young phenomenon. Authors like Osterwalder (2005) claim that even if mentioned in business literature already in 1957, it only came to be a popular concept during late 1990's due to information technology increasing the available business design choices for managers. Thus, a new way of describing how value is generated to customers was needed and business model as a concept came to the mainstream (Osterwalder 2005). Unified general meaning for business model has not been agreed upon, mainly because different authors have been writing about business models when they are not necessarily meaning exactly the same thing and in business literature, the word itself is used to describe various aspects of business. There is not an universally understood definition, making it important to look at the concept and define it in terms of this research.

Osterwalder (2010) defines business model as describing the rationale of how an organization creates, delivers and captures value. By the definition used by Teece (2009), a business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits. Or in other words a business model describes

the design or architecture of the value creation, delivery and capture mechanisms employed. In forming a somewhat similar definition, Casadesus-Masanell and Ricart (2010, 195) propose that **business model is a reflection of the firm's realized strategy – the way the company operates and creates value for its stakeholders**. Osterwalder (2010) also talks about that business model is like a blueprint to firm's strategy, that can be used as a tool to change organizational structures, processes and systems.

To put it in short, a business model aims to explain and simplify how the businesses most important parts, processes and activities create value for the company's stakeholders using some form of representation. In the context of strategy, business model is a reflection of the firm's realized strategy, describing "**the logic of the firm, the way it operates and how it creates value for its stakeholders**". A business model can consist of many forms of value creation that derive from different sources and as together they form the whole business model. (Casadesus-Masanell & Ricart 2010)

2.2.3. Strategic Use of Business Models

As per their nature, business models are changing and dynamic. They can be understood to reflect their environment and the changes in environment are reflected in the changes in the business models. Firms can select a business environment or be selected by it, as well as they can shape the environment by acting in it – the business environment of a firm is in fact a choice variable (Teece 2009). It is folly to say that successful business models always have certain characteristics, but they are naturally depended on the time and context what they operate in. As Osterwalder (2005 and 2010) explains the nature of business models clearly, they are an expression how the firm does business, a snapshot and a description at a specific moment in time.

Despite this dynamic and forever changing nature of business models and the concept, the usefulness of business models in practice has been realized for various reasons. In the last section, definition of business model was introduced. For what the whole construct aims at, is to gain some kind of advantage over competitors in understanding how firms realized strategy is actually working. The tools and representations that help to simplify

and visualize the core aspects of the firm can be great help for companies looking to innovate, when they know that the industry is changing rapidly and they need to act fast with limited knowledge and resources. Essential reason for trying to understand a business model at any certain point would be to know how to plan, implement and change things towards better business practices. For these reasons, business models concept can be used as a tool to gain understanding about what a company's business is really about. (Casadesus-Masanell & Ricart 2009 and 2010)

As different studies suggest (e.g. Casadesus-Masanell & Ricart 2009 and 2010, Osterwalder 2010), business model is a representation of firms realized strategy, thus it can be also a tool for analysing and communicating strategic choices. Osterwalder (2005) identifies five categories of functions that help managers, when they look at the business logic of the firm. The areas where business model constructs help are deeper understanding and sharing (i.e. communicating), analysing for better performance, managing different parts of the firm, understanding future prospects and the possibility to patent business models. In his later work, Osterwalder (2010, 15) **sums up the usefulness of the concept to spawn from the ability "to create new strategic alternatives".** This comes close to the ideas of Teece (2009, 191) who claims "business models can both facilitate and represent innovation". Teece (2009) understands the benefits to come from the increased understanding of the essence of business models: they help in understanding different subjects such as competition, innovation, market behaviour, strategy and competitive advantage.

Business model concept can – and should – be used by managers dealing with strategy to understand their own positions and possibilities. Above sources are just few examples how different authors have identified the reasons for the concepts usefulness. To put it short, **a business model can be understood to be a helpful tool for communicating, for analysing, for managing and understanding, and for strategic innovation** – as summarised in the table 2.

Table 2. Strategic uses of business models

STRATEGIC USE	DESCRIPTION	SOURCES
Communication and sharing	Business model can help to capture, visualise, understand, communicate and share the business logic internally and externally.	Teece 2009, Osterwalder 2005 and 2010, Casadesus-Masanell & Ricart 2009 and 2010
Analysing business logic	Business model becomes a new unit of analysis. Business models can improve measuring, observing, and comparing the business logic of a company. For example, it can be used to identify relevant measures.	Teece 2009, Osterwalder 2005 and 2010, Casadesus-Masanell & Ricart 2009 and 2010
Managing and understandind operations	Possibilities to improve the management of the business logic of the firm. The business model concept helps in design, planning, changing and implementation of business models.	Teece 2009, Osterwalder 2005 and 2010, Casadesus-Masanell & Ricart 2009 and 2010
Strategic innovation	The business model concept can help foster innovation and increase readiness for the future through portfolios and simulation. Creation of shared language allows to easily describe and manipulate business models to create new strategic alternatives.	Teece 2009, Osterwalder 2005 and 2010, Casadesus-Masanell & Ricart 2009 and 2010

2.2.4. Strategic Choices and Consequences

To begin with, similarly to the definition of business model, different researchers have described differently what are the business model elements and what parts should be included in the representation of a business model. Complete business models are often too complex to write down and work with, thus a simplification is needed and can be used in understanding what a company's business really is about as discussed in the previous section (Casadesus-Masanell & Ricart 2009 and 2010). Even if business models might be simplifications, the constructs are always made from concrete operations in the business.

One of the most prominent and commonly used ways to understand and map out different elements of business models is the **Business Model Canvas** (Osterwalder 2010). Business Model Canvas typifies nine different elements of business models: customer segments, value propositions, channels, customer relationships, revenue streams, key

resources, key activities, key partnerships and cost structure. According to Osterwalder (2010), these nine elements cover the four main areas of business: customers, offer, infrastructure, and financial stability. Large amount of elements can be a helpful way to look in depths of a business model, but there are other ways to do it too.

In contrast to Business Model Canvas, Itami and Nishino (2009) describe business model being composed of only two elements: **a business system and a profit model**. A business system means the "system of works", how the production/delivery system is designed to serve the needs of firm's customers. A profit model is the process how the firm will make a profit in its given business, in other words, how it plans to increase sales and/or reduce costs. These combined make the business model, the representation of how the firm works.

Teece (2009) approaches the same problem from the perspective of strategy and states that there are six relevant elements in a business model that needs to be considered. These are identifying market segments, what benefit the company delivers to the customer, the technologies and features of the product and service, revenue and cost structure, the way how technologies are assembled and offered to the customer, and the mechanisms by which value is captured and competitive advantage is thus sustained.

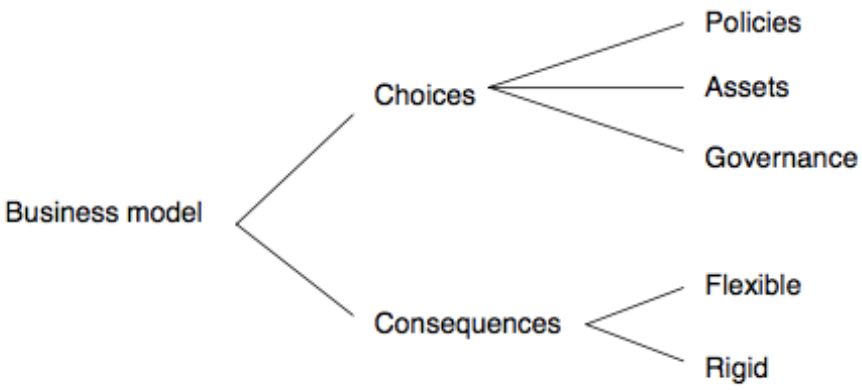
When sustainable innovation and business models are considered together, Boons et al. (2013) propose that business model elements include at least three elements: the value proposition, the configuration of value creation including how the firm links with suppliers and customers, and the revenue model including how costs and benefits are divided among actors in the surrounding environment. When looking at sustainability from the environmental perspective as it is looked at in this study and discussed in the next section, the most relevant thing to understand is not the value proposition of the firm, but how can the firm through its operations reduce environmental impact. Thus, the focus being on the how costs and benefits are divided among actors in the environment.

From these different definitions, a conclusion can be drawn that a business model is constructed of different elements, often described in different words by different authors. These elements have effects in the firms' realized strategy. The problematique of what are the relevant elements to study and include in one representation does not necessarily go away with the different normative approaches to the elements of business models. Even if all above normative approaches are talking about the same things, clear synthesis of what is relevant and what is not, is not hundred per cent clear.

What is looked next is less demanding approach, even if sort of normative in its own as well. Casadesus-Masanell and Ricart (2009 and 2010) define **the business model and its inherent quality to be the "logic of value creation and value capture".** Value creation can naturally derive from many sources, yet identifying the sources of value creation is essential for any firm. In addition, Casadesus-Masanell and Ricart (2009 and 2010) also state that **business models are composed of choices, and the consequences derived from these choices**. This is similar to the decision theory -based view that Ansoff (1965) has on strategy, that the strategic problem of a firm is to decide how to optimize its assets.

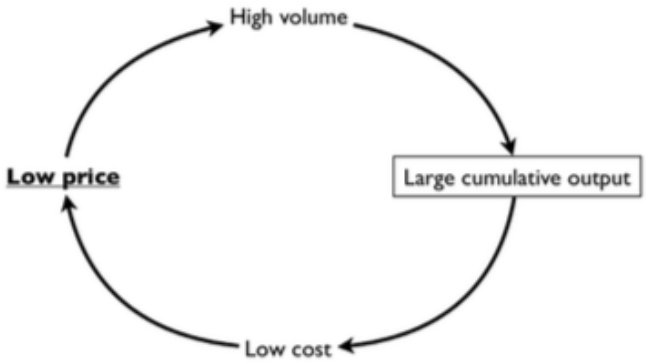
Casadesus-Masanell and Ricart distinguish three types of choices: policies, assets, and governance structures. Policies refer to actions that the company adopts for all aspects of its operation (e.g. locating plans in rural areas, airlines use secondary airports). Asset choices refer to decisions made on tangible resources (e.g. manufacturing facilities, airlines choice to use certain aircraft model). Governance choices refer to the structure of contractual arrangements that rule over decision rights over policies or assets (e.g. business model choice can be to use certain assets such as fleet of aircraft, which leads to a decision whether the company should own the fleet or lease it). Essentially, the focus of the approach is on **the most meaningful strategic choices that a company can make and the results of these strategic choices**, which forms the core part of the business. (Casadesus-Masanell & Ricart, 2009 and 2010)

Figure 6. Elements of a business model (Casadesus-Masanell and Ricart 2009, 3)



What they propose is that when an analysis is made of a business model, first look has to be made into what are the key choices that the company makes (or has made) and what are the consequences of these choices. The business model can be represented as by looking at virtuous cycles. These virtuous cycles are feedback loops that strengthen the cycles' different parts. For example, below in the figure 7, Hondas' choice of setting low prices is pictured in the virtuous cycle loop. The consequences were high volume and high cumulative output, which allowed the company to benefit from the learning curve and lower costs. This in turn helped Honda to lower the prices again as the marginal cost of production was decreasing. (Casadesus-Masanell and Ricart 2009, 4-5)

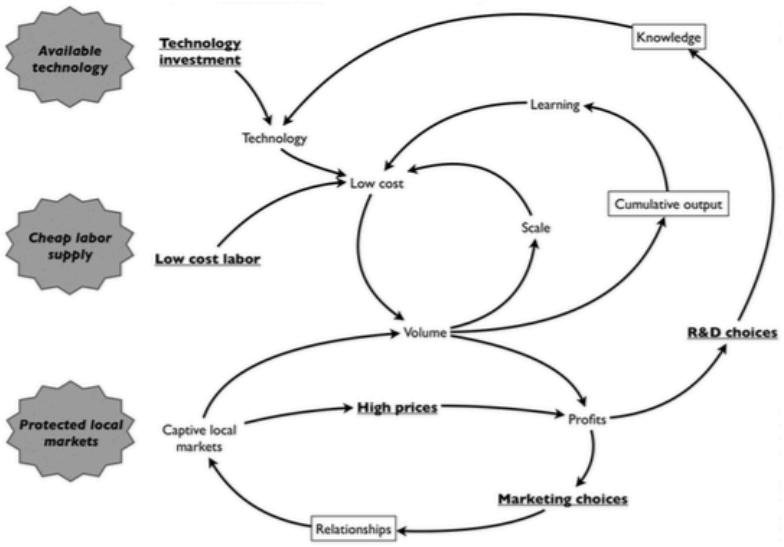
Figure 7. Example of a virtuous cycle (Casadesus-Masanell and Ricart 2009, 5)



Virtuous cycles are hard to stop when they gain pace, explaining some of the most successful business models that can stay in business for decades. On the other hand, with failing business these virtuous cycles can become vicious cycles, one bad choice resulting to bad performance in another part, which in turn comes back to weaken the first part. The finding of these feedback loops results in a map of a subset of choices and consequences connected by the theories to form a business model representation, or in other words the best guess of how the actual business model works. (Casadesus-Masanell & Ricart 2009 and 2010)

On figure 8, an example of Traditional Catalan business models main virtuous cycles is explained in simplified figure (Casadesus-Masanell and Ricart 2009, 8). The figure explains how the business models create value and how the different choices and resulting consequences affect each other to create virtuous cycles – cycles that reinforce the different parts of the business, thus making the business model more successful in the long run.

Figure 8. Traditional Catalan business model main virtuous cycles (Casadesus-Masanell and Ricart 2009, 8)



Casadesus-Masanell and Ricart (2009 and 2010) claim that this approach works especially well in business research, because it does not impose strict limits like some normative approaches do. In their minds, imposing limits to what business model is might actually not represent reality, thus they do not consider strict categories or variables existing in the business models because of the nature of it. Other authors such as Mintzberg and Quinn (1998) offer their support to the non-normative theory, as descriptive theories (such as Casadesus-Masanell's & Ricart's) rather explain the world as it is, not what it is supposed to be. Of course, both approaches of normative (i.e. prescriptive) and descriptive theory are useful on different contexts, and both are also used in this research. Going back to the conceptualisation of business models to choices and consequences, it is in fact normative itself, even if not every strict one. As the business model per definition is "the logic of the firm, the way it operates and creates value for its stakeholders", an analyst studying the business model is better off at not looking at every single aspect of a business model (because it is not possible, at least in very effective way), but to identify key characteristics that matter to the organization, identify those choices and their consequences to draw a representation of how the firms most crucial aspects work (Casadesus-Masanell & Ricart 2010).

The argumentation for this approach fits well for the purpose of this research of not finding and describing business models in full, but rather trying to find the most relevant parts of these business models that relate to the development of smart solutions. This results in only looking at the value created through smart solutions that form only part of the business model of the companies. How important this part really is, depends of course on how it is applied in the organization and how much value it creates. Thus, **Casadesus-Masanell's and Ricart's concept of choices resulting to consequences is used as the framework to understand value creation in the business models**. There are three arguments to use this not-so-normative approach rather than looking at extensive business model constructs such as Business Model Canvas in this research. First, as said before, **the research is not aiming at complete, detailed by all different aspects of a business models**. Rather, the aim is to find more about some of the key choices of value creation. Second reason relates to that and is more practical; it is **not possible in the**

scope of the research like master's thesis to describe as many exact business models as the number of companies in the sample size. Lastly, third and the most important reason: **it makes no sense to limit or impose bounds of business model elements on a novel field allowing new value creation models applied in new ways**.

So what is the focus when this research looks at the business models and key characteristics of value creation? From large amount of sample companies and with limited data, it is hard to construct a virtuous cycle figure like one seen above about Catalan Traditional business model in that amount of detail. Rather, **what the research is trying to find is the key value creation characteristics, key choices that the companies make – parts of the business model, but not the full representations**. By being able to describe the parts of the business model that create value through technological development in new ways, both concepts can be used to help in strategic decision-making and help managers to be able to grasp the efficiency and the consequences of the firm's strategy in practice. What already identified value creation models have been discussed in literature is summarized in the next section. Before that, business model concept for sustainable innovation is looked at as one interesting discussion point that arise from the interception of the development of new ways to create value, technological development and the change of environment driven by megatrends.

2.2.5. Business Models for Sustainable Innovation

As part of this research also aims to find out how smart solutions support sustainable innovation and sustainable business models, it is important to look at these definitions as well. As identified earlier, resource scarcity, climate change and global population increase are some of the drivers of today's business environment, as well as ever increasing competition through global economy leading to the demand for companies to operate in more efficient ways than before – or face decline. The link between sustainable innovation and economic performance has gained more interest especially in the 2010's, where we are seeing rise of new global and local challenges such as climate change, resource scarcity, international markets and financial crisis (Boons &

Lüdeke-Freund 2012). These challenges provide opportunities for new kind of solutions. Most of them being sustainability challenges, sustainable innovation combined to new business models is positioned to be win-win situation (Porter & Kramer 2011). The business model concept itself is understood to be an important tool for researchers and practitioners to make progress on sustainable innovation (Boons et al. 2013).

As described by Boons and Lüdeke-Freund (2012), the concept of **sustainable business models can provide the important link between the firm and the larger environment they operate in**. This is especially important notion once a look is taken at what is discussed in this and next section considering business and value creation models in addition how the companies can benefit from new smart way of using resources.

Sustainable innovation and business models are often understood through the definition of eco-innovation. The definition made by European Commission (2008) forms a basis to understand what is eco-innovation. Eco-innovation is defined as **production or exploitation of novelty in products, processes, services, management and business methods aiming to prevent or reduce environmental risk, pollution and other negative impacts of resource (i.e. energy) use**. The European Commission definition is highly focused on the environmental sustainability, leaving the other two traditional pillars of sustainability in social and economic aspects without attention. Carrillo-Hermosilla et al. (2010) have a larger definition stating that sustainability innovation is anything that improves sustainability performance, in terms of ecological, economic and social criteria, in adding that these criteria have different meanings in different context. Boons et al. (2010) understand it also in very similar way that sustainability is not about only environmental sustainability. In addition to considering these three aspects, sustainable innovation should be integrated not only to products and services, but to new business and organizational models as well – business and organizational models being the most important part where to address sustainability as these provide opportunity to affect the system at large.

It has to be admitted, that to consider sustainability holistically and on the level of whole society, addressing it in terms of ecological, economic and social criteria should be sought for. Companies should not focus on only one aspect, but think how they can address all the three through changes in their business and organizational models. Yet, in the scope of this research, going in to the depths of the criteria of all three pillars of sustainability is not sensible or feasible as sustainability in business models is just a part of the research. The research is especially interested in the possibilities and applications of reducing resource use, or in other words being more efficient regarding natural resources, in other words being resource-smart. In the next section, with the introduction of the different identified value creation models, their sustainability is also looked at – meaning whether they are directed to reduce resource usage or if they can only be used for that among other purposes as well. Thus, the European Commission definition of eco-innovation will be used as the basis to define sustainable innovation in the context of this research. On other studies, this has been labelled as resource smartness or simply resource efficiency (Ritola et al. 2015). The focus is on the **environmental impacts and effects of the new business models and whether the value is derived from better environmental performance** when the companies use applications related to smart, connected processes, products and services.

2.2.6. Why Discuss Strategy, Business Models, Value Creation and Digitalization Together?

The last section of this chapter discusses why it is important to discuss business models related to the current phase of digitalization including the change of environment that it is causing. As discussed earlier, the business model as a concept came to be more widely used when the information technologies allowed new ways of value creation. This resulted for a need to describe these in relevant terms. Porter and Heppelmann (2014) describe how the third, currently on-going phase of digitalization will disrupt the markets once again. There rises a need to understand the development in the perspective of companies, and **business model as a concept can be a tool to facilitate this strategic discussion**. All these reasons can be generally applied to any business field in the current

world and are not only limited to the sphere of digitalization. Yet, there are few clear reasons why it is very important to discuss business models especially in this context.

First, the development of globalised economy supported by technological development in digitalization and defined by its interdependency, will most likely increase the related business models and how many companies need new ways of value creation that rely on data, analytics, cloud and software (as many companies in fact do already).

Second, information has always had a difficulty in being able to price itself. Related industries have always had business model issues, because information is hard to price, and consumers have many ways to obtain certain types without paying. Figuring out how to earn revenues, or create value, from the provision and collection of information from users and customers is a key (but not the only) element of business model design in the information sector. (Teece 2009)

Also, industrial applications of digitalization have huge potential socioeconomic impacts, as industries account for nearly two-thirds of the world economy (WEF 2015) and the estimates claim that the market value of this potential ranges from $14 trillion to $33 trillion dollars (Vermesan 2014, IIC 2015). To understand the opportunities, it is essential for companies to understand what are their possibilities for development in the near future. After all, new types of products alter industry structure and the very nature of competition, exposing companies to new competitive opportunities and threats (Porter & Heppelmann 2014). In this, understanding the layers of business models can help.

At the same time, despite the realized potential, industries have problems in catching up what the development is about. According to several sources (e.g. Vermesan 2013, WEF 2015) there are difficulties in understanding the available business models and the long-term implications of digitalization to the industries. Many great technological achievements simply fail commercially because of little, or no, attention has been paid to designing a working business model to introduce them to the market properly (Teece 2009, Casadesus-Masanell & Ricart 2010). This can and should be changed by better

understanding of the underlying value creation models as well as their role in innovation and business performance. Often companies have problems in changing their business models with the technological development (Teece 2009). To be able to discuss and answer to these challenges, it is important to look at the business models in this specific context.

In addition, ICT development and the demands of socially motivated enterprises constitute important sources of recent business model innovations (Casadesus-Masanell & Ricart 2010) and it is especially relevant for this research since sustainable and ecological innovation is often supported by the adoption of new technologies (Boons & Lüdeke-Freund 2012).

Lastly, as there are clear first mover benefits related to technology adoption as well as it is relatively easy to copy a business model once it is established (Teece 2009), it is important to consider business models related to Hyperconnectivity. Hopefully, by shedding light to the various ways that companies can create value and integrate the value creation models into their business models, the research can also give easy thinking frameworks and ideas for those in charge of strategic business decisions in their companies.

2.3. Value Creation through Smart Solutions

This section discusses how companies can create value through **smart solutions** (i.e. smart, connected processes, products and services). There are four parts in this section. First part describes the development from companies' perspective and strategy. The second part focuses on the identified value creation models. The third part is about how virtuous cycles and feedback loops can be formed through the value creation models the way described in the last section. The fourth and last part is on the sustainability of the value creation models. Clarification should be made here that what is researched and introduced in this section is the business model elements, the value creation models,

relevant to the development. As our sample consist of companies and industries related using so-called Industrial Internet and Internet of Things, the literature review is especially focused on the applications and value creation models found in sources considering those – even if most ways of value creation have similar characteristics in organizations on any sector and almost no organization can really afford not think about how their business relates to digitalization and the smart solutions it allows.

2.3.1. System of Systems – Technology Behind It

In section 2.1, the larger field of digitalization was discussed, with the notion that smart solutions are the practical level how companies are adopting the new technologies to their business models. As explained earlier, organizations have included "smartness" in their products, machines, services and operations for years. Now with the development of Internet and network connectivity, this data can now be analysed further on, often in real time – and this is an opportunity that companies look to benefit from.

To describe the digitalization and this development from companies' perspective, Porter and Heppelmann (2014) introduce a hierarchical system level development. This approach has been edited and taken to different contexts by other authors like Juhanko et al. (2015). On the table 3, both Porter and Heppelmann (2014) and Juhanko et al. (2015) are introduced parallel to each other. What hierarchical system level development – in other words **System of Systems or Network of Systems – means is change towards smart processes, products and services happening in five phases. The phases build on previous phase, requiring functionalities or enablers of moving from one phase to the next.**

In the first phase, product/component is not smart, meaning it works alone without connection or features to gather data about its usage. In the second phase, product/component gathers data about its usage. This can be used to make better

decisions about the future usage and/or development of it. The third phase includes the previous steps and background data analytics, the product/component becoming connected to platform that controls data of large amount of the same product. The fourth phase, product system is where many different products can be analysed to together to create value and direct development. And the last, fifth phase is when systems collaborate with each other to create new ways of creating value, efficiency and better operations gathered from large amounts of data between systems. (Porter & Heppelmann 2014, Juhanko et al. 2015). The further on the phases the companies move, the more their business models will not only involve just one aspect or just one company, but instead they comprise of highly dynamic networks of companies and newly formed value chains (Vermesan & Friess 2014).

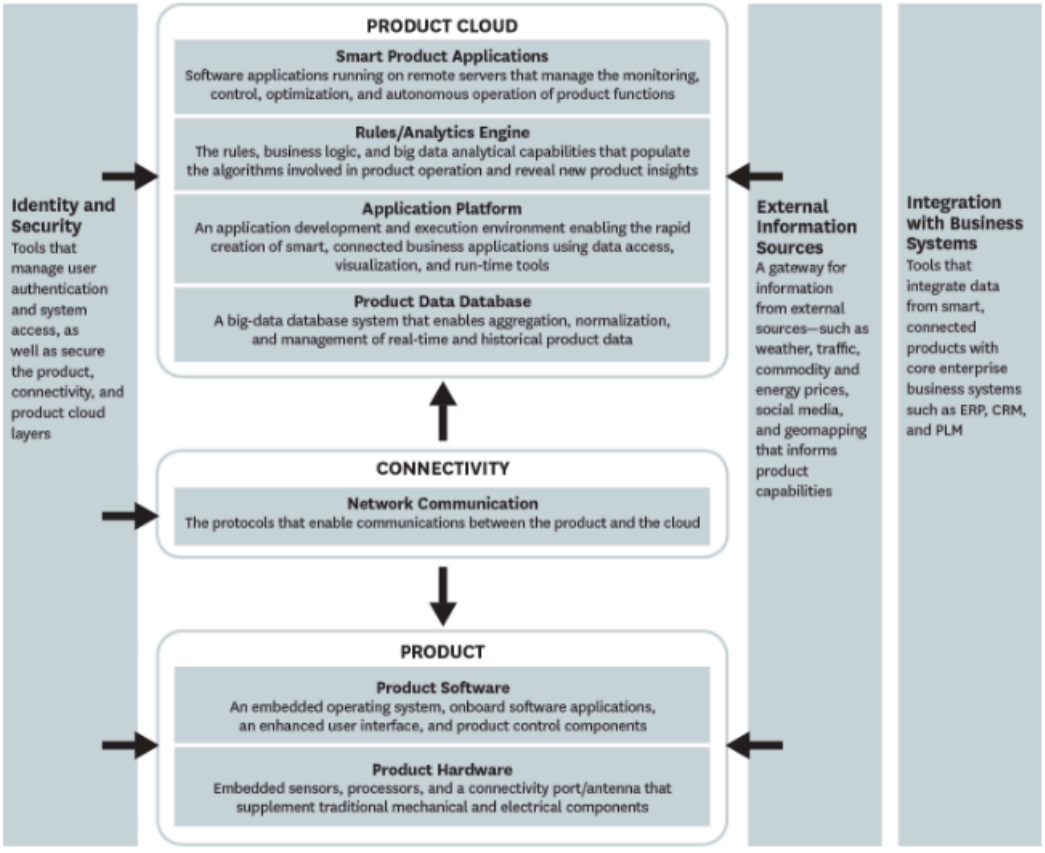
The table 3 combines both the product-based view of Porter and Heppelmann (2014) and more Industrial Internet-based view of Juhanko et al. (2015), to form a unified picture of how this development can be seen on the point of view of technological development in products/components. Agriculture example given is described by Porter and Heppelmann (2014) to give an idea what this means in practical terms. The terms that the authors use for the five phases differ from each other, but the stages on themselves describe the same things.

Table 3. Five steps to integrate smart solutions and the source of value creation (Porter & Heppelmann 2014, Juhanko et al. 2015)

PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	SOURCE
Product	Smart product	Smart, connected product	Product system	System of systems	Porter & Heppelman (2014)
Component	Smart component	System	System of systems	Network of systems	Juhanko et al (2015)
NETWORK					
Intranet	Intranet	Intranet	Extended intranet	Internet	Juhanko et al (2015)
VALUE CREATION FROM					
Mechanical functions	Monitoring	Control	Automation	Autonomy	Porter & Heppelman (2014)
Mechanical functions	Sensors and knowledge	Data and analysis	Sharing of data, standards and interfaces	Autonomical and reliable systems	Juhanko et al (2015)
EXAMPLE FROM AGRICULTURE					
a tractor	a tractor with ability to collect data on its performance	a tractor with ability to put together data collected, analyse it and offer suggestions based on the analysis	Farm equipment system, where tractors connect with tillers, planters, and combine harvesters, sharing data, standards and interfaces between them	Farm management system, which includes farm equipment system, weather data system, seed optimization system, and irrigation system allowing each system of benefit from the data to provide the best results	Porter & Heppelman (2014)

The main focus of this research is to understand the business models and their value creation, not necessarily every aspect of technological tools on a very deep level. Table 3 describes the development in phases that could be relevant for a company to be able to identify their current position in the development. Yet, it is important to realize that there are underlying technological mechanisms that are not discussed in depth here. These **underlying technological mechanisms can be referred as the "technology stack" (e.g. Porter & Heppelmann 2014).** To put in short, it means **the technical features of the processes, products and services require: data, analytics, real-time connectivity, cloud-services, application platforms, sensors, databases, network communication, product software, product hardware, application of external information sources and ways to integrate all these to business systems.** Technology stack as Porter and Heppelmann (2014) describe it can be seen in the figure 9, yet as described earlier on the scope and focus of the research, individual sections are not described further than this short intro.

Figure 9. Technology stack of smart, connected products (Porter & Heppelmann, 2014)

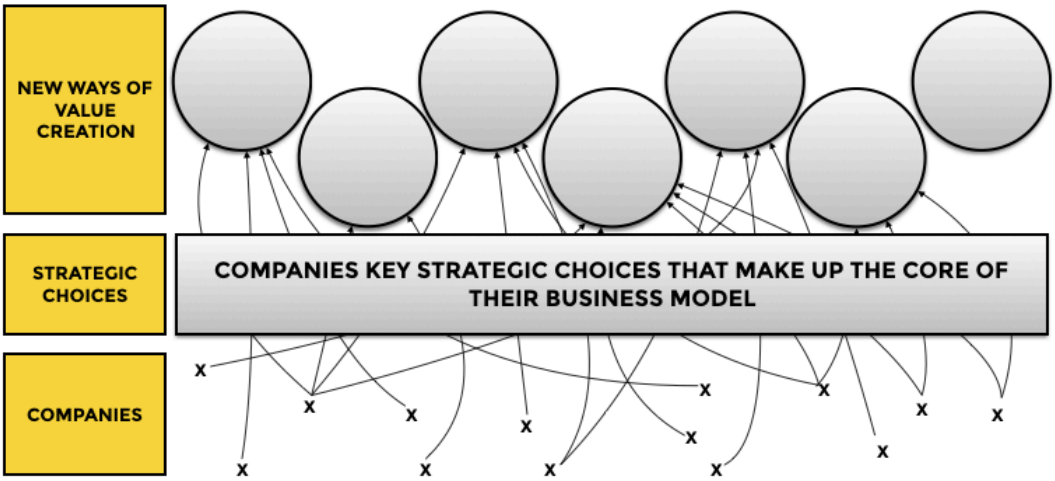


The vast amount of these technological tools form the base of digitalization and play a key role for companies how they can adopt different value creation models in their businesses. **For example, vast amount of application developers operate on this technology stack level of value creation – these technology focused companies are not the main research focus of the study**. These technical sources of the value creation and how they produce value specifically in specific cases is not necessarily the focus of the research, rather finding out how in larger context these are applied to, for example to create energy savings to create more efficient operations. **Yet, understanding the technology stack at least as a term is important to be able to grasp the development at all.** The immense development is described well by the chairman of General Electric Jeff Immelt who says: "If you went to bed last night as an industrial company, you're going to wake up this morning as a software and analytics company" (IIC 2015). Not researching further on of this technological level is a limitation of this study as described earlier, but as for the purposes of this research more interesting is not necessarily what is used, but how and for what? From this brief introduction on technology in this section, transition to the value creation models and strategic choices is made.

2.3.2. Strategic Choices and Virtuous Cycles in Business Models

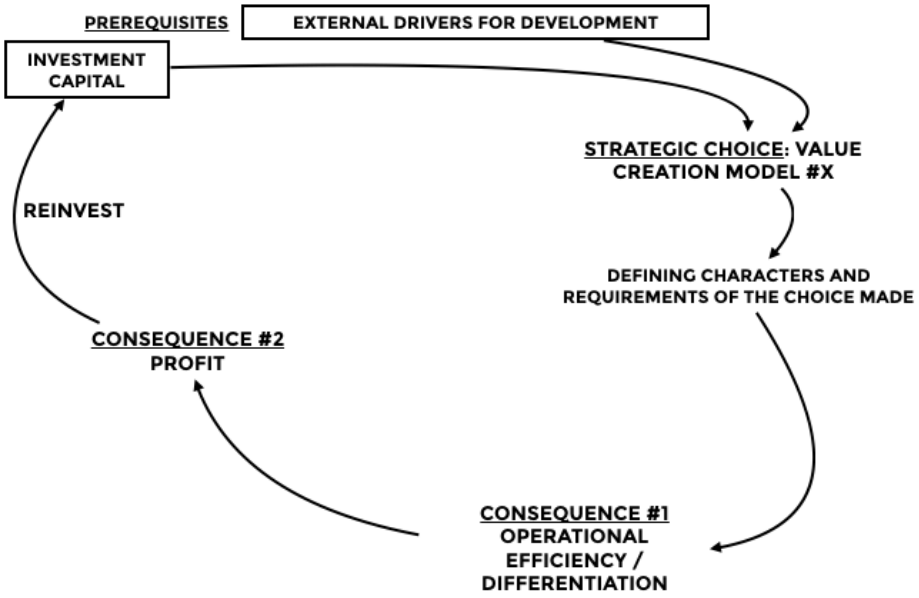
The development and change towards smart solutions can be understood through the five technical phases described, but what it means for company's strategy? As discussed earlier, the current wave of **digitalization doesn't necessarily change the basic tenets of strategy: to gain competitive advantage, a company has to be able to differentiate itself to command a price premium, operate at a lower cost than its rivals, or both** (Porter & Heppelmann, 2014) – in other words, provide some kind of value to the customer. Companies operate with limited resources and have to make strategic choices, and these choices – if successful – lead to competitive advantage that allows superior profitability compared to the industry average. Certain strategic choices are available depending on, for example on the technological development of the company and the investment capital owned. Figure 10 pictures the strategic choices that are available for companies through new ways of value creation.

Figure 10. Companies' available strategic choices



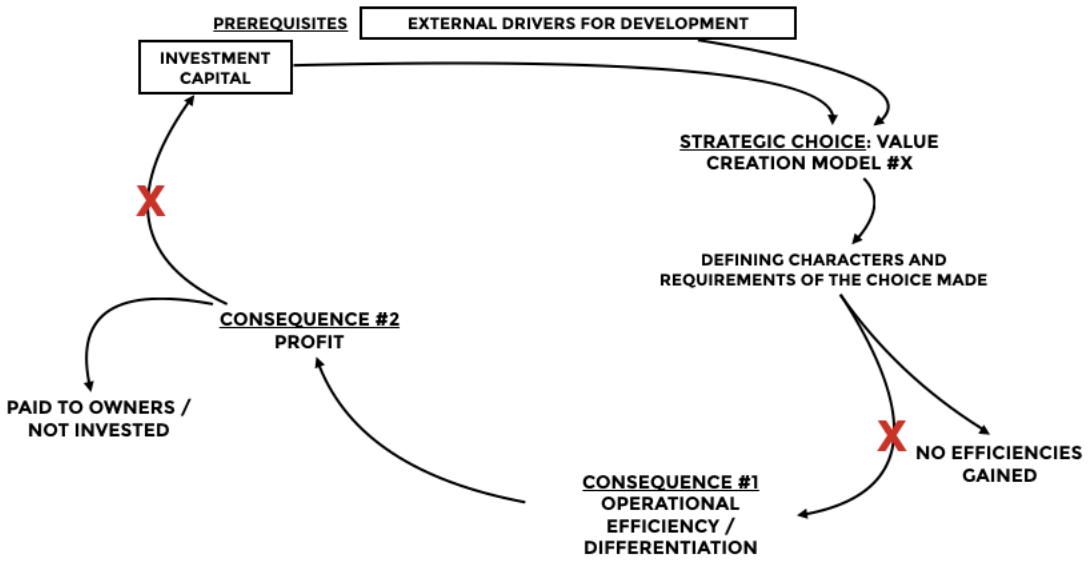
These strategic choices can reinforce one another and define a coherent and distinctive strategic positioning of the company, creating feedback loops that can be called virtuous cycles when looked at business models (Porter & Heppelmann 2014, Casadesus-Masanell & Ricart 2010). Figure 11 shows a representation of virtuous cycle created through value creation models related to digitalization. The prerequisites from company's perspective are to have investment funds and understanding for the external drivers that shape the competitive environment (especially the technological development i.e. digitalization and smart solutions). Then a strategic choice has to be made how to invest the money to create value, which results in consequences of the choice made. Successful business models lead in broad terms to operational efficiency or differentiation, which in turn leads to profits. These profits can then be reinvested, completing the virtuous cycle.

Figure 11. Value creation and Virtuous cycles (applied from Casadesus-Masanell and Ricart 2010)



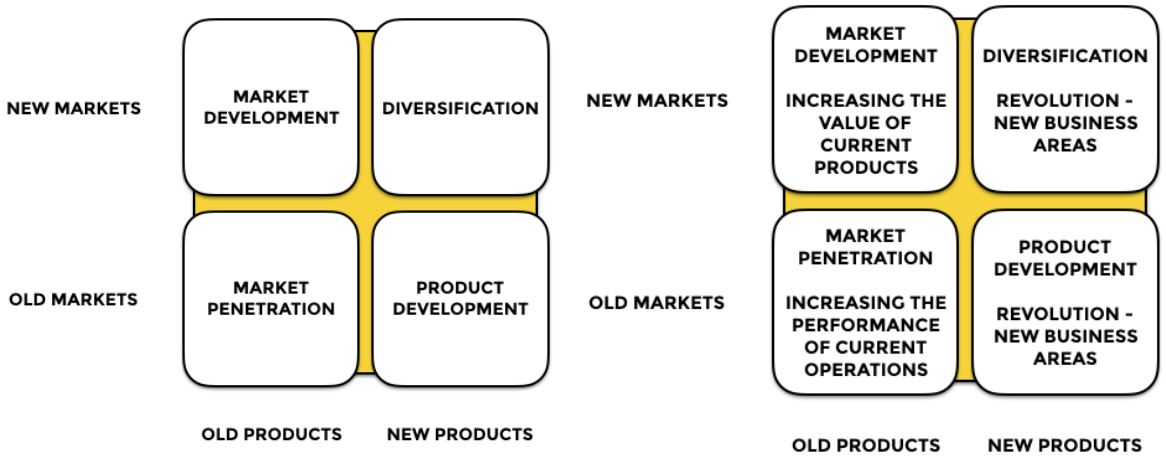
There are few clear points that have to be right if a company is to complete the virtuous cycle. Naturally, the value creation model has to be chosen right to fit the companies' context and if efficiencies are not gained, the cycle will not complete itself. Another point where a decision can be made wrong is to whether to pay the profits for the owners or to invest them to be able to gain value better in the long run by adding new value creation models to the business model of the company. Naturally, companies are supposed to create profits for their owners in the current economic system, but having the right balance between the investments and dividends is the key. Below in figure 12, are these key points of decisions shown to draw the picture of vicious cycle.

Figure 12. Value creation and Vicious cycles (applied from Casadesus-Masanell and Ricart 2010)



Related to Industrial Internet and its applications, according to Juhanko et al. (2015), companies can create value in three areas of business. These three categories are 1. increasing the performance of current operations (i.e. evolution), 2. totally new business (i.e. revolution), or 3. increasing the value of current products by making them smart to approach new markets. The categorization follows in a way traditional strategic understanding and division between new and old market as well as new and old products – as described in the earlier section as the Growth Vector matrix (Ansoff 1965). The difference being, that Juhanko et al. (2015) sum up totally new business in one category without making the distinction between new and old markets. Yet, the distinction still exist that companies can choose to invent new products and direct them to old markets or new markets, thus the Growth Vector's diversification and product development strategies can be understood to be both what Juhanko et al. (2015) mean with totally new business areas. This is pictured in the figure 13.

Figure 13. The Growth Vector matrix and Industrial Internet integration areas (edited from Ansoff 1965, 99 and Juhanko et al. 2015, 21-22)



The combined approach can be used to distinguish companies' larger strategic directions. Smart solutions and for example Industrial Internet can really be applied to almost any kind of organizations point of view; IIC (2015) divides its member organizations to five categories of energy, transportation, healthcare, public sector and manufacturing, which shows the that the development is happening all around. Currently, it seems that the real business case for most manufacturers, energy companies, agriculture producers and healthcare providers is the adoption of Industrial Internet solutions to create incremental results by increasing the value of current products and services or increasing the performance of current operations (WEF 2015). On the other hand, the largest business potential for development can be found in creation of new markets, new growth on top of existing business models (Ailisto et al. 2015). To these four categories of larger strategic approaches, existing subcategories of value creation can be found in case of Industrial Internet to find more distinctive descriptions how value really is derived through in the field. These ways of value creation are discussed on the next section and can be attained to the above four categories as specified with the figure 13.

2.3.3. How Companies Create Value through Smart Solutions

First, it has to be mentioned that there are various ways, many of them unidentified and yet unseen how companies can benefit from the usage of **smart solutions**. **Applications of smart solutions are rapidly developing and are very diverse, because the field has not yet experienced vast standardization** (Vermesan & Friess 2013). The distinctive quality, or main mechanism behind, of all new forms of value creation is still quite simple: to generate actual and advanced information from real world to be able to optimize business and technological processes based on the information (Vermesan & Friess 2013).

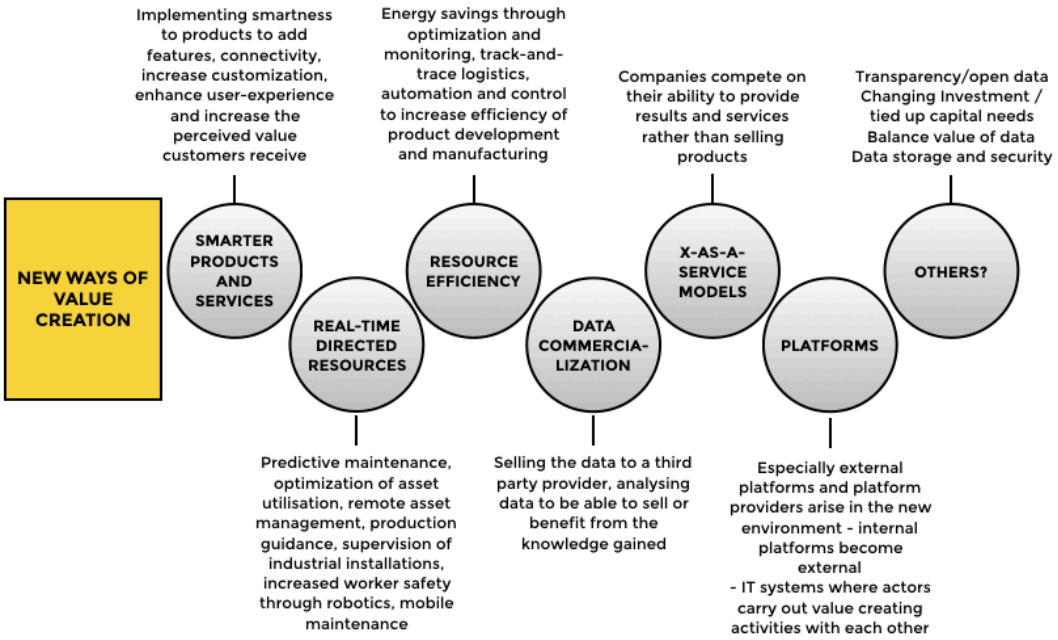
The next seven parts introduce six common identified ways of value creation as well as others briefly in their own section. This is based on literature review ranging sources from the state-of-the-art Finnish literature (Juhanko et al. 2015, Ailisto et al. 2015) regarding Industrial Internet to the global literature from various sources such as World Economic Forum (WEF 2015), Porter and Heppelmann (2014), and Vermesan and Friess (2013 and 2014). A short summary of the value creation models can be seen on figure 14.

Figure 14. New ways of value creation

In practice, the value creation models descriptions were read on each source, how they were described and what was the link with other sources describing similar things. Then different value creation models were categorized to similar groups, based on the understanding of where the value derives from. This was done to form groups that match similar type of value creation models to smaller amount of groups –

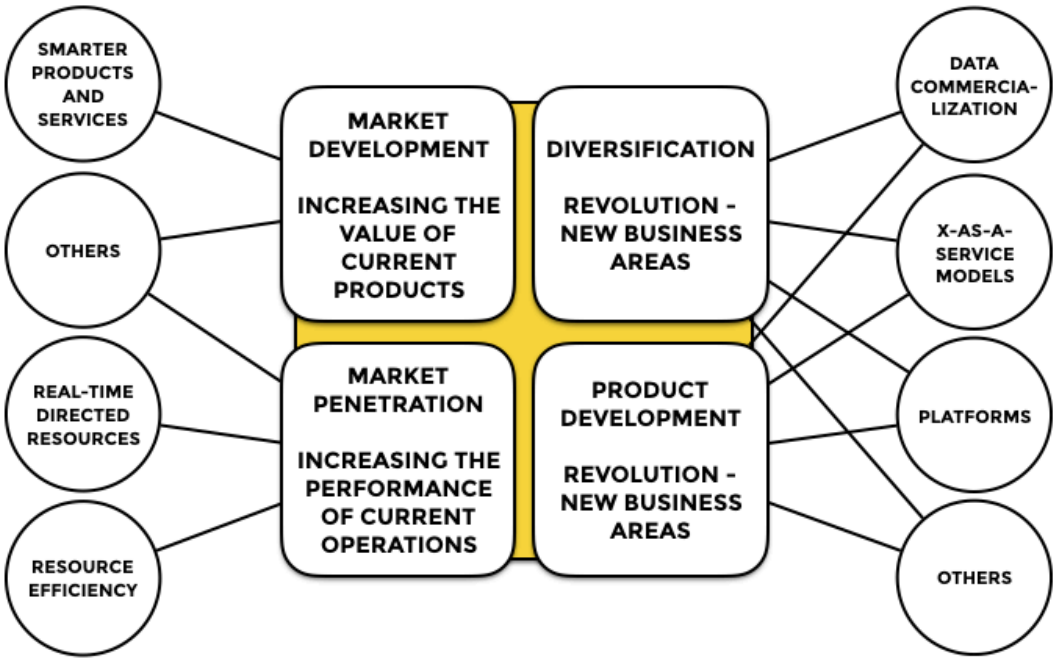
even if there are naturally many ways to benefit from any of the six named value creation models and in them there are many different business model applications. The framework should thus be seen as a macro-level approach to the value creation in the field, even if more specific examples are given there are thousands of more example in each category if one was to look all existing possibilities. The full table of different value creation models including the categorization and their academic sources can be found on Appendix 1. Figure 15 depicts a synthesis of the value creation methods as well as their definitions to be able to compare them easily with each to other. The definitions were formed through the categorization process of value creation models and summing them up into a coherent whole.

Figure 15. Description of the new ways of value creation



In the figure 16, value creation models relation to different strategic business areas they can be applied to was made based on the work of Juhanko et al. 2015.

Figure 16. Value creation models through smart solutions



What should be highlighted here before going into the description of each of the value creation models is that business models are most often complex and rarely derive value from only one source. The examples provided after explanation of each value creation model are supposed to help the reader in grasping what these new ways of value creation are and how they for example fit in the larger picture of a company's business model as well as understanding that value creation can come from many sources. Even if above are made clear distinctions between value creation models and their relative strategic positioning, in fact these value creation models often are interdependent and one company rarely uses just one, but looks to benefit from several different ways to create value. Yet, **the reason why to categorize these into separate models is that it makes it easier in terms of strategy to understand the different parts of the business model, to be able to make better decisions in the future.** The focus of examples provided with each value creation model is intentionally on Finnish forerunner companies due the focus of the study in general, even if few examples are also from abroad to provide more perspectives. These benchmark examples are gathered through various sources to give the

reader better grasp of each value creation model and what it means when applied to in practice.

Smarter Products and Services

Increasing the value of current products by integrating smartness to existing products and services is one of the easily understandable ways to create value through smart solutions and also a requirement for many of the actual business models to really work as they are based on the ability to collect data**. Implementing smartness to products can be used as a tool to add features to existing products, add connectivity, to increase customizations for the customers, enhance user-experience in better service and increase the experienced value product received by the customer** (WEF 2015, Ailisto et al. 2015). This results in increased turnover and sales prices through providing better customer value in more efficient and effective products and services (Ailisto et al. 2015, Juhanko et al. 2015). Increasing the value of current products and services is incremental business development, thus easily understandable and often easily applied by companies (Ailisto et al. 2015) – after all adding sensors to current products or processes to gather data is a simple process to create a better products and services.

Example of smarter products and services would efficient waste disposal provider Enevo, which integrated sensors to waste disposals and collects data about them to monitor and optimize waste collection (Ailisto et al. 2015). Another example is a company doing smart energy management in Finland, ThereCorporation, whom decided to make the old heating systems smart by including data-collecting sensors into them (ThereCorporation 2016). For consumers, ThereCorporation offers possibility to track, monitor and control home energy usage and for utility companies they offer platform that connects homes to demand response, thus offering tools to avoid most expensive and polluting electricity creation during peak hours. ThereCorporation is a first of the example discussed that clearly shows that value creation derives from many sources in addition to working in the space between industrial and consumer services by offering both. Another example

would be forestry machinery used in Finland, which has sensors, computers and network connectivity to be able to count the cut wood as it is done in real-time, calculate volume and resistance of the wood to find the right purposes for it and is able to let outside transport service and factories know of these facts as well as the location where the materials can be picked up. One of these forerunner companies is Ponsse (Ponsse 2016), whom does all the above and more. By being able to include all these high-tech qualities in its forestry machinery, Ponsse is increasing the value brought by the machine for its owner. Another big Finnish company Kone has for long been interested in smart solutions and has been heavily focusing on the development of digital operations. Kone just announced in February 2016 (Kauppalehti 2016) that it will be making a strategic decision to include sensors and smartness to all its elevators, automated doors and escalators so that it can gather data and optimize operations more efficiently. All these three examples already provide a realization that at least the forerunners are not only taking advantage of one part of the digitalization development, but rather take advantage of several different ways to create value.

Real-time directed resources

According to World Economic Forum (2015), the most widely used application of Industrial Internet is predictive maintenance and remote asset management. This is done to increase the performance of current operations. **Real-time directed resources, predictive maintenance, optimization of asset utilization, remote asset management, production guidance, supervision of industrial installations, increased worker safety through automation and robotics, and mobile maintenance are ways that are listed by various sources as common applications of smart solutions** especially in industrial settings (WEF 2015, Ailisto et al. 2015, Juhanko et al. 2015, Vermesan & Friess 2013). Through the use of sensors, data analytics and real-time data, equipment failures and maintenance periods can be predicted and reduced. This results in reduced unexpected downtime maintenance, which of course results in clear savings and certainly provides the companies with direct, yet incremental business benefit to pursue.

For manufacturers being able to direct resources real-time offers lots of possibilities: they can for example analyse sensor data in real-time from production lines to create self-regulating processes that cut waste and avoid costly human interventions (Manyika et al. 2013). Some well-known companies already using real-time directed resources in large scale include Caterpillar, ThyssenKrupp and ThamesWater. For example, ThamesWater, the largest provider of drinking and wastewater services in UK, uses analytics, sensors and real-time data to find out about equipment failures and to be able to respond to critical situations faster (WEF 2015). A Finnish example would be a steel manufacturer Outokumpu (IBM 2016), whom decided to move from reactive to proactive maintenance of its production lines. This required adding features to gather data about and optimize maintenance management as well as analyse it in real-time, which was achieved through the use of IBM analytical tools and cloud-services – resulting in maintaining quality, better efficiency of delivery, cut maintenance costs as well as increasing safety for the workers at Outokumpu's steel mill (IBM 2016). Kone is another good example of a Finnish company using real-time directed resources in their attempt to optimize their maintenance services.

Resource efficiency

Resource efficiency means smarter use of natural resources and **energy savings through optimization and monitoring, track-and-trace logistics, automation and control, operational efficiency of product development and manufacturing are some of the applications that increase the efficiency of product development and manufacturing to reduce the operational costs. Incremental benefits can often be achieved and provide clear strategic incentive that companies can target.** (WEF 2015, Ailisto et al. 2015, Juhanko et al. 2015, Vermesan & Friess 2013).

How the current wave of digitalization is changing resource smartness is for example by allowing companies such as Pesmel to succeed in global markets. Pesmel makes highly automated internal logistics, storing, packing and product management systems for metal,

paper and converting industries, taking advantage of high technology in industrial production (Tekes 2015). Another example is energy savings company Leasegreen, which specialises in turnkey solutions in energy efficiency projects (Leasegreen 2016). Leasegreen offers automation, monitoring and control, more efficient lighting and heat capture. For example, one of their clients, a furniture company Isku's production factory reduced energy costs by 50% from over a million euros a year to about half a million with Leasegreen's solutions (Leasegreen 2016). Another established frontrunner of resource efficiency is Finnish welding equipment manufacturer Kemppi, which has created a system to monitor and document all welding online through cloud-service. This helps in optimization of operations, improved quality and productivity and cost savings in being able to find deviations in the processes faster in their global network (Kemppi 2016).

Data Commercialization

From totally new business areas that smart solutions allow, one clear new opportunity is **the commercialization of data and data analytics**. **This can mean both selling the data to a third party provider, whom uses the data the way it wishes or analysing the data to be able to sell or benefit from the knowledge gained.** This commercialization spans from the realization that the data that the company collects and possesses can be used for other purposes than what it is currently used for. More and more companies are looking into using their data in better ways and the possibilities with being able to handle massive amounts of data (or simply referred as Big Data) will provide business opportunities across industries. Of course, most companies use data already, but what is meant by data commercialization is the ability to collect larger amounts of it and apply it to different contexts than before. (Ailisto et al. 2015, Juhanko et al. 2015)

Examples of companies commercializing data are analytics firm Data Rangers (Ailisto et al. 2015). Data Rangers uses trend analysis and data to be able to predict future trends. Another great example of using data is originally a weather-data focused company

Vaisala, which have turned their weather-data for the benefit of various uses in renewable energy, aviation and road customers (Vaisala 2016).

X-as-a-service models

One of potentially largest opportunities, or at least changes, in the business models is the change from product sales to **X-as-a-service** models, often referred also as the **Outcome Economy** or **Servitization**. **X-as-a-service business models mean that companies compete on their ability to provide results and services rather than selling products.** One aspect of X-as-a-service business models is the change of risk from the customers to the sellers, after the providing companies are in charge of assets used to produce the service. This naturally requires new ways to deal with the capital asset management of the firm, yet this is helped by the new ways to control connected assets through the smart solutions more efficiently. (WEF 2015, Ailisto et al. 2015)

Good example of one of the first industrial companies using X-as-a-service models is Rolls-Royce PLC, whom integrated outcome-based model, "Power by the Hour", in their service for airlines to use the engines made by Rolls-Royce (Ailisto et al. 2015). This "Power by the Hour" model was introduced about 50 years ago, which is an interesting insight that some of the possibilities are just more easily available to companies now due digitalization, even if they are not distinctively new or revolutionary as such per se. More recent success story example of X-as-a-service business model would be Finnish elevator and escalator company Kone and their approach to service models for their customers. By combining real-time data analysis, energy optimization and savings with connectivity and maintenance services, Kone rather sells the service of making people flows in the buildings as smooth as possible rather than just selling an elevator or an escalator. This shows in their business as well, with about half of their current turnover coming from service business (Juhanko et al. 2015). Another example would be providing software and hardware as-a-service like Finnish company 3StepIt is doing. They apply circular economy thinking in updating organizations IT-systems and hardware by owning the hardware themselves, then just supplying it to their customers and updating it whenever needed (3StepIT 2016).

Platforms

The big winners of the new digital business field according to various sources (e.g. WEF 2015, Seppälä et al. 2015) are the platform owners and partners, who take advantage of the systems collaborating with each other and offer possibilities for others to collaborate through their platforms. It has to be noted straight away that platforms have also existed before and are very much part of companies' business models already. Yet, the progress of digitalization allows more sophisticated methods of processes to interact with each other in new ways and connect previously unconnected actors and companies (Juhanko et al. 2015, Porter & Heppelmann 2014). Arising is the **Platform Economy**, driven by the transformative qualities of cloud, smart and connected products and the Internet. By definition, platforms refer to **"information technology systems upon which different actors – that is, users, service providers and other stakeholders across organizational boundaries – can carry out valued-adding activities in a multi-sided market environment governed by agreed boundary resources"** (Seppälä et al. 2015). Platforms connect various types of actors with their network effect and economic benefits (Seppälä et al. 2015). The Internet of Things and related services create networks that can be used in collaboration with each other, for example incorporating entire manufacturing processes that convert factories to smart environments (Vermesan & Friess 2014). Earlier described System of Systems explains how different systems connect to each other, but what connects these systems are platforms, the mediums that create value for themselves and their customers by creating the connections between the systems. **Platforms create their value from the power of network effects, allowing more things and networks to connect with each other by creating value on the synergy of these networks** (Vermesan & Friess 2014, Gawer & Cusumano 2014).

Industry platforms can be divided into two categories. These are internal platforms and external platforms. Internal platforms focus on companies own operations, services and products. Internal platforms are assets organized in a common structure, which helps a company to produce efficient and innovative products and services. External platforms are extended to include partners and collaborators into a platform that is specific to the domain and operations of the host company. External platforms create an innovative business ecosystem, where external innovators can develop their complementary

products, technologies or services. (Seppälä et al. 2015, Gawer & Cusumano 2014). In addition to the two types of industrial platforms, often referred type are **platform providers or owners when talked about more consumer related services** (e.g. Uber, Airbnb). Providers or platform owners open up the platforms to any third parties and parties can often collaborate in the platform without the need to interact with the platform owner necessarily (Seppälä et al. 2015). **What smart, connected systems allow especially are the use of external industry platforms and being platform providers** (Porter & Heppelmann 2014, Juhanko et al. 2015), **thus this being the focus of the new value creation models on this study.**

Example of this was given earlier when agriculture was discussed briefly in the table 3 on section 2.3.1 (Porter & Heppelmann, 2014). These platform providers would be the mediums that connect the irrigation, weather data and farm equipment systems with each other to create more holistic and efficient approach to the whole process of growing food. These platforms are one concrete example that is rising from the new wave of digitalization that hasn't been there before – in fact we have been forced to rely on historical data and assumptions made about the future based on that. With the new paradigm, the ability to include historical data and assumptions about the future to more specific and real-time data is changing how better decisions can be made in many contexts. (Porter & Heppelmann, 2014).

Platforms vary much as they are comprised with such a high range of actors and their purpose can vary from ecosystem of actors to more specific use. Digital platforms are used by many of the examples given earlier such as Vaisala, Ponsse and ThereCorporation. These companies use platforms for their specific business purposes or for limited amount of actors (usually referred as internal platforms). Larger ecosystem builders that offer their services for other companies are ought to be the biggest users of platform economy. Internationally companies like IBM and GE's Predix are few of the examples leading the development of the external Industrial Internet platforms globally (Greentechmedia 2016, IBM 2016). In Finland, both Tieto and Elisa are developing their

own Industrial Internet ecosystems, which are aimed to serve as platforms for companies to create efficiencies through the use of their platforms (Elisa 2016, Tieto 2016). For example, Tieto's Industrial Internet services take care of data collection, analysis and governance for their customers and with the software added to the platform, machines can be optimized, controlled and even maintained automatically to create efficiencies across business operations (Tieto 2016). Also, Finnish companies such as Kone and Kemppi are developing external platforms themselves, where their partners and collaborators can access their data sources and operations to create efficiencies through faster development that way (Kauppalehti 2016, Kemppi 2016).

Other value creation models?

The above six value creation models are only a division of already identified opportunities which appear commonly in the literature and can be divided under distinctive categories. Other possible value creation models have been mentioned across the literature review, yet finding distinctive categories for these was deemed difficult or irrelevant – and in some cases it was not sure if there really was value creation or value destruction in place. These other, possible value creation models are introduced briefly in this section.

Cloud services are mentioned as a form of new business opportunities. These could be labelled as platforms of data storage and identified as a form of platform economy, but for example authors such as Juhanko et al. (2015) distinguish them as a separate, important value creation model. Some Finnish cloud-service providers are for example BaseN, Nordcloud and F-Secure. Technology stack behind smart solutions open up a new front of technical services related to the development and these companies offer technology that able other companies to benefit from the development, to use cloud services, different software and apply it to their own systems. Similarly, application developers could be named as the one other source of value creation and business models. They operate on the technology stack level in the development, thus are merely a requirement for the other value creation models to be able to come true rather than being at similar level as the other six value creation models identified. **The technological**

providers, the application developers of hardware and software consist in fact a large number of companies that make their business from the development, yet as they are not in the main scope of the study these companies are listed in the others sections without distinguishing categories between them. (Juhanko et al. 2015) Also, as seen by the explanation of technology stack by Porter and Heppelmann (2014), the companies operating on the technology stack level are numerous and often formed in niche-markets with focus on certain technology, studying all of those as well in the scope of this study is not feasible. The mentioned six value creation models are more of a macro-level descriptions of value creation compared to the more micro-level descriptions that relate to the technology stack.

Continuing to other possible value creation models, one yet quite untapped, potentially disrupting change can be the public sector and governments whom can through the use of smart processes **open up their transparency, resulting in improvements especially in sustainability through less waste and more accountability on the utilization of resources like water, energy, fuel, fertilizers and pesticides** (WEF 2015). The same logic of opening up data and being transparent is already being planned by some private sector actors such as Kone in their plans to **open up their data about their operations so that other organizations can join in creating better solutions together with them** (Kauppalehti 2016). Similar plans have been announced by Kemppi, whom is planning to open up its vast data gathered to a platform called Internet of Welding by 2017, so that software developers and other partners can start developing their solutions better in collaboration with Kemppi (Energy Global 2016). Also, in a sense this transparency is present in the ecosystems created around Industrial Internet (by Tieto and Elisa for example), where many actors join the same platform to create value for each other.

It is also clear **that investment needs are changing and tied up capital needs are changing.** These can in some cases reduce the need for investments as in the case of platform providers, where they don't have to offer all services themselves, but can trust the actors on the platform to generate services for each other. On the other hand, it can also increase the investment need for the company through having to keep all machinery

on its own name, when offering X-as-a-service for example. This **can lead to both value creation and value destruction, depending on the case**. Somewhat unclear are also **what kind balance value does data have** and what kind of intangible asset value it can bring, and how it can be in the benefit for the company (Juhanko et al. 2015, Ailisto et al. 2015).

Value Creation through Many Sources

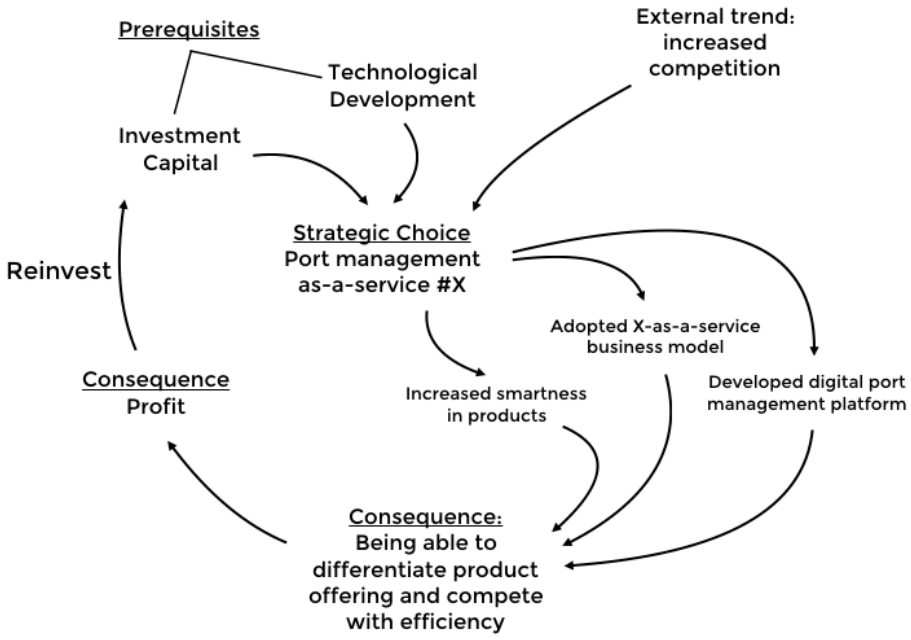
As shown by the examples provided in each section, the real value seems to lie in the intersection of all these value creation models or in the synergies between some of them and the best practice benchmarks seem to be the ones, whom can combine them in various ways. For example, a company can take benefit from real-time directed resources, new ways of commercializing their data, transform to x-as-a-service models and doing this by providing new energy efficiency to their customers and partners. **Most examples case companies seem not to focus on just one way of value creation in their business models, but usually on a combination of several**. Business models rarely are as simple as only deriving value from one source, which is clearly seen in the examples provided in each section.

As already discussed and seen by the example provided earlier, it is quite clear that companies applying new ways to create value often do not only look into one way to create value, but by choosing one way, it leads to adopting others in the process as well. The examples of Kone, Outokumpu, Vaisala and others show us how companies when applying some of the new ways to create value, realize that they have to adopt new ways of working and choosing for example create predictive maintenance systems almost automatically leads to increasing smartness in products and processes.

Good example of a company that has really captured the essence in applying many of the value creation models is Cargotec (Zysman 2014, Digile 2015). In the face of increased competition, Cargotec decided to began selling "port management services". Not to end of its manufacturing business, but as an additional way of selling its products by increasing intelligence of its products, developing a digital platform capable of managing

and integrating the various types of port equipment they were offering. Great example of how, even if the strategic decision was to offer services instead of products, what abled and what kind of value creation models Cargotec used were to increase the smartness of their products and create a platform to integrate them – and then sell it as-a-service. (Zysman 2014, Digile 2015)

Figure 17. Virtuous Cycle of Cargotec's Port Management-as-a-Service



As a reminder here, this is by far no means the whole business model of Cargotec depicted in the figure 17. It is merely as representation of their strategic choice at a point of time, the result of that choice to the business model aspects and how it can be formed as a virtuous cycle figure in a very simplified manner. The meaning behind understanding all these value creation models, and related examples is aiming at providing new information, or a framework, to look at the companies' choices in rapidly developing field. By understanding these value creation models offers us the benefit of distinguishing the strategic choice made in the process. This should help persons responsible for strategic development in understanding the strategic aspect of technological development and its adoption for their company and to be able to make choices about their company's

future. What is discussed in the next section is the sustainability of the value creation models as understood in the earlier sections regarding the environmental sustainability.

2.3.4. Sustainability of the Value Creation Models

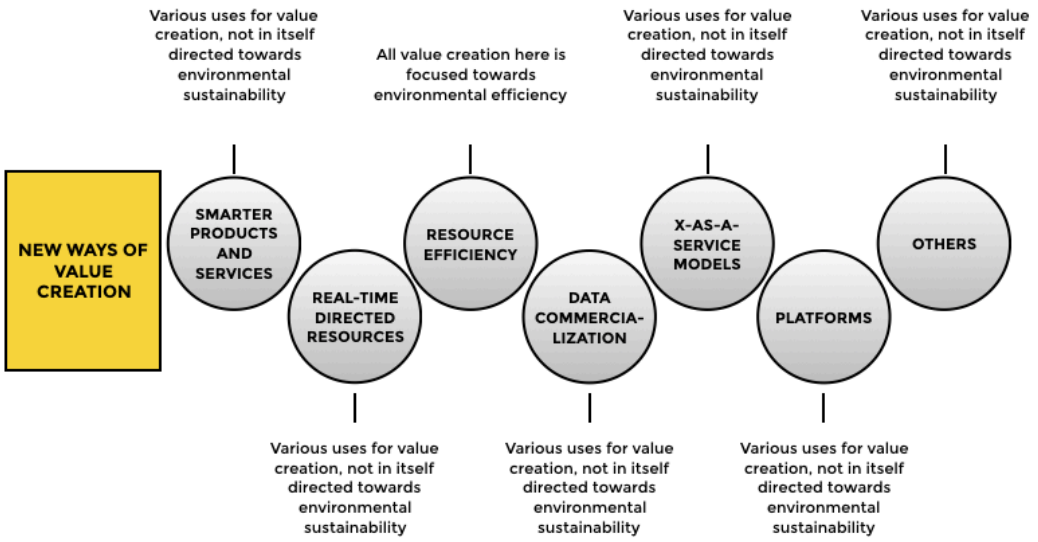
As one of the research questions is to look into the sustainability of value creation achieved through technological development, sustainability is also looked at the context of the identified value creation models. As discussed earlier in the business model section, how in this research sustainability is understood is through the environmental sustainability. In the context of the value creation models, the ones directed straight towards lessening the resource usage were deemed as supporting environmental sustainability. As one might expect, considering the large categories and various ways to create value inside each identified value creation model, this proved to be nearly impossible or not feasible based on the literature in very meaningful way.

Environmental sustainability is ingrained in all value creation models in a way or another. After all operational efficiency or differentiation with new products and services can not at least in the long term compete unless they apply more resource saving or smart approaches to resource usage than the competing products and services provide (Porter & Heppelmann 2014). Yet, it **certainly can't be argued that these value creation models could not be put in use in other ways or in industries that could be labelled unsustainable**. For example, coal mining companies can hardly claim to be in a sustainable business, but they can benefit from these new value creation models like any other firm. Thus, adopting the value creation methods necessarily will not make a company sustainable, but rather can help them towards smaller environmental impact in whatever business they are in if put in to use with the intent to lessen environmental impact.

Only one of the value creation models is clearly a category, where all directed methods point towards lessening environmental impact, resource efficiency. Through optimization and monitoring, track-and-trace logistics, automation and control increase in the efficiency of product development and manufacturing can be made to reduce the

operational costs and environmental impact. Incremental benefits can often be achieved and provide clear strategic incentive that companies can target. (WEF 2015, Ailisto et al. 2015, Juhanko et al. 2015, Vermesan & Friess 2013). Naturally, all companies indifferent from the industry they are in are shooting to being as efficient as possible to gain competitive advantage. Other value creation models can be put to various uses and can't be distinguished as only directed towards reducing environmental impact. On the figure 18, the sustainability of the value creation models is simplified.

Figure 18. Sustainability in value creation models



Based on the findings on the literature review, the **viewpoint of sustainability is not taken further on the actual data collection and analysis, rather the sustainability is understood to derive from other sources meaning the external trends that drive the development**. The megatrends introduced give a good, meaningful context why sustainability should be part of any business model and value creation model in this modern age – if we are as a species going to survive the next hundred years as well. To trying to define the value creation models as sustainable per se seems like a waste of effort considering the literature review and larger development is what directs the development in general. The way different value creation models have synergies and link up to the resource efficiency as a value creation might be more interesting point to find

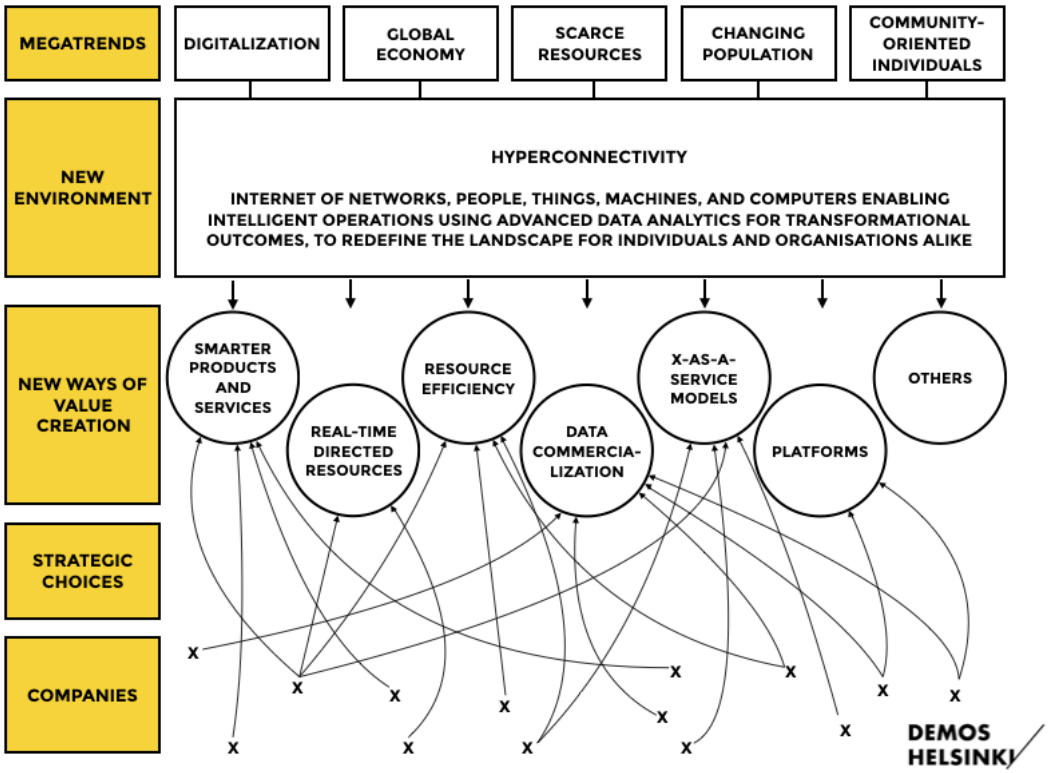
out, and as seen by the examples found from the literature, this is in fact the case in many of them. In general, the value creation models can be applied in different ways, in many contexts, but a wise decision-maker would apply them only through understanding the larger context of the development.

2.4. The Big Picture – Value Creation in the New Environment

The value creation models that the technological development allows through smart solutions is a result the current wave of digitalization. Value creation draws from operational efficiency and new smart solutions that able differentiation from competitors. The last section of literature review **provides a summary of all sections and looks at the development from the macro-level towards the micro-level to form an understanding of how the different parts relate together.**

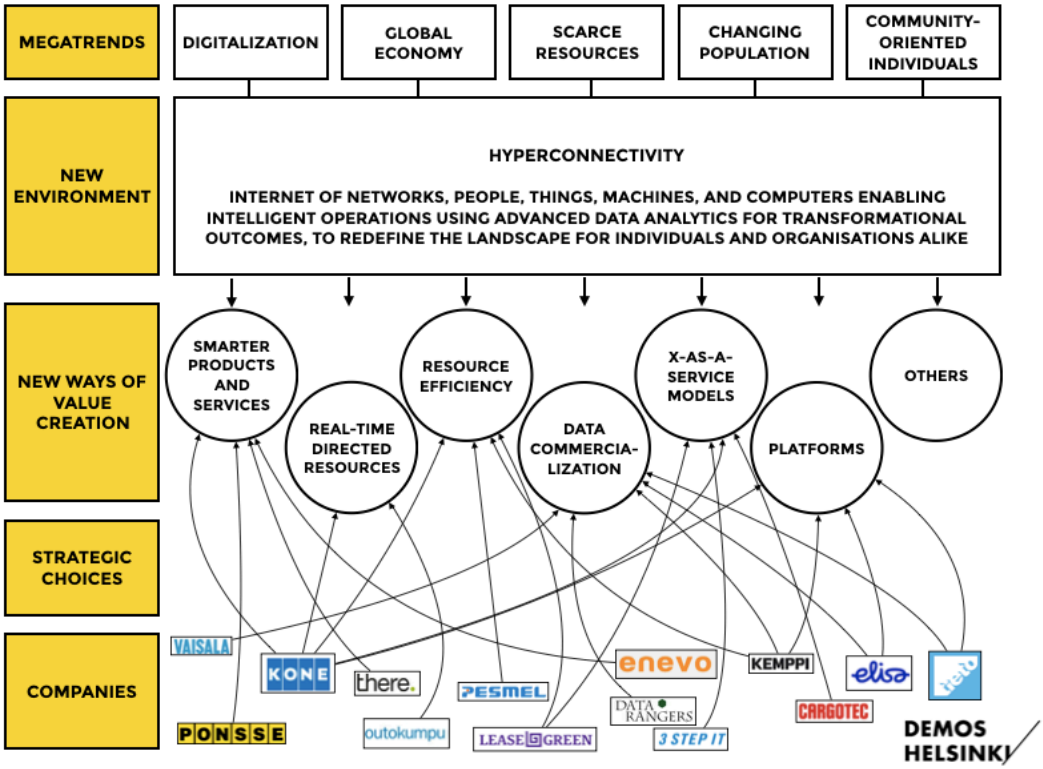
The figure 19 describes the big picture, how the different parts of the review relate to each other. The world is shaped by the megatrends, digitalization being one of the most prominent ones with other megatrends supporting the development of Hyperconnectivity, the new environment that we live in. This Hyperconnectivity – the Internet of networks, people, things, machines and computers – creates new types value creation models. To benefit from these new ways of creating value, companies have to make strategic choices on which ones are the most relevant to them, most applicable to their business and strategy. Thus, it is important for the companies to understand the different options available and the focus of the research is in understanding these models better. The value creation models and their relation to companies' strategy and business models can be understood through the strategic framework discussed in section 2.2.1 as well as in section 2.3.2. Most successful businesses are able to pick from strategic choices available the right ones for them and create virtuous cycles that reinforce themselves.

Figure 19. The Big Picture: How companies create value in their new environment



In the figure 20, the big picture is enhanced with the benchmarks and examples discussed in the literature review to form us a clear picture how companies can choose the available value creation methods. In addition to that, strategic choices are pictured in relation to the business area, context and time they are made. Thus, these examples only serve as the purpose to understand the process of strategic choices and their interaction in companies, rather than provide a full description of business models.

Figure 20. The Big Picture with Benchmarks



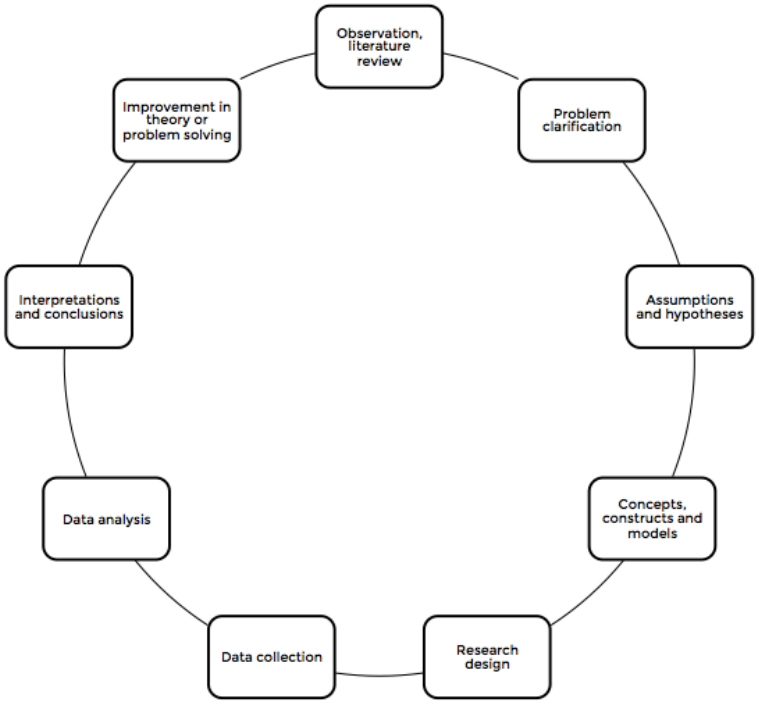
The figure 20 with the examples and the big picture concludes the review of the existing knowledge. The next section will be discussing research methodology, followed by the analysis of the empirical data gathered and then related to the literature review.

3. METHODOLOGY

Chapter three describes how the topic of the study was researched, when and how the data was collected, the reasons and justification why it was done in this particular way as well as the analysis and interpretation methods. What links heavily to this section is also section 5.3, where the overall evaluation of the thesis, discussion on its reliability, validity and limitations is done. This section is only discussed in-depth at the end of the study, even if some limitations are already mentioned as they arise in the process.

At its heart, **the purpose of business research is to gain understanding of how and why things happen, to shed light on new perspectives and correct out wrong ones – to be able to create information that helps to make better decisions** (e.g. Ghauri & Gronhaug 2005, Blumberg at al. 2005) In general, this is the purpose of this research as well. Roughly, the research follows the "Wheel of Research" by Ghauri and Kronhauq (2005, 19), which describes on figure 21 the continuing process of research that builds on top of existing knowledge in the hopes of contributing to this knowledge and further research.

Figure 21. Wheel of Research (Ghauri & Kronhauq 2005, 19)



Before explaining the research methodology further on, a note must be made about the researcher approach to research itself – the philosophy of the researcher. If contrast is made between two most distinguished research philosophies, positivism and interpretivism (Blumberg et al. 2005), the research on this case is leaning towards interpretivism. This in practice means that I as a researcher, believe that the social world is constructed and is given meaning subjectively by people rather than it being possible to look at the social world as externally existing. The research is driven by interest, and the researcher is also somewhat part what is observed, rather than the research being totally value-free and independent, outside analysis of an external situation in the world. Even if the main research focuses on quantitative analysis and is done in the best manner possible to reduce the researcher bias, as per the nature of any research some form of interpretivism always plays role in it – at least to the author's personal understanding. Whether this viewpoint plays a major role in this research can be only judged by its readers, but explicitly stating my own approach to research and understanding of social world, is part of good research ethics – thus stated here even if rather quickly. For example, Blumberg et al. (2005, 19-29) discuss more in depth the differences between research philosophies, if the reader is interested in learning more about research philosophy in business research.

As a general approach, this study is a mix of **exploratory** (i.e. explanatory – depending on the literature source) and **descriptive research** (Ghauri & Kronhauq 2005 and Blumberg et al. 2005). Because of the novelty of the field, the research has some characteristics of exploratory research. Exploratory research is especially useful when the research problem is badly understood, when there is a lack of common understanding of it and its implications (Ghauri & Kronhauq 2005). Exploratory research tries to answer to questions of why and how using theories, or at least some form of hypotheses, to explain why certain phenomenon occur (Blumberg et al. 2005) Descriptive research is better when the problem is clearly understood and structured, as based on the theory parts of the research questions are – answering more to questions of who, what, when, and where (Ghauri & Kronhauq 2005, Blumberg et al. 2005). A deficiency of descriptive research is that they can not always answer why something occurs (Blumberg et al. 2005).

Considering the focus of the research, to explain the phenomenon holistically, this research has some characteristics of both approaches.

For using both exploratory and descriptive research, either qualitative, quantitative or mixed research methods are a possible choice (Ghauri & Kronhauq 2005). In this study the researcher deemed that the most interesting and purposeful way to approach the problem is through applying **methods of quantitative analysis, mainly based on the availability of data, the possible sample and the goal of the research to study more than just a few companies as a case**. In general, quantitative research means using numerical data or data that can be transformed into useable statistics to answer and help in analysing the possible answers for the research questions (Blumberg et al. 2005). This is done to be able to generalize results among larger sample population, to formulate and uncover patterns in research topic. The focus of the methods is in quantitative analysis in addition to some characteristics of qualitative analysis in the research as well, which mainly forms around the open-ended questions and interpretation of larger constructs. When considering the research questions of the study, the focus of the empirical part of the research is in trying to understand the ways and strategies how to adapt new ways to create value. In this, the empirical part if especially useful in accumulating knowledge about whether the synthesis and theoretical framework created in the literature review hold true in case of the sample companies or whether changes are in order to the frameworks created to really understand the field.

3.1. Unit of Analysis, Sampling Decisions and Data Collection

There were two types of data and sample used in the research. **Primary data was collected by the author through a survey from Finnish Industrial Internet Forum members and secondary data was already collected data about the Finnish start-ups reporting Industrial Internet / Internet of Things** as their industry sector at last years Slush by the organizers of the event (Slush is a major technology start-up and investor event held in Helsinki each year). These were assumed by the author to be representative of the current moment forerunners of the field in Finland, the ones that are shaping the industry right now, even if it has to be admitted that the real disruption and most

innovative solutions that really are the forerunner technologies in few years' time can still be on the desk of an innovator, rather than being formed as a company and operating already. The next sections will describe the data used as well as the reasoning for both primary and secondary data.

3.1.1. Primary Data

Primary sample of the research was chosen to comprise of Finnish Industrial Internet Forum (acronym FIIF used after this) member companies that can be seen to be – most likely a major – part of the forerunners in Finland looking to benefit from the technological development and digitalization currently happening. According to their public website (FIIF 2016), FIIF has 238 members in the beginning of 2016 varying from companies of different size to universities, research centres and innovation funds. FIIF describes itself to be "a company driven activity that catalyses starting, testing, planning, breeding or failing fast activities, which concretize the Industrial Internet visions into a good sustainable business for Finnish Companies" (FIIF 2016). Essentially, it is a network of actors working and interested on the opportunities that digitalization allows for companies in various industries. As the network of forerunner actors in the field, it was deemed to be suitable for this research as the sample to represent the forefront of innovation and new business models in the field.

From the full FIIF 238-member list, 46 were identified as innovation funds, universities or research centres that were ruled out of the sample because of the focus was decided to be on companies. Further 37 were ruled out based either on their industry sector (media), on the lack of personal contact information to be found online, on the lack of working website or working contact information available on their website. **This left a population of 154 companies to be surveyed. From 154 surveyed companies total of 39 answered the survey, giving representativeness of 25,3% of the whole sample.** In general, this is a big enough sample to form a decent representativeness of the sample considering that sources like Blumberg et al. (2005) claim that over 5% representativeness is enough. For the purposes of this research this was deemed to be enough as it was supplemented by the secondary data as well. Obviously, to achieve

better representation and precision of sample, it should amount as many actors from the whole population. However, in general the sample was understood to be big enough for this given context at being over one fourth of the whole population, yet naturally it offers us some limitations, which are discussed below. The whole list of FIIF members at the point of time of the study can be found on Appendix 2.

The actual practical research method of the study to acquire primary data was an online-survey, which provided both quantitative, standardised data as well as more open descriptions and data about the research questions. Surveying larger number of companies was chosen as a method, because the aim of the research is to gain understanding of the development at large. To understand a phenomenon on the context of many companies, a larger sample size makes sense and provides the researcher with better insights on the development of in general (Blumberg et al. 2005). If then more in-depth look is wanted in further research, for example case studies and interviews can be conducted afterwards as a continuation of the research. Using a survey provides larger amount of data that can be analysed due the possibility to have larger sample size than what could be achieved for example by conducting face-to-face or phone interviews.

The biggest advantage of online-survey is, as stated, that it allows collection of data from larger number of companies due to easy access to them. It also allows both defined and structured questions as well as open questions. The most important disadvantages of online-survey are that the questions are set and there is no flexibility in the research process as well as there is a possibility of understanding parts of it incorrectly as the respondent most likely will not ask questions about the survey.

The survey was built based on the literature review and theoretical framework created on defining the new environment, strategic choices and value creation models. The first part of the survey focused on the definitions of the new environment, the second part on the strategic development areas in relation to technological development and the third part on the value creation and business models in practice. The whole survey can be found on Appendix 3.

The respondents were identified either with their appearance on FIIF website, on Demos Helsinki existing contacts or using companies own websites to find out relevant personnel from the companies to answer the survey. These were picked to be the CEOs, CTOs, or business development personnel of the companies – to get answers from persons who are directly in contact with the business development, strategic decision-making and technological development in their daily working life. Even with these precautions, it has to be stated as a clear limitation, that a person's role in the company and understanding of company's strategy in addition to the interpretation of the questions in the survey plays some role in how the survey was answered. Two anecdotal cases in the study were, when two persons from the same company answered the survey, small differences between the respondents could be found. This is, even if anecdotal, a sign that responding to a survey on strategy, value creation and smart solutions are also matter of perspective and understanding.

The survey was conducted on phases from December 2015 to March in 2016 through Google forms. The first version of the survey was validated with an experienced external professional working in the field smart solutions as well as mentors from both Demos Helsinki and Aalto University School of Business. In addition, the first respondents of the survey were used to validate the quality of answers and the survey itself, thus resulting in longer timeframe of answering. The survey was sent with a short email briefing about the survey and the research programme with a link to the actual survey. On the survey there was a short brief to the questions, which can be found on appendix 3, before the actual survey. In general, the survey was deemed to be anonymous, but the respondents had the choice to share the answers on certain questions to get a chance to feature on the study itself with their company. The data itself regarding the questions was analysed as a whole data set, from which individual companies can not be distinguished – except of course on the cases were a certain company approved the usage of the data and appear on the discussion of the results with their name or logo.

The companies, which answered the survey, also represent the population of FIIF members in their company size, with answers coming evenly in proportion from micro, small, SME's and large companies. From the whole population of 154 companies, there were 61 Micro-enterprises (less than 10 employees, with annual turnover less than 2 million €), which totals 39%. Out of the 154, 30 were Small Enterprises (less than 50 employees, with annual turnover less than 10 million €), which equals 19%. 21 were SME's (Small and Medium-Sized Enterprise. Less than 250 employees, with annual turnover less than 50 million €), totaling 14% of the whole sample. And lastly, 43 were Large Enterprises (larger than above), equaling 28% of the sample. The percentages roughly are similar to the percentages of answers coming from total of 39 companies, with 26% micro-enterprises (10 responses), 18% small enterprises (7 responses), 21% SME's (8 responses), and 36% of large enterprises (14 responses), which shows that larger companies were little bit more represented in the sample than in the general population. The categorization to company sizes follows the general categorization used by Finnish Statistics Center (Tilastokeskus 2015).

As FIIF has many companies from different industry sectors, development in certain industry and representatives within a sector was certainly one of the limitations in the study. The answered companies explained their industry sector to be either IT (both software and consulting 49% -19 responses), manufacturing (31% -12 responses) and various others (e.g. construction, energy, ICT 20% -8 responses). Looking at the whole population, industries were divided around the sectors as follows: 66% IT, 24% manufacturing and 10% various others. Considering the higher answer rate from larger companies, the distribution of sectors is understandable, as many of the micro enterprises are small software and consulting companies, which were overall answering the survey proportionately less than other. This is to give the reader a sense of what kind of companies did answer the survey, yet it must be understood that each individual industry that the FIIF member companies represent are so huge and the sample size considerably small, so that no conclusions can be drawn about individual industry sectors based on this survey.

The choice of the sample was made on the basis of access to respondents and the available resources for conducting the study. Of course, this means that the primary sample is not a representative sample of all companies in Finland, any individual industry sector or beyond FIIF members and their focus sectors. Even in conducting research on FIIF members, only 25,3% of the sample is little questionable, but for the research methods and the adding of secondary data to the study, 25,3% can be deemed to be large enough sample in case of the primary data.

3.1.2. Secondary Data

Secondary data was already collected data about the participant companies from the start-up and investor event Slush 2015, that listed as their industry sector to "Industrial Internet / Internet of Things". As per definition, secondary data is supposed to be used as an alternative to gather information on the selected research problem, information that someone else has already collected and usually for other purposes (Blumberg et al. 2005). Information gathered by Slush organizers about their companies fits the definition of secondary data more than well and it also offers similar sample answering the questions of the research, if not perfectly all of them, at least in an applicable way to the main questions of the study.

One of the main arguments of using secondary data in this way is the saving of time, having easy access to the already existing data and being able to reduce possible researcher bias from the process (Blumberg et al. 2005). In addition, it offers more insights and verifying for the framework created as well as offering more insights into what is happening at the forefront of innovation and business development. As for the data itself, it contains many things that were not necessarily useful for the purpose of this research as well as it also lacks some aspects of the study. Especially parts of strategy are not described in the data, but it offers more insights on questions relating to the new environment and the value creation models. All companies had made a short description of themselves, a company description as well as product/service description, meaning this data can be used to give more insights in to the development and help in the aim of understanding the research questions.

The data sheet contained total of 1318 start-ups participating in Slush 2015. From the whole list, 117 marked their industry as "Industrial Internet / Internet of Things and out of the 117 whom did so, 52 were from Finland. These 52 comprised the sample of secondary data, with all of them having replied to the questions of Slush to describe their company, products and services. The timeline of collecting this data has been around August to November 2015, giving short enough time between the data collection times, even if no overlap between the primary and secondary data collection. Out of the 52 Finnish II/IoT companies, 10 companies were also part of the population of FIIF member. Three also answered the survey, thus being part of primary data, reducing **the secondary data to comprise 49 companies** to avoid doubling certain companies in the sample. The secondary data sample comprised of 38 micro enterprises and 11 small enterprises, which all have been in operation for 5 years or less. Considering the primary data had a small shortage of micro enterprises compared to the whole population, the secondary data also in this way complements the primary data. The sub-industries for the secondary data were variously described by the companies, and does bear no resemblance to the classification made on the FIIF members. Clearly, most companies in the secondary data sample were focusing on a specific solution among the II/IoT field, which was labelled as one of their industry sectors and used also to describe the secondary sample's industry in this study.

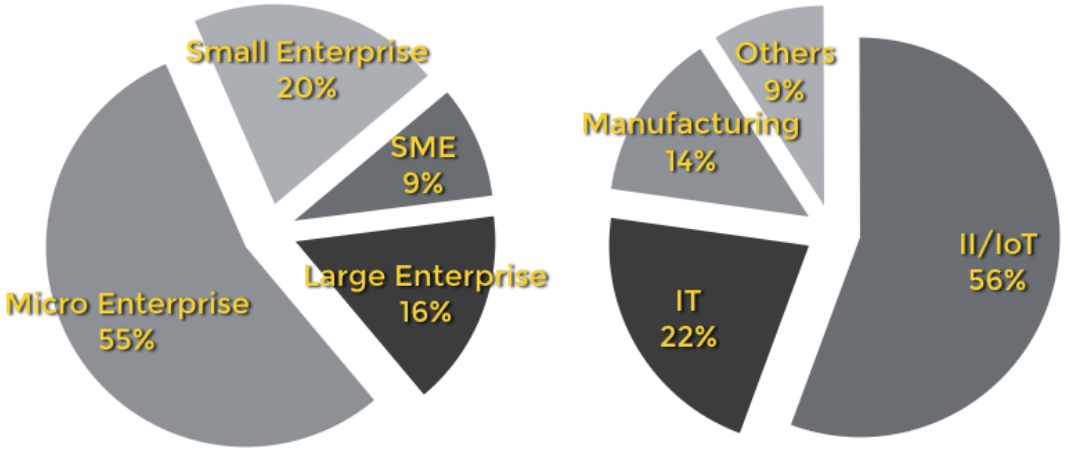
One more aspect of data collection was additional part of secondary data that was collected regarding the companies of primary data. This another part of secondary data was company descriptions that were gathered from the primary data companies for the analysis of the value creation models. This was done through visiting all company websites, looking for the section that describes the company and finding the one to three sentences that describe the company's core – the main thing that they do and how they create value. This was done to uniform the data for the analysis and be able to account the whole sample of companies, total being 88 companies in Finland working on the field.

3.1.3. Synthesis

Despite the fact that both primary data and its data collection methods having its limitations as well as secondary data did not answer all the same questions, **the results of the survey can be considered to be useful in gaining an idea of Finnish forerunner companies' development, strategy, focus value creation areas and ways to benefit from technological development as well as in testing the literature review and theoretical framework created to understand the development at large**. In addition, the results increase our understanding of the terms used by the companies related to the development.

In total, the sample companies comprised of 48 micro enterprises, 18 small enterprises, 8 SME's and 14 Large enterprises. The industry sectors were identified to be IT (19), manufacturing (12), others (8) and Industrial Internet/Internet of Things (49). These are shown in percentages in figure 22, giving example of what kind of forerunner companies were looked and what was their size.

Figure 22. Company size and industry sector among the sample



The whole data set had information about the companies, their descriptions as well as the description of products and services related to smart solutions. The descriptions had information on most used terms to define the new environment and value creation ways.

In addition, the primary data had more advanced answers relating to the strategic positioning and focus areas. This is discussed carefully with each section of analysis so that the reader knows what part of the data was used and whether both primary and secondary sample was included.

3.2. Data Analysis and Interpretation

In chapter four, data findings and analysis is presented. With each topic the use of primary and secondary data is discussed as well as the analysis methods – a point to be made concerning the explanation here being short. Especially this is important as different types of analysis and data is used for different questions. For example, there were some parts that only primary data was used that are mentioned in the relevant sections.

Concerning the analysis and interpretation of the data, this was **mainly done through descriptive statistics in the form of frequency distribution tables (i.e. percentages) and data displays in matrixes and frameworks from the literature review**. The survey included open-ended questions as well as the collected secondary data, which provided with large amount of descriptive data. This **qualitative data was coded and categorized** in its relation to the value creation models and strategy framework used to be able to analyse the development and built more insights especially about the value creation models. Open questions were used to verify the understanding of the responder on the concepts surveyed, and whether the theoretical framework holds in fact true when taken to the companies' view. Thus, both standardized and more open-ended data were used in the analysis and search of answer for the research questions.

Practically, the gathered data was reorganized with the help of Excel sheets, which allowed the data to be drawn into tables. In addition to using Excel tables to sort out and analyse the data, Keynote was used to draw insightful figures and Excel basic formulas, calculations of means and other values as well as more advanced Data Analysis tools were used such as Pivot tables to calculate frequencies of words in the questions

with larger amount of data. Pivot tables were especially useful when looked at the value creation models from the company and product descriptions to find appearances of certain characteristics. This was used on the more open data part of the research, where appearances of words were analysed through reading the appeared words in the original texts.

4. EMPIRICAL FINDINGS AND ANALYSIS

Part four of the research covers the empirical findings, analysis and discussion in the same section. These three aspects are put together for the reason to be able to present findings and discuss their relevance and importance in the same sections as the questions right away as the topics differ from the environment to the strategy, value creation models and the big picture. In general, the following sections follow the order of first presenting the findings, then visualizations in the form of figures or tables of the data gained, followed by paragraphs of analysis and discussion. Each section relates to part of question or questions on the survey and the primary data as well as discussed on each section whether only primary data or the whole sample was used in the analysis. The whole survey can be found on Appendix 3, but each section below also describes the questions that were analysed for it. The analysis is done in the light of the literature review and framework created based on that, with appropriate honing and suggested changes made based on the empirical findings and analysis per section.

4.1. The New Environment – Definitions

One of the main research question was to find out how the companies viewed the development overall, especially what were the terms they used to describe the development in their companies. Naming of the field is important as companies have difficulties in understanding the development and the possibilities that arise (e.g. Vermesan & Friess 2013, WEF 2015), thus finding a common language to talk about seems like an important first step to be able to discuss the development in more complex situations. This was one of the reasons why the research itself started from macro-level moving towards micro-level and to understand the macro-level the naming of the development at large must be in place before any further research can be done logically.

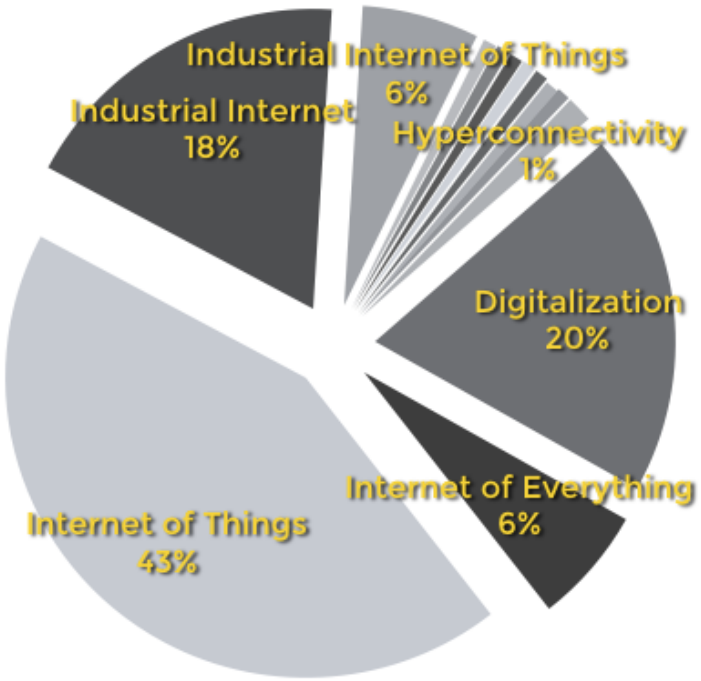
Both primary and secondary data were used to gain knowledge about this. On the online-survey for the primary data sample, companies were asked: “When you talk about the opportunities created by “smart solutions”, what terms do you use?” The question was in the interest of the research as defining the field, terms and common language is a basis

for being able to develop a coherent view of the new environment in addition to whether the terms researched in the literature review were in use in the companies. The sample companies reported using total of twelve different words (six words were given as options based on the literature review) to describe the development on their point of view as well as one company reporting that they do not talk about this development in their company. For the secondary data, the twelve different words were used to find occurrences of these words in the company descriptions, to gain more perspective and larger amount of answers. This of course limits the way the secondary data sample is applied that they were not able describe the development at large in any term like an open-ended question, rather it focused on finding the relevant terms identified. But as the most common terms are similar and most likely new terms to describe the development could have not been found, it is assumed that the findings show the most relevant terms at larger scale very well. The total numbers can be seen in the table 4 below as well as in percentages on the figure 23.

Table 4. Terms used by companies and number of occurrences

TERM	# OF OCCURRENCES PRIMARY DATA	# OF OCCURRENCES SECONDARY DATA	% OF APPEARANCE
We don't talk about these terms in our company	1	Not applicable	0,7%
Hyperconnectivity	2	0	1,4%
Digitalization	26	2	19,6%
Internet of Everything	8	1	6,3%
Internet of Things	25	37	43,4%
Industrial Internet	21	5	18,2%
Industrial Internet of Things	9	0	6,3%
Serverless applications	1	0	0,7%
Integrated combination of machinery, automation and intelligent software, many times connected to sub systems	1	0	0,7%
System of systems	1	0	0,7%
Industrial digitalization	1	0	0,7%
Internet of Things and Services	1	0	0,7%
Smart solutions	1	0	0,7%

Figure 23. Terms used by companies in percentages (terms occurring only once are not written, but appear on the figure)

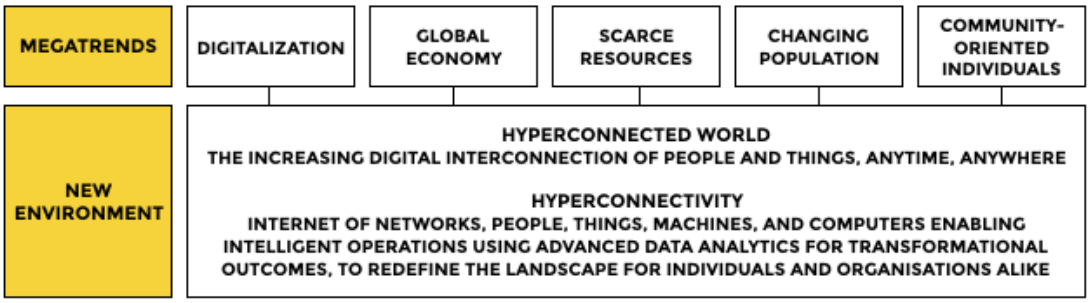


Considering the literature review and the definitions related to the terms, the distribution is hardly surprising. After all, the most common used terms Internet of Things (43,4%), digitalization (19,6%), and Industrial Internet (18,2%) are the terms defining the field from the companies' perspective. Thus, it makes sense that these are the most often used words in companies when they talk about the development. One might find a bit surprising that Internet of Things is used a lot more than the Industrial Internet as according to some sources in the literature review (e.g. Juhanko et al. 2015), Internet of Things can be seen to more describe the consumer perspective to digitalization. Yet, as many of the companies do not work solely on business to business-markets, but also business to consumer-markets, it does make sense that they use the term Internet of Things as the definition fits more closely to that market. In addition, Internet of Things is often considered to describe the increasing smartness of products (Porter & Heppelmann 2014), which is probably easily associated with adding sensors and connectivity to things – thus increasing its appearance in the common language.

What seemed to be the most interesting result from the survey was the lack of use of term Hyperconnectivity. Again, might not be surprising considering its used to describe larger development as well, rather than only companies' perspective, but still it shows that the term, despite its original meaning and source in the World Economic Forum, it is not used and probably not understood very well by companies (WEF 2015, Pentland 2015 – also Hyperconnected World used, which did not appear on the survey at all). Considering the developing field and somewhat unclear difference between Internet of Things and Industrial Internet, the defining of the whole field by a term should be considered to be able to form a common language. Terms such as Hyperconnectivity or Hyperconnected World seems reasonable and sensible as these are not associated with much of the development yet, meaning they could be used to define the whole field starting to shape up. Similar term and definition could be the Internet of Everything, which essentially also grasps the development and "everything" in it.

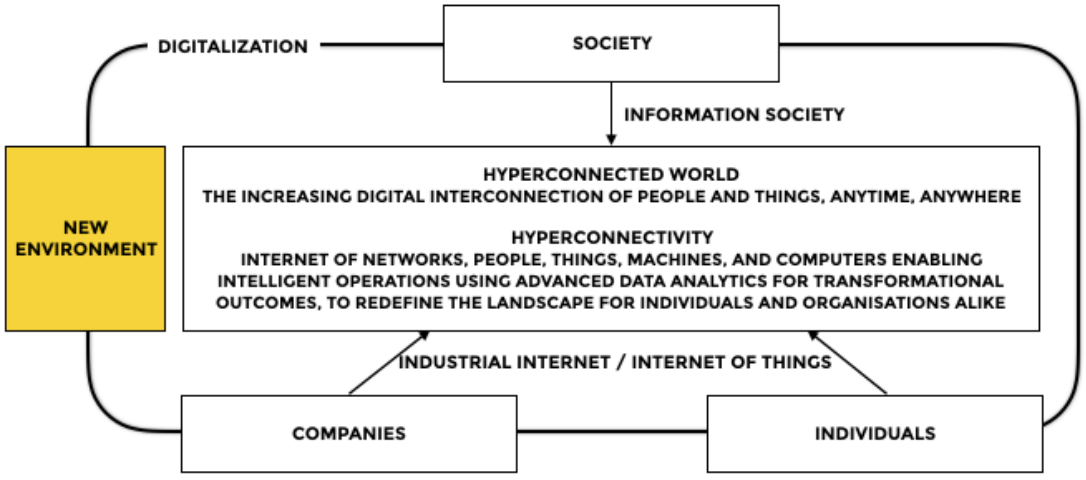
What is proposed next is the continuation of the literature analysis and the empirical analysis. The Hyperconnected World, is used rather than only Hyperconnectivity, as it described better the nature of the development as accounting the whole world. **Hyperconnected World means the increasing digital interconnection of people and things, anytime and anywhere** (WEForum 2015). What allows the creation, is in fact **the Hyperconnectivity**, which is chosen as it represents and describes the development of the systems as something totally new. Hyperconnectivity thus means the already discussed definition as being **the Internet of networks, people, things, machines, and computers enabling intelligent operations using advanced data analytics for transformational outcomes, to redefine the landscape for individuals and organizations alike.** This definition was used previously to define the whole environment and Hyperconnectivity, but it seems using both Hyperconnected World and Hyperconnectivity defines the field more clearly than just using Hyperconnectivity – at least to the author's perception.

Figure 24. Hyperconnected World driven by Megatrends



Not surprisingly, **the empirical findings of the study show and the literature review suggests, companies major definitions and the words they use are Internet of Things, Industrial Internet and Digitalization.** The major definitions and terms used are Internet of Things and Industrial Internet, which as stated in the literature review and confirmed by the empirical findings, describe the view point of companies to the development. Figure 25 depicts this approach mapping the relations between the terms– to address both the language used by companies as well forming the unified picture what the development describes and how, essentially all terms try to describe the same thing, even if from different perspectives.

Figure 25. Information Society, Industrial Internet and Internet of Things as part of the Hyperconnected World



Naturally, when companies talk about the development, they should only be aware that everyone understands the terms in similar manner. **The most important thing, in mapping out the environment and how to talk about it is that whomever talks about it, understand the terms and their meanings in a similar manner so that consensus and communication between the actors can be fluid and meaningful.**

4.2. How Companies use Value Creation Models

The main research question was in trying to find out how Finnish forerunner companies create value through smart solutions and what are the key characteristics of value creation. **Six distinguished categories of value creation models were identified in the literature review. These were tested on both primary and secondary data**. In addition, a separate section for other value creation models are discussed here to find out whether the companies use other forms of value creation than the identified six and what these could be.

4.2.1. The Six Identified Value Creation Models

Both primary and secondary data were used in getting better grasp of the six identified value creation models as well as their popularity among the companies. On primary data, one of the survey questions was to find out how companies implement the value creation models if they do, are they existing business areas, something in development, something interesting or irrelevant. On secondary data, word coding was used to find out relevant terms (e.g. “smart”, “service” and “platform”) to distinguish the value creation among the secondary data sample. Based on the appearance of keywords, the value creation models were distinguished as the main ones of the business. Secondary data also had on its sample whether the company is at a stage of “concept only”, “working on product”, “going to market”, and “growth and scale” – these categories were identified as “concept only” and “working on product” meaning “under development” compared to the original

survey and “going to market and “growth and scale” as “existing business”. If there was no appearance of the keywords, it was deemed to be in the category of “not mentioned”.

The appearance of value creation models was also translated to averages, to get a better view of the differences of popularity of them among the sample. In primary data, this meant translating the value creation models on a scale from 0 (Irrelevant, or not applicable) to 3 (Existing business area). Similarly, on secondary data the same scale was used, but if there was no mention of the value creation model keywords in the company descriptions, the value used for average calculations was 0,5 (between irrelevant=0 and interesting=1). In practical terms, calculating the average values means that the closer the value is to 3, the more companies use it as an existing part of their business.

Table 5. Distribution of value creation models in the sample

	Making existing products and services "smart"(e.g. adding features, connectivity and enhancing customer experience)	Real-time directed resources (e.g. predictive maintenance, optimisation of assets)	Resource Efficiency (e.g. energy savings through optimisation and monitoring, track-and-trace logistics, automation and control, product development and manufacturing)	Commercialization of Data Analytics (e.g. using and selling data or knowledge gained from analytics)	Services instead of products (e.g. X-as-a-service business models)	Acting as a Platform Provider (e.g. offering platform where other companies can operate)
PRIMARY DATA						
Irrelevant, or not applicable for us	1	2	2	2	2	6
Interesting, but no actions taken	3	5	9	11	5	8
Under development	11	14	6	16	16	11
Existing business area	24	18	22	9	16	14
AVERAGE	2,49	2,23	2,23	1,84	2,18	1,85
SECONDARY DATA						
Not mentioned	38	44	40	29	21	39
Under development	1	0	0	2	2	0
Existing business area	10	5	9	18	26	10
AVERAGE	1,04	0,76	0,96	1,48	1,89	1,01
TOTAL AVERAGE	**1,68**	**1,41**	**1,52**	**1,64**	**2,02**	**1,38**

When looking at the primary data, the distribution shows that most common existing business areas are “making existing products and services smart” and “resource efficiency”, followed by “real-time directed resources”, “services instead of products” and “acting as a platform provider”, with “commercialization of data analytics” being the least used model. The distribution also shows how “services instead of products” and “commercialization of data analytics” were the ones being most developed at the moment, followed by “real-time directed resources”. Most companies seemed all value creation models to be at least interesting, if no actions were taken thus far – and only “acting as a platform provider” seemed like irrelevant, or not applicable for small group companies.

The averages indicate that the most adopted value creation model is to increase the smartness of products and services. Considering the whole development, in some cases this can be also seen as the requirement for the functionality of some other parts, thus appearing as the highest used when companies consider the development. Three other value creation models had higher average than two. Real-time directed resources are seen as one of the most largely adopted ways to create value that especially manufacturers are taking in for example through predictive maintenance (WEF 2015), offering clear incremental benefits often immediately. Similar incremental benefits are offered through resource efficiency and related value creation, which scored the same as real-time directed resources. Moving towards services instead of products is also a clear development path recognized in the literature review as well as quite common when considering the development of the primary sample companies. Commercialization of data analytics and acting as a platform provider were less used value creation models. In case of data commercialization, companies do not probably yet see the value of all the data they gather as well as they don’t see how data can be used in the benefit of them. Being a platform provider will most likely be a business of only limited amount of companies, as platforms always need the population of companies to act in it to be able to create the network effect needed to be successful (Gawer & Cusumano 2014). The study was, as already mentioned especially interested in external and platform providers rather

than the internal platforms that can also create value through new digital methods, yet the externality and collaboration were the defined characteristics of the new type of platforms (Gawer & Cusumano 2014). What would be interesting to see if the study was replicated in larger context, whether the value creation models would follow similar distribution and whether finding more insightful facts on the differences between the distributions could be found.

On secondary data, the results were somewhat different. The distribution shows that most often appearing value creation is through the use of different service models, commercialization of data, making smart products and services as well as operating platforms. The secondary data is especially focused value creation through x-as-a-service models, probably due to the focus of less manufacturing type of firms and more small companies looking to benefit from data and looking to serve other companies. On the analysis of the secondary data there is a clear limitation of capturing the essence of the value creation models through the use of keywords only, yet lesser appearance can be a result of also focusing on other value creation models or that the value creation models themselves are not something that companies use to describe their business.

Considering the total averages of both primary and secondary data, it seems that the x-as-a-service models are dominating in total. Their value is higher than any other value creation model, showing that the technological development is allowing new ways to create services as well as specialize in certain aspects of business and offer them through services with greater efficiencies than what other types of business like selling products would allow. There are some sources that the servitization (e.g. Juhanko et al. 2015), is turning over fast to all industries, both b2b and b2c markets. Yet, the differences between the adoption of the value creation models are not huge and certainly they are all very much in use in the sample companies.

Considering the data and how many of the value creation models were at use, it seems that the value creation methods are describing things that create value in general for the companies and are often intertwined in the business models related to Hyperconnectivity.

When both data sets were put together, on average the companies were found to have either as an existing business models or as developing one on average 2,9/6 of the value creation models – with the primary data showing as high value as 4,5/6 and secondary data indicating appearance of 1,5/6 value creation models. This shows that value derives from not only one source, instead the value creation models in their generic descriptions mean the various ways that companies create value for themselves and their stakeholders. This supports the hypothesis that was described the literature review and shown by examples that often one value creation leads to another and/or the value creation models have clear synergies, at least on the macro-level discussed here.

The synergies between value creation models provide similar results than other studies (e.g. Ritola et al. 2015) have been shown as well, even if in different contexts. **Companies rarely draw value from one source, but rather compete with different ways of value creation.** In general, the much lower appearance of value creation models in secondary data is probably due the fact that the companies were not filling a questionnaire that is prefilled with options describing the value creation methods they use. Often in company descriptions, simplicity is the key and if the company's product is for energy optimization, it can show up in this particular data as only being in the resource efficiency category based on the secondary data used. Yet, if surveyed, the results might be much different and companies could be able to recognize all the value creation models they use better. Naturally, this is only discussion due about the nature of the study and to really test this viewpoint, further research would be required.

4.2.2. Other Value Creation Models

As a part of the analysis, also value creation models outside of the sphere of the six identified major categories were looked for. This was done with combining both primary data, secondary data and by collecting more secondary data about the primary sample companies. The primary data source was an open question about how the companies create value ("At the moment, how are smart solutions applied in your company?"). The secondary data source was the company and product/service descriptions made by sample companies. Further secondary data was gathered on the primary sample companies to

uniform the data to account for same amount of text in principle. This was done through visiting company websites and finding out the one to three sentences that describe the company, its main functions and business operations (similar to the company descriptions on secondary data sample companies). This resulted having company and product/service descriptions about the whole sample of 88 companies. After that the data was collected to an Excel sheet and by using Pivot Table, most frequently appearing words were found. From the most frequently appearing words, all words appearing more than 0,10% (equaling 6 appearances in the whole text of 5953 words) that describe value creation or something possibly related to value creation were singled out. Below on the table 6 is the list of picked keywords (with singular and plurals forms combined) with high appearance and the number of occurrences in the whole list of 1734 counted different words with the grand total count being 5953.

Table 6. The most frequently appearing terms describing value creation and their relation to six value creation models

Word	# of occurrences	% of total occurrences 5953
service/services	78	1,31%
solution/solutions	78	1,31%
System/Systems	42	0,71%
IoT	40	0,67%
product/products	36	0,60%
Data	31	0,52%
smart	31	0,52%
device/devices	29	0,49%
sensor/sensors	27	0,45%
software	25	0,42%
Cloud	23	0,39%
application/applications	21	0,35%
platform	20	0,34%
Analytics	19	0,32%
mobile	19	0,32%
control	18	0,30%
company	17	0,29%
Digital	16	0,27%
technology	16	0,27%
Network/Networks	15	0,25%
equipment	15	0,25%
Industrial	15	0,25%
Internet	15	0,25%
information	14	0,24%
Sensors	14	0,24%
Management	13	0,22%
Wireless	12	0,20%
monitoring	11	0,18%
embedded	10	0,17%
Intelligent	10	0,17%
automation	9	0,15%
Online	9	0,15%
Provider	9	0,15%
Remote	9	0,15%
things	9	0,15%
global	9	0,15%
health	9	0,15%
tools	9	0,15%
energy	8	0,13%
environmental	8	0,13%
manufacturing	8	0,13%
Processes	8	0,13%
Production	8	0,13%
design	7	0,12%
efficient	7	0,12%
industry	7	0,12%
content	7	0,12%
communication	6	0,10%
developers	6	0,10%
efficiency	6	0,10%
logistics	6	0,10%
machines	6	0,10%
Process	6	0,10%
R&D	6	0,10%
secure	6	0,10%
social	6	0,10%
support	6	0,10%

The word list shows quite familiar terms that have come up in the study many times, showing that there are clearly certain keywords that describe the value created by smart solutions. To analyse the following list of keywords, two-part process was done. First, categorization was done to find out on which value creation model the keywords relate to. Second, to confirm the categorization that the keywords are actually used in the context categorized, example of all keywords were tested by finding them in the company or product/service descriptions and reading these through to confirm that they relate to the context described here. The whole analysis is explained below.

When the most appearing words were looked by each value creation model, similarities and categories can be found. For example, value creation through smarter products and services come up as "smart, product/products" on the table. Real-time directed resources are shown in the words like "monitoring" and "remote", where as resource efficiency appears through many words such as "industrial, management, automation, energy, efficiency, environmental, manufacturing, processes, production, efficient, industry, logistics" and "machines". Data commercialization is described by words such as "data" and "analytics". As-a-service business models are seen in the high appearance of "service/services" and platforms naturally appear with words describing them in "platform" and "provider". **These keywords clearly relate to the identified six categories of value creation models also when examples were looked from the actual descriptions through locating the keywords in the company and products descriptions.**

Yet, there are some words that don't seem to describe any specific value creation model like "solution/solutions, company, global, health, R&D" and "social". In addition, another group of words can be found that describe the technical side of the whole development. These include for example "device/devices, mobile, control, system, digital, technology, equipment, internet, information, sensor/sensors, application/applications, wireless, embedded, intelligent, online, things, tools, design, content, communication, developers, network/networks, process, secure" and "support". These seem to relate most to the earlier discussed technology stack (Porter &

Heppelmann 2014), which describes the value creation and requirements for any application of smart solutions to be able to work. **Naturally, there are lot of companies using these technologies alongside their value creation through the larger six value creation categories, but there also seems to be a group of companies only operating on the level of this technology stack**.

The findings on describing words on different value creation models is summarized in Table 7. In general, the categorization of the words and looking up to their links in the text gives a strong hint that the value creation models do work in the context and as specified in their meanings. The most interesting discovery was probably that even if **there was not a clear other value creation model category similar to the already identified six, there was clearly a category of technology providers and users of the technology stack, which any company looking to benefit from smart solutions has integrate as part of the business somehow**.

Table 7. The describing words of different value creation models

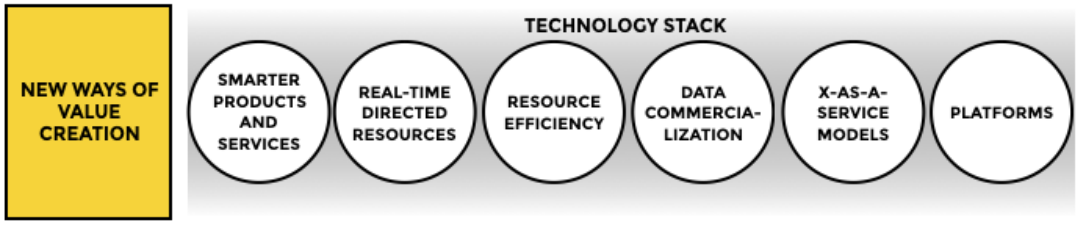
Value Creation Model	Related Describing Words
Smarter products and services	smart, product/products
Real-time directed resources	monitoring, remote
Resource efficiency	industrial, management, automation, energy, efficiency, environmental, manufacturing, processes, production, efficient, industry, logistics, machines
Data commercialization	data, analytics
X-as-a-service	service/services
Platforms	platform, provider
Others	solution/solutions, company, global, health, R&D, social
Technology stack	device/devices, mobile, control, system, digital, technology, equipment, internet, information, sensor/sensors, application/applications, wireless, embedded, intelligent, online, things, tools, design, content, communication, developers, network/networks, process, secure, support

4.2.3. Synthesis

Based on the keywords and the relation to value creation in the field, some conclusions can be drawn. There are clearly identified **six ways how companies create value for themselves, which are categorizations of larger amount of ways to derive value from as described in the literature review. Yet, there is another form of value creation, which is also important to the companies and has the most ties to the technology stac**k (Porter & Heppelmann 2014). Yet, this technology stack as the way for companies to create value, seems to be the requirement for the development as discussed earlier, it is pinpointed here that the framework introduced earlier needs to be refined based on this analysis. The identified six value creation models, from the strategic point of view are the main ones and the relationship between strategy, value creation models and virtuous cycles is discussed in the next section. What is looked here is the categorization of value creation models and the framework discussed.

Originally, the value creation models were distinguished in the six identified groups as well as "other" value creation models. What the analysis of the value creation models would point out to, is in fact that the six main categories hold true at the macro-level of value creation. Behind them lies the technology stack, which many companies are focused on, and all companies have to use the tools it offers somehow to be able to use the six identified ways to create value to their business. This technology stack also gives possibilities for companies to create their expertise on it, rather offering their services and expertise on the technology to other companies to allow them to benefit from the technological development. The edited framework considering the value creation models is pictured in the figure 26.

Figure 26. The Six Value Creation Models and the underlying Technology Stack



4.3. Strategic Development Focus

One part of the survey was focusing on the strategic development of the companies. **For the primary data, the survey included questions about the current strategic focus of application of "smart solutions" at the company as well as the respondents' opinion of what strategic development focus should be.** This was done by asking a multiple choice question on what are the current strategic focus areas with being able to answer to multiple sections as well as the secondly asking what should be the one main focus area for the company in their strategic development related to smart solutions. The actual survey questions can be found on Appendix 3. The distribution of answers for current strategic focus is displayed in the figure 28, but first figure 27 is displayed again to remind about the strategic development focus areas that were presented on section 2.3.2. Secondary data was not used as it was not applicable in general to form unified data on the matter with the primary data.

Figure 27. Strategic development focus of companies (explained in section 2.3.2)

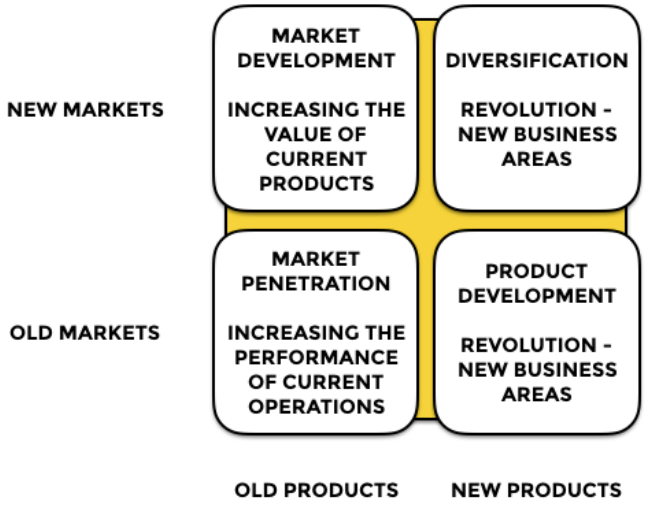


Figure 28. Distribution of current strategic focus of smart solutions in the primary data sample companies

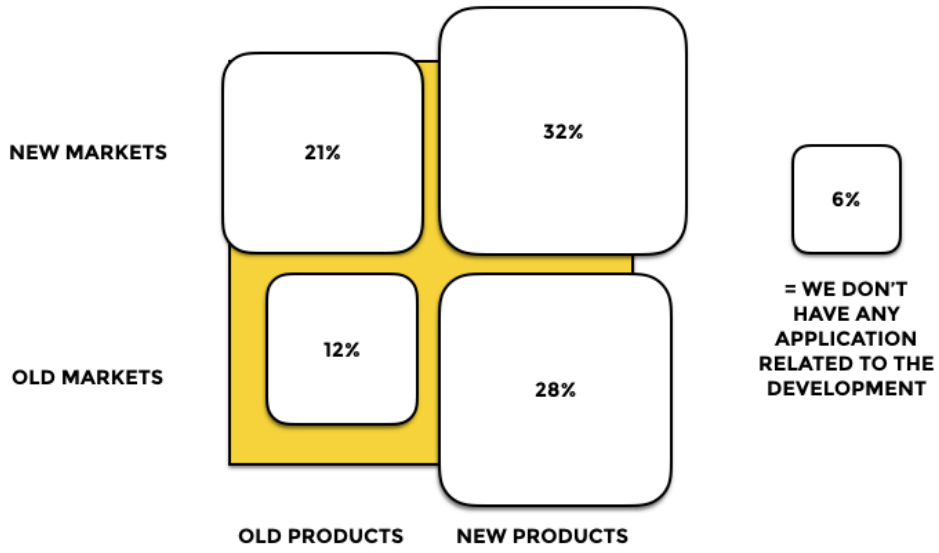


Figure 28 shows that companies currently focus the development of smart solutions to create more not only to create more efficient solutions, but more largely to enter new markets, to create new products for old markets as well as new products for new markets. Considering that the smart solutions created often are new and unique in their context, it is understandable that their focus is on creation of something new, not just trying to make current operations more efficient.

Also, what was asked from the respondents is what they believe their company should be focusing on regarding the development and usage of smart solutions. The distribution is displayed on figure 29.

Figure 29. Distribution of wanted strategic focus of smart solutions in the primary data sample companies

Figure 29 shows us how the respondents believe that their companies should be focusing even more than what they are to new products in both old markets and new markets, with both sections growing largely from the current situation (8% and 17%). This strengthens the hypothesis that smart solutions and technological development is essentially creating new and biggest opportunities lie there despite the most obvious opportunities for companies to be present in the efficiency of old markets and old products – and has more qualities of an emergent market than anything else (WEF 2015, Ailisto et al. 2015, Porter & Heppelmann 2014). This is in addition to the fact that the respondents do seem to, at least partly realize that the biggest opportunities lie in creation of something totally new and unforeseen and would like to see their business focus even more to those areas.

On the other hand, it can also be discussed whether the framework based on Growth Vector Matrix and combination of the classification made by Juhanko et al. (2015) works at all. It has a major limitation in as the focus area depends heavily on the person's perspective and understanding of the strategy area as well as the company's

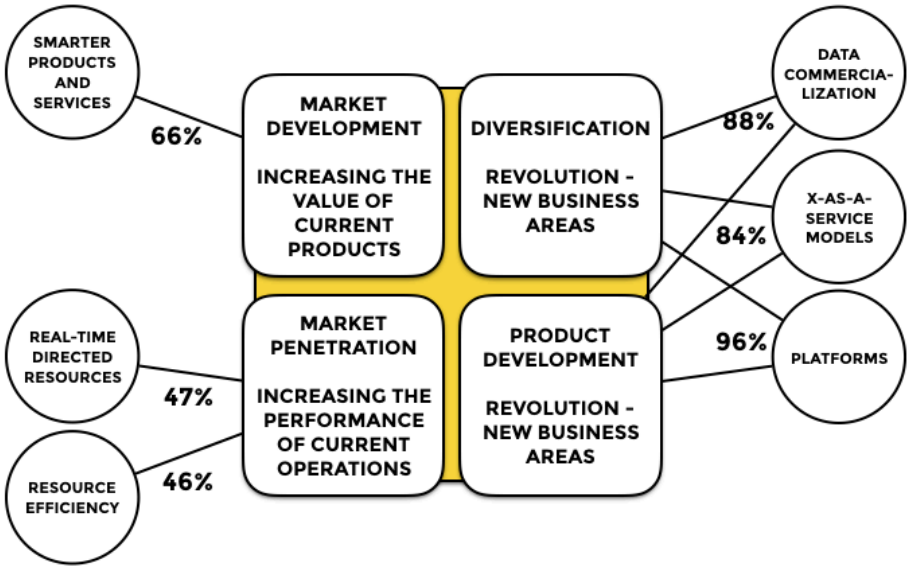
position. An example could be drawn from earlier discussed open source innovation platforms that Kone and Kemppi are developing – as a sort of external R&D platforms (discussed in section 2.3.3.). Consider a new invention for logistics system, which makes it more efficient than before to move anything between locations. If a startup company comes up with it and starts to sell it as a products or a service, it is directed towards new markets and new products. If large company's internal R&D group comes up with it, it can be viewed as the creation of operational efficiencies inside the firm. If the development continues toward the direction set by Kone and Kemppi in their approach to open, external R&D platforms, the line between the different strategic focus categories is hard to judge and in fact the whole framework itself maybe way over its due-date. Is it market penetration or differentiation, if a startup company on an open R&D platform that is offered by large corporation like Kone, comes up with a solution that offers efficiencies and starts developing it and selling it to Kone? For the example, it provides the perspective matter of the strategic focus area and **gives us a hint that in the current day and strategic thinking, maybe more advanced frameworks could be applied – or rather at least that the framework discussed is not very informative or useful for companies to plan their strategy with.**

For the sake of discussion, secondary data of startups could be added to the conversation. The data shows that the companies are either in the phases of "concept only", "working on product", "going to market", and "growth and scale". Naturally for young companies this is the case, and if applied these categories to the growth matrix above, it is clear that all of the 49 respondents would end up market development, product development or diversification. Thus, another possible hint that the development of these technologies as a new phenomenon is directed to totally new ways to create value, towards new markets and/or products. This is of course hypothetical and secondary data does not give good enough data to make further conclusion on it.

Also, the literature review proposed a framework of combining strategy and value creation models, which was presented in the section 2.3.2. This divided the value creation models to their respective strategy categorization of market penetration, market

development, product development and diversification. The survey for the primary data was also used to test this theoretical framework to find correlations between the value creation model explained to be existing or under development by the companies and their responses to the strategic development field of their companies. Combining the strategic framework and related value creation models to different sections based on the literature, it seems like literature and the whole categorization towards different strategic areas seem not to hold true. Figure 15 in section 2.3.2. shows us the original categorization of value creation models to different strategic areas. What is added in the figure 30 below are the percentages of connections made between the "existing" and "under development" value creation models compared to the described strategic development area by each individual response.

Figure 30. The Relations of Value Creation and Strategy – and the lack of it



Total of 177 connections between existing and under development value creation models to their strategic development area were made, from which 122 were to the strategic area categorized in the literature review. This is total of 69% meaning 31% connections were off. These 31% were divided among the value creation models shown in the table (in addition to two 2% of missed links to "we don't have any development related to smart

solutions" and still describing of using some value creation models). Smarter products and services, real-time directed resources and resource efficiency had total of 44 missed connections, from which 32 were towards new business areas. This means that 73% of the missed links were in fact linked to the either diversification or product development, meaning that these three value creation models were understood to be creation of new business areas.

The fact that the connections made is so low in addition the majority of the connection made towards new business areas, this could hint to the direction of "smarter products and services", "real-time directed resources" and "resource efficiency" as value creation models are understood by the respondents – and in fact are – to be more about new products for old and new markets rather than about more efficient current operations. All have high miss-rates at 34%, 53% and 54% as compared the strategic area of the company and the development of value creation models, which shows us that the strategic framework created in fact lacks some aspects or does not work in this context. It could be even hypothesized that most value creation that smart solutions and Hyperconnectivity allows is due new products changing the environment in transformative ways that differ so much from the old ways to create value that they don't even compete in the same field (e.g. Porter & Heppelmann 2014 discusses this). Many companies working in the field are consulting and software companies, which main purpose is to challenge the ways of working of traditional players. Another thing that was not studied in this research was how old or new these companies are. If you consider that the development of new technological tools is just surfacing, most companies are likely to be relatively young and developing their solutions to the field. As the solutions and possible the companies are new, the value creation models they use are most likely be understood as new products and services directed to new markets, at least in the perspective of the companies. For example, from a company's perspective, adding sensors to a heater can transform the heater to be a new product and give the opportunity to enter new markets. On the other hand, it can also be understood to be incrementally increasing the qualities of an old product to gain access to larger markets (as it was understood in this study in the examples discussed). This points out to the relativity of the

concept and understanding it – and probably the fact that the division to such categories does not work very well in this context.

In this, **more descriptive research might be in order in addition to a larger sample size to confirm the hypothesis that the framework itself is not applicable. What would be interesting research question further on might be to combine traditional strategic thinking and the development of strategy through the revolutionary smart solutions** and how they challenge the traditional ways of doing business. This might hint to the direction that the sayings about the third disruption in IT are not made up just on the speech (Porter & Heppelmann 2014), but are in fact true and most value creation comes from totally new ways to create value, which truly is transforming the environment for organizations and individuals alike, just like World Economic Forum (WEF 2015) describes the development to be and what was used in the synthesis of the whole development in this study. Considering that the framework highlighted, it can be hypothesized that the classical strategy frameworks do not work so well and an approach from of the Blue Ocean Strategy (Kim & Mauborgne 2005) could be applied better to the context at least if companies want to be competitive in the new environment – yet this would call for additional research so that any theoretical conclusions could be made out of the strategic nature of the field.

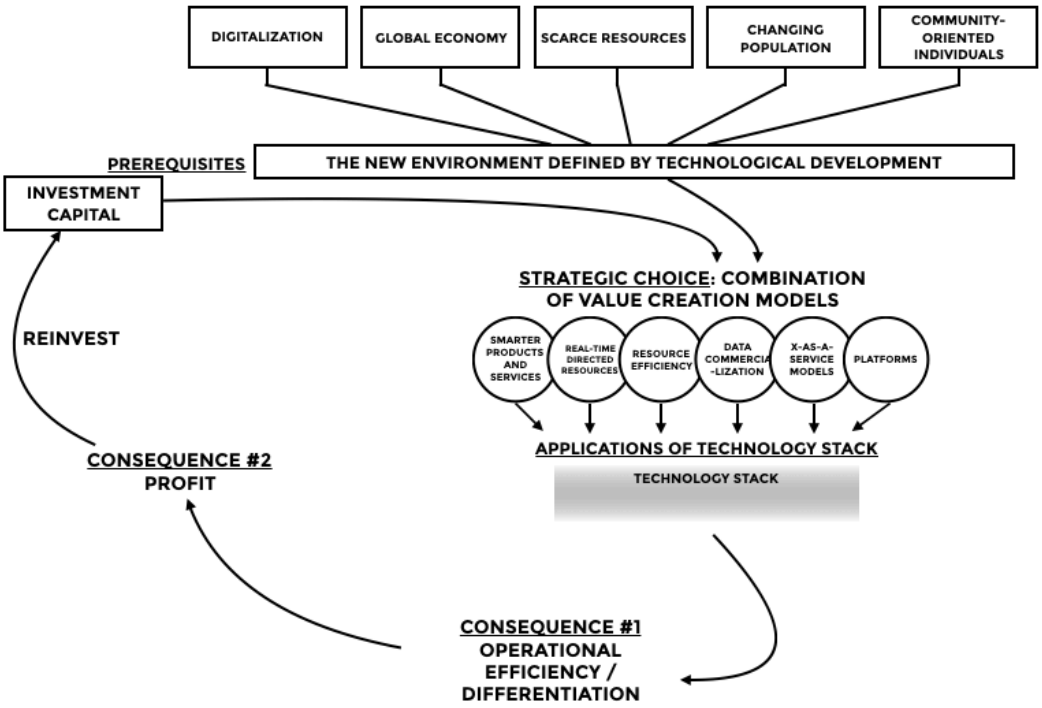
4.4. Strategy, Value Creation and Virtuous Cycles in Business Models

This section considers mainly the analysis and discussion based on the results of the empirical findings, especially relating the different parts of the results together and looking strategy, value creation models and virtuous cycles in business models allowed by technological development and smart solutions. As already discussed, it can be viewed that the strategic development in the field rarely is only about focusing on better efficiency. Rather the new technologies are disrupting in a way that they support the development of companies to focus on new products and/or new markets. Differentiation from existing competition through more efficient ways to create value and differing

totally from competition seems to be strategic development direction. Even if the digitalization development doesn't necessarily change the two basic tenets of strategy (Porter & Heppelmann 2014), it could be hypothesized that the basic strategic frameworks like Ansoff (1965) and Porter (1980) are somewhat outdated for the application on this specific context. The strategic aspect of the digitalization could be further studied and for example the Blue Ocean Strategy by Kim and Mauborgne (2005) could offer some interesting viewpoints to this, even if not more closely studied here.

The six identified value creation models and the underlying technology stack can be seen as the main value creation source for all business models at the moment in the field. Naturally, to be able to grasp business models at any more specific level, case-study type of studies would be required to distinguish the more concrete and practical applications of the value creation models in business models. Yet, the study shows that the development offers new ways to create value and by knowing the available choices – or at least some of them – persons responsible for the strategic decision making of their respective companies, can understand the possibilities offered to them better. The sea of possibilities is pictured through the value creation models that are available for companies. These can be also understood, as earlier discussed through the concept of virtuous cycles in business models (Casadesus-Masanell & Ricart 2009 and 2010). Below, is an edited framework of virtuous cycles through smart solutions on figure 31. Even as ultimately a simplification, it can be applied to the existing business models of companies as complementing it or forming a part of it, as it essentially only pictures a part of a business model, not the whole construct in any case.

Figure 31. Virtuous Cycles through Smart Solutions



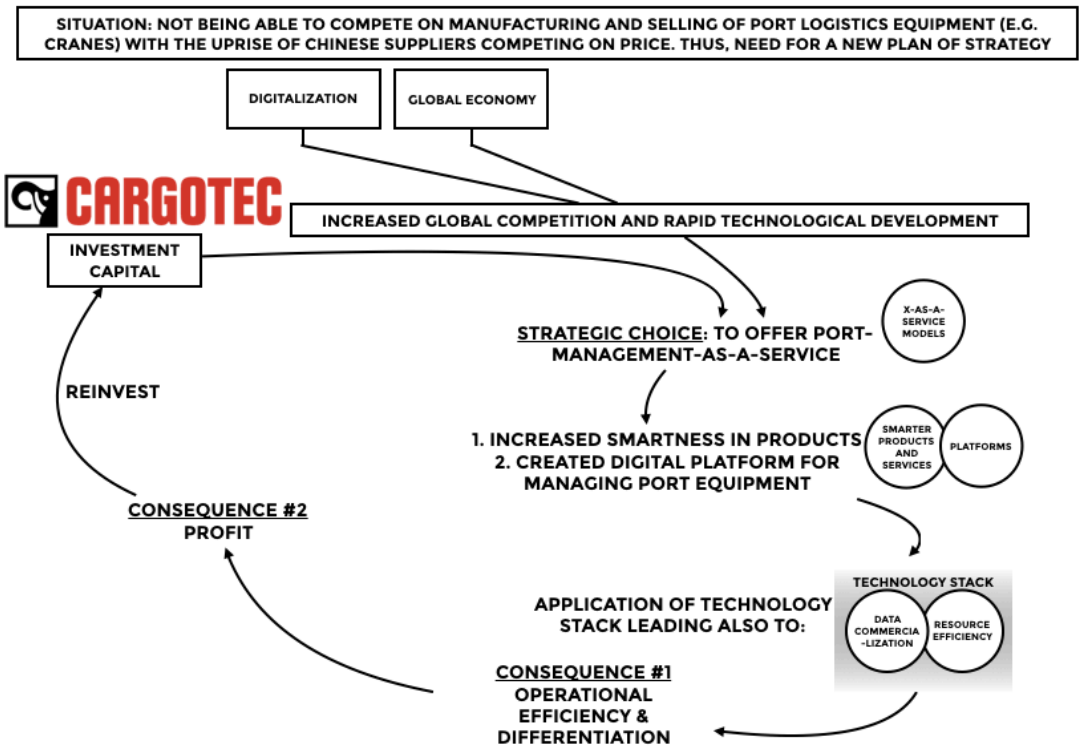
What figure 31 in practice means, that companies need to have the prerequisites to be able to develop at any scale. This means both investment capital and the external environment defined by technological development. Understanding the value creation models that the technological development allows, gives the companies a field of strategic choices where the company can pick the right combination for them. This also needs understanding of the technology stack that will allow the implementation of the value creation model to the business practices and existing business model of the company. Through these strategic choices, the company can then increase its competitiveness, to create operational efficiencies and/or differentiate itself from the competition. This naturally leads to increased profits, which can be invested again to develop even better way to create value. As a general framework, it is limited in its approach to strategic decision-making and it does not go to the subtlety of neither business models, value creation, strategy or technological tools itself. **Yet, combining all of them on macro-level seems like an interesting position to understand overall**

development of organization, and hopefully as a construct can be useful for understanding the relations between the areas.

There are two main relations, or consequences, that need to be true for the virtuous cycle to work. These are the relations between "defining characters and requirements of the choice made" and "operational efficiency / differentiation" as well as "profit" leading to "investment capital". If either of these relations is not used efficiently, the cycle turns quickly into vicious cycle picture in discussed earlier in the section 2.2.4 on figure 12. Of course, this is again ultimately simplification and does not provide any further information on what are the ways to really avoid the vicious cycle, rather just providing a framework to look at the most important relations in the making of virtuous cycles.

These edits could be taken to the example of Cargotec and port-management-as-a-service discussed on section 2.3.2. (Zysman 2015, Digile 2015). To fit the new edited figure, the example of the strategic change to as-a-service model is pictured below in figure 32.

Figure 32. Edited Virtuous Cycle of Cargotec's Port Management-as-a-Service

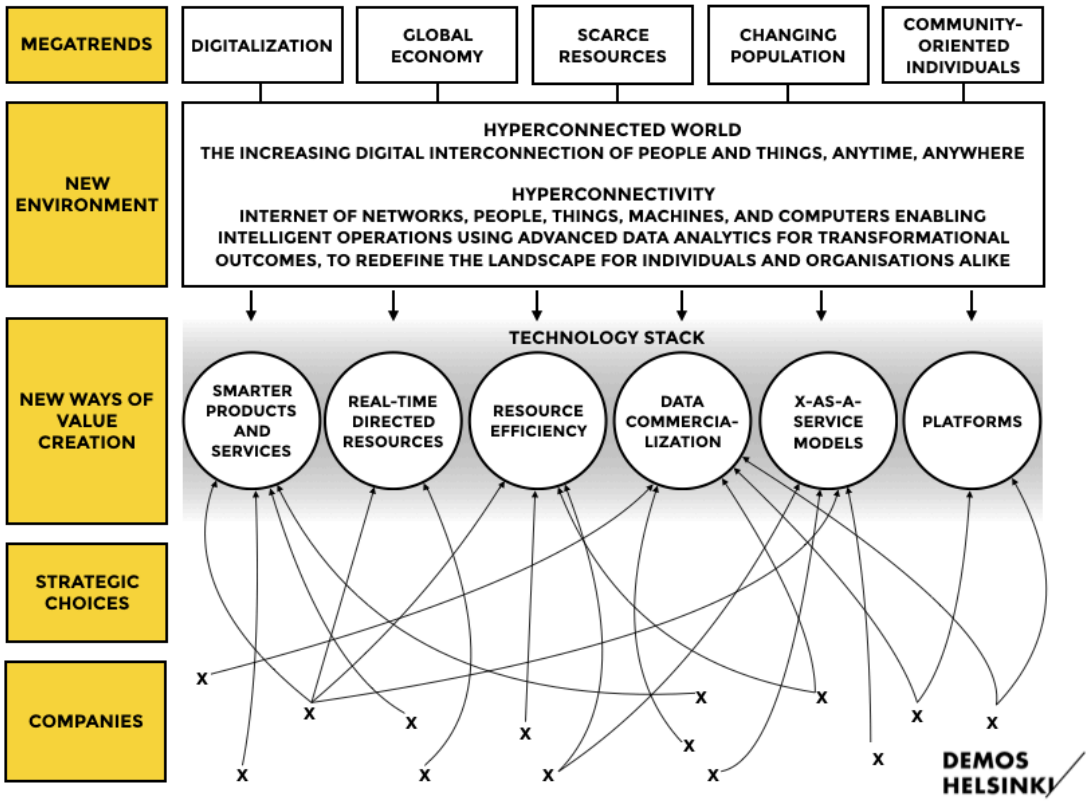


As a discussion point, the relationship between value creation, business models and strategy as well as understanding the whole process through virtuous cycles is an interesting one. The combination of the theory provides a framework, which even if not tested by the actual research and only seen by few examples throughout the study, can provide decision-makers and anyone interested in strategic development with an interesting framework. Taking this approach to a set of case studies on strategy, business models and value creation would be an interesting further study and could provide with new insights on how companies can develop their strategies better related to Hyperconnectivity.

4.5. Synthesis – The Big Picture and Link to Sustainability

As the synthesis of the empirical findings, analysis and discussion, the last section of chapter 4 introduces refined framework to understand the whole field, the naming of it, the value creation models and the underlying technology stack as well as companies' strategies and distribution among the figure. To take all separate refined parts from the chapter 4, an updated framework is presented on figure 33.

Figure 33. Updated Big Picture: How companies create value in the Hyperconnected World



The main contribution of the study is in fact the honed big picture to the whole development from the companies' perspective, spanning from the driving megatrends, to the definition of the new environment, what kind of opportunities it creates to understanding the strategic choices of the companies. As such, the figure offers possibilities to discuss the development on the big picture, both in relation to companies' strategies as well as the new environment and what drives it. The big picture and edited figures also give snapshots of Finnish companies, and small clue about how the Finnish ecosystem of companies benefitting especially from Hyperconnectivity is shaping up, even if by no means it claims to be extensive, detailed or comprehensive. This is pictured on figures 34, 35 and 36. Further research on the ecosystem of Finnish companies and also to other geographical areas would be need to draw any more conclusions on how Finnish companies are competing on global scale.

Figure 34. Big picture with Benchmarks

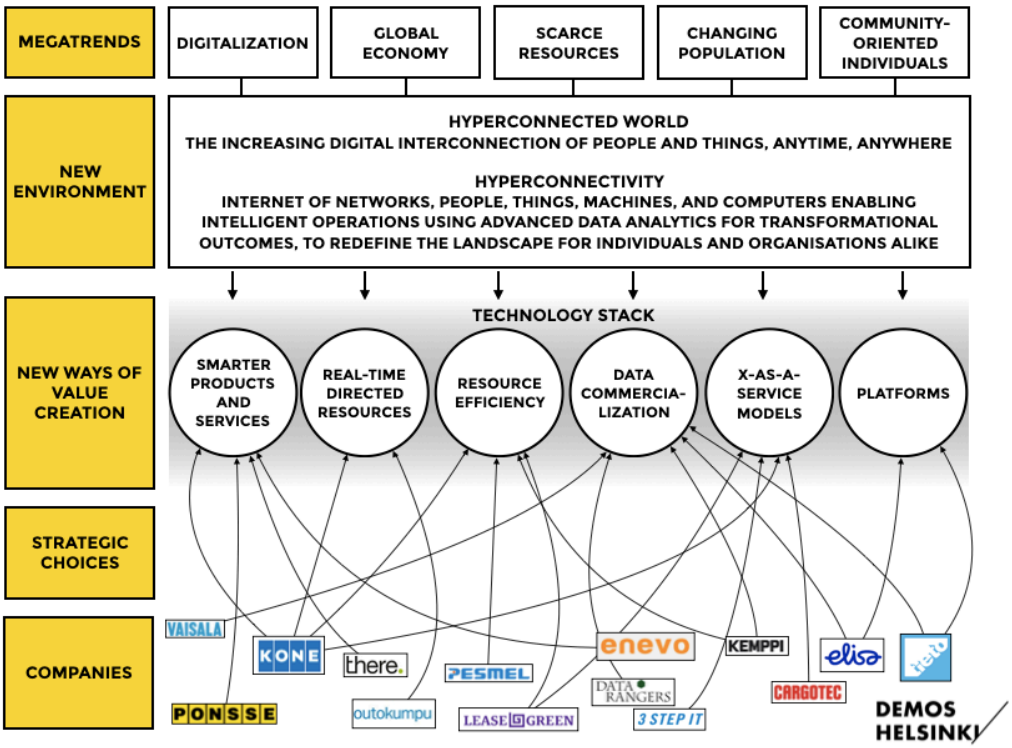


Figure 35. Big picture with some of the FIIF members (primary data)

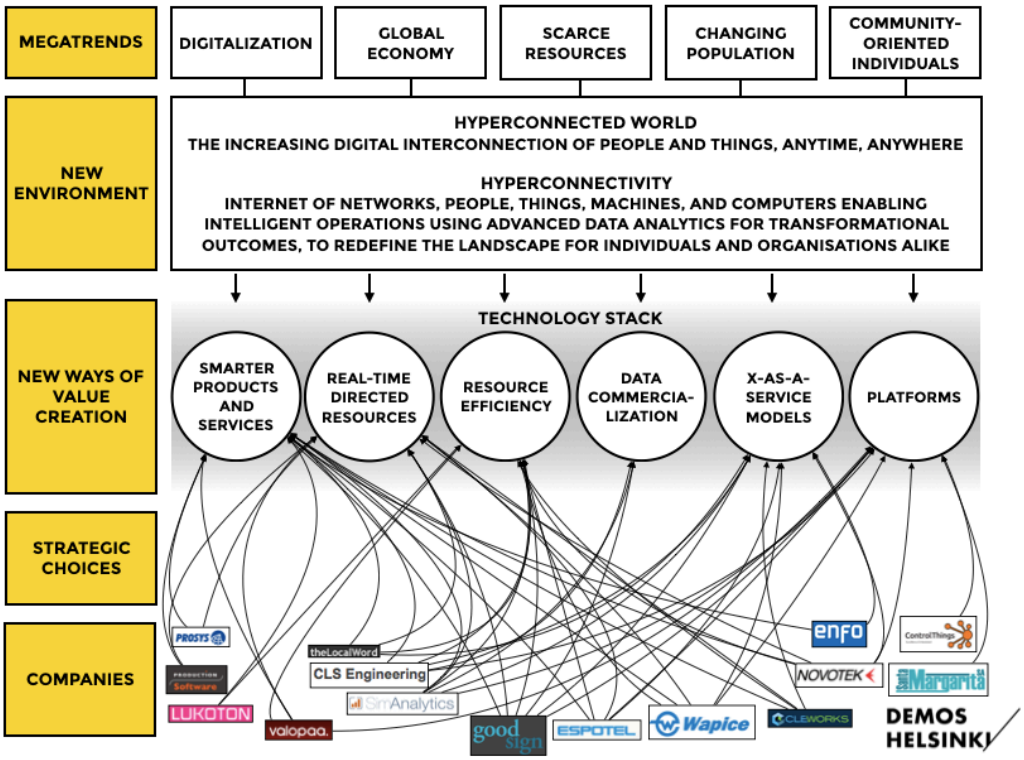
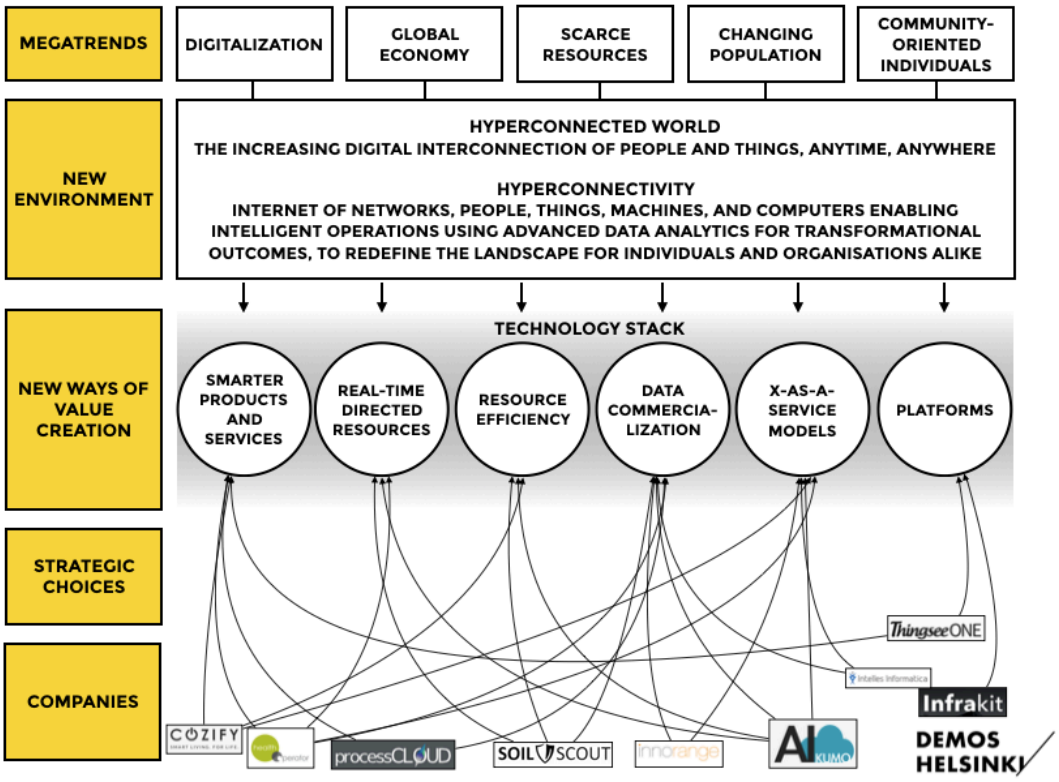


Figure 36. Big picture with some of the Slush start-ups (secondary data)



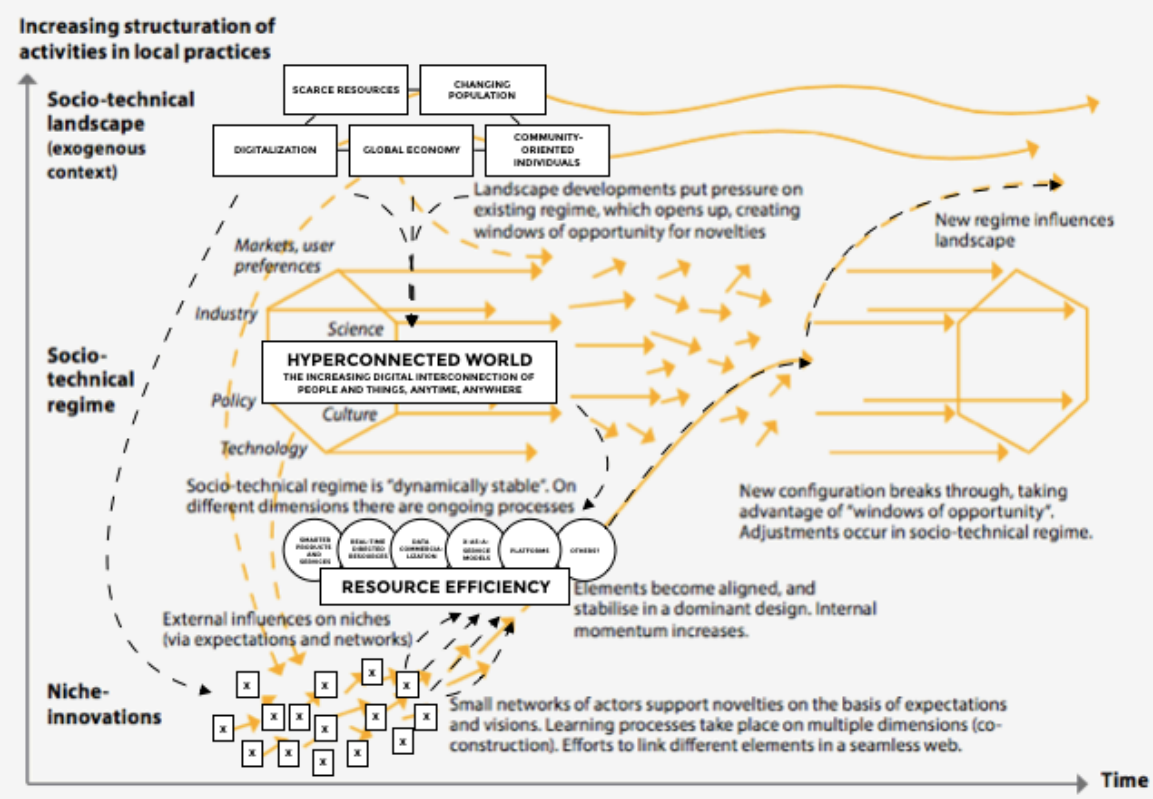
What the big picture also allows is the discussion on what is the direction of the development at large. If the megatrends are understood to be the driving force of the development and understood to be what they are as presented in this study, some discussion and even conclusions can be drawn on how the development of the new environment will be shaping in the future. In theory, the study did not research this point of view further than the understanding of the megatrends how they are understood as affecting our world in general. Yet, **this opens up the question of what kind of development and strategy is wise, especially if the framework is considered as a practical tool.** The question that the framework proposes – or a matter of discussion – is thus: if one understands the whole big picture and the implications of the megatrends, are the only viable options for any organization in the long run to apply any kind of value creation, strategy or business model in a way other than being more efficient in terms of resources than what is currently in use?

From the understanding gained from the study and elsewhere, authors personal response would be yes, as the humanity itself is faced with many yet unsolved problems that are directly related to our survival as a species. If the challenges such as climate change, resource scarcity and population growth are understood with the best scientific knowledge and facts ingrained in decision-making, the organizations that create and operate our everyday lives must change so that they account for the solving of these problems, at the same time when they fulfil our daily needs. So **the hypothesis being, that if one understands the big picture, the only real option for organizations in the long run is to apply any kind of value creation, strategy or business model in sustainable way**.

As a discussion point and **interesting perspective, the big picture itself could be applied to the model of socio-technical change described by Geels** (2011). Geels looks the world through the lens of socio-technical landscape, socio-technical regime and niche-innovations. Applied to the framework of this study and to make the reasons for sustainable applications of value creation models, this would mean the following. The socio-technical landscape, the exogenous context means the world driving megatrends that in the short run, can not be altered. The landscape development affects and puts pressure on the existing regime that describes the current state of the world: the markets, industries, science, policies, technologies, and culture. This also means the actors in this regime, for example the large companies like Google, Apple, Facebook and the likes are very much part of the existing regime that defines in what kind of culture and society we live in. The pressure on regime level development opens up new opportunities for niche-innovations. These niche-innovations gain from the external influences of the change driven by the landscape level development as well as the regime level development. From companies' perspective this could mean the innovations made by large companies, but also the startups, individual innovators and other actors, who can promote the success of niche innovations. In the long run, niche-innovations affect the regime level development as small actions come together to forms cohesive wholes. The niche-innovations are dependent on the individuals and organizations and their ability to draw knowledge from the landscape and regime level change and adjust that to the niche-innovations. The value

creation must thus be chosen as in the light of the larger context, if one wants to be successful in the long run and if one wants to be able to have positive effect in this world. What Hyperconnected World means in this constructs is the whole new developing environment, yet similarly it describes the very thing that shapes the new regime to a society that works in different ways in terms of markets, industry, policy, science, technology and culture – can even affect the landscape level development.

Figure 37. The Big Picture adapted to Geels (2011) "Describing the role and change of socio-technical regime"



Of course, further research could be done for example is this in principle true in the long run and whether sustainable development is in fact inevitable – or impossible – yet this was something that this specific study could not reveal as more than merely a discussion point. Naturally, if this is taken as a point of view to the development, very practical implications arise from strategic point of view on how the value creation models should be applied to current operations and to create new. Questions and answers on where the value derives from in the long run, what is needed in creation of new business

and how the whole framework could be used as a tool to map out the future direction of a company – through better understanding of what is possible, to why it's possible and to how it should be applied in sustainable way and why.

5. CONCLUSIONS

The last chapter of the thesis concludes the research with the overlook of it all. Main findings are presented on their own sections divided to theoretical contribution and managerial implications. Other sections are evaluation of the study and lastly suggestions for further research. But before heading into the conclusions and contributions, first a quick recap of why the research was done, what were the research questions, motivation and research gaps found and answers sought for.

The motivation and goal of the study was to understand the undergoing change that the new technological development offers and the possibilities that it brings to companies (and other organizations through understanding the companies' context). This was done by looking into Finnish forerunner companies, to research the development in Finland, in the aim of helping companies understand the context better and offer subsets of strategic options through the understanding of value creation, strategy and business models. Additionally, the research aim was to look into sustainable development in the field, define the whole field to make common language as well as form a big picture of the whole – the developing area. The main audience of the study are persons directly related with strategic decision-making in their company.

The main research question was:

"**What are the key characteristics of value creation in Finnish forerunner companies looking to adjust their business models by using smart, connected processes, products and services?**"

To fill these knowledge gaps, the following three research questions were brought forth:

1. **What are the most often used terms and definitions related to the development?**
2. **Are there any identified and existing models of value creation? How these include sustainable business model characteristics?**
3. **What are the characteristics of value creation in Finnish forerunner companies looking to adjust their business models by using smart, connected**

processes, products and services?

To be able to understand the value creation models and their use better, strategic viewpoint and business model definitions were introduced quite early in-depth during the literature review process. These frameworks were especially useful in understanding the role of value creation in business models and the strategic choices that the value creation models. In fact, a fourth sub-question for the study could be formulated based on the study as it also answered totally another research question itself:

4. **What is the relationship between value creation models, business models and strategic decision-making when the development of the Hyperconnected World and its possibilities are taken into account?**

The fourth question seems to be in fact the practical one, what the development means for the strategic decision-makers that were the main audience of the study and how they can react to the information and use the frameworks posed in the study. This is especially discussed in the managerial implications section, but it also offers some interesting points of discussion related to the theoretical contribution of it. These four questions were answered in various ways throughout the research and the conclusions drawn from theoretical point of view and managerial point of view are introduced in the next sections.

The poised research questions arose from six general points of interest that were identified as the motivation of the study, why it is interesting and where are the research gaps. First, it is a development field with huge possibilities for companies and other organizations alike – estimations varying from value of $14 trillion to $33 trillion, with industrial companies accounting for 2/3 of the whole economy (Vermesan & Friess 2014, IIC 2015). Second, the aim was to support the Naked Approach research project in speeding up and directing the paradigm shift towards smart, hyperconnected environment in the Nordic context (Naked Approach 2015). Third, the motivation was to understand better technology's role in creating ways for smarter use of resources and creating sustainable wellbeing. Fourth, a major research gap was found in the field, where companies clearly have difficulties in understanding the development and the possibilities

it offers for them (Vermesan & Friess 2013, WEF 2015). Fifth, little studies have been done on the field especially on the Finnish context, thus the research aim was to shed light on this. And lastly, the novelty of the development has lead to many different definitions and unclear meanings of the terms related to the field, the research aimed at finding some clarity and help in understanding the differences between the definitions as well as their uses.

In general, the study answered the research questions, if not fully at least by providing some new information, frameworks and perspectives to them. These are discussed in the sections below, first from the theoretical point of view and then from the practical, managerial point of view. To summarize these points, conclusion was also formed about the most interesting points that can be drawn out of the whole study. These eight points are listed below and discussed in respective sections in detail after.

1. **The New Environment is not defined, but terms describe the same development from different perspectives**. The best ways to describe the whole digitalization development are **Hyperconnected World** and **Hyperconnectivity** (or practically whatever word that has a common understanding among the actors discussing it e.g. IoT, Digitalization, Industrial Internet).

2. The New Environment can be viewed through **Technology Stack and six Value Creation Models** that arise from it.

3. **Value Creation Models in general have synergies** - companies usually benefit from several of them.

4. Six identified value creation models describe the current possibilities in detail, yet **further research questions arise from what will be in few years as the rapid technological development continues**? Other value creation models will arise and might be adopted quite fast and what these might be, this study could not offer more than few anecdotes on.

5. Hyperconnectivity seem to offer **the largest and most interesting opportunities, when focusing on new markets and/or products**, and by its nature as an emergent market is focused in those areas rather than just looking how to increase efficiency of old products and old markets (even if those can sometimes be the most easily understood and adopted in practice leading to immediate incremental benefits).

6. **Thinking Value Creation through Strategic Choices and Virtuous Cycles that make up the Business Model can help decision-makers to understand** the development, their own organization, the choices they can make and the most likely consequences.

7. **Finnish ecosystem of companies operating in the field is alive and kicking**, but further research would be needed and comparisons with other geographic areas.

8. If one understands the big picture, **the only real option for organizations in the long run is to apply any kind of value creation, strategy or business model in sustainable way.**

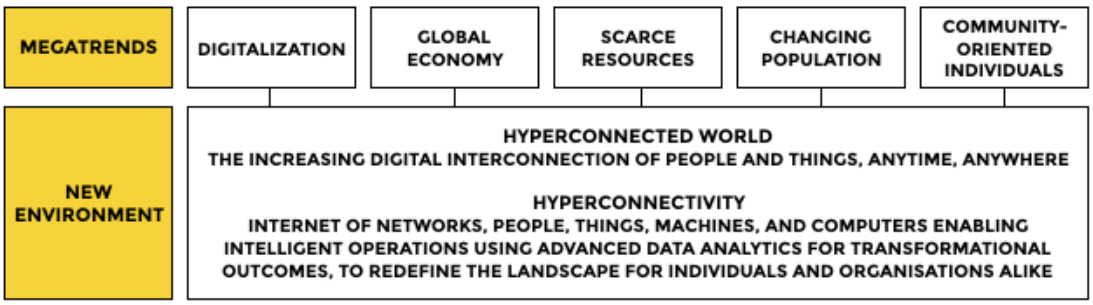
The way these are shown in the study is first discussed from the point of view of main findings and theoretical contribution and after that through the more practical point of view on the managerial implications section. These conclusions and discussion points are looked individually in their respective sections to describe their meaning in detail, where from they were drawn as well as what is interesting and useful about them.

5.1. Main Findings and Theoretical Contribution

5.1.1. Definitions of the New Environment driven by Megatrends

The wide scope of the literature review in addition to the empirical findings looking at different definitions and terms lead to few conclusions on the New Environment driven by Megatrends. First, the megatrends are the drivers that shape the new environment – especially from the point of view of digitalization with Porter and Heppelmann (2014) referring the change of environment as the third disruption in IT. The whole environment can be defined by Hyperconnectivity, or referred as the **Hyperconnected World, the increasing digital interconnection of people and things, anytime and anywhere** (WEF 2015). The **Hyperconnectivity is defined through the internet of networks, people, things, machines, and computers enabling intelligent operations using advanced data analytics for transformational outcomes, to redefine the landscape for individuals and organizations alike** (edited from IIC 2015).

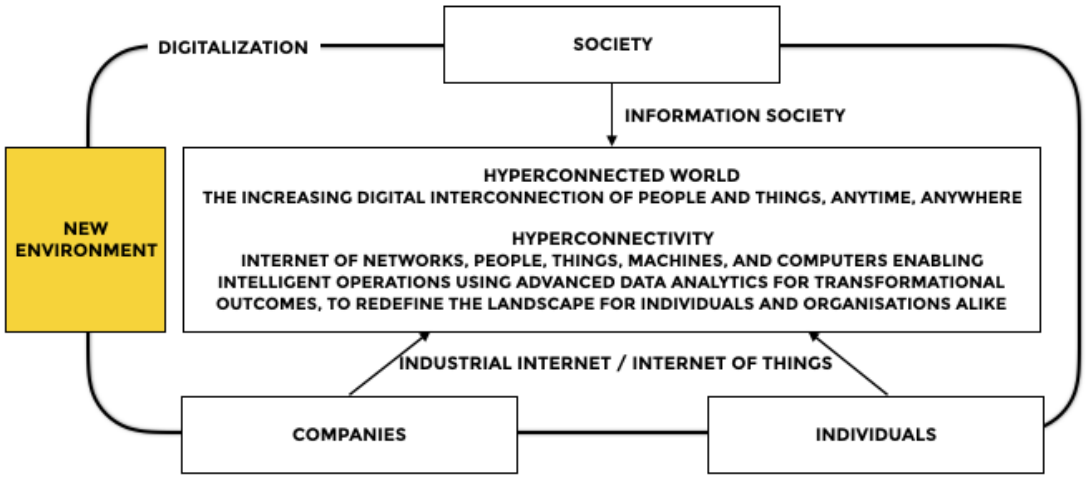
Figure 38. The Hyperconnected World driven by Megatrends



Yet, as the empirical findings of the study show and the literature review suggests, companies do not talk at all about Hyperconnected World or Hyperconnectivity. The major definitions and terms used are Internet of Things and Industrial Internet, which as stated in the literature review and confirmed by the empirical findings, describe the view point of companies to the development. Internet of Things often refers to more consumer point of view, whereas Industrial Internet towards the companies point of view – even if more classification of companies could be discussed to be made on whether the company

provides only B2B customers or also B2C, which are more inclined to use Internet of Things as more easily understood by individuals (e.g. Juhanko et al. 2015). Thus, figure 39 depicts this approach clearly – to address both the language used by companies as well forming the unified picture what is the new environment and offers new definitions for it based on the literature review and the empirical findings.

Figure 39. Information Society, Industrial Internet and Internet of Things as part of the Hyperconnected World



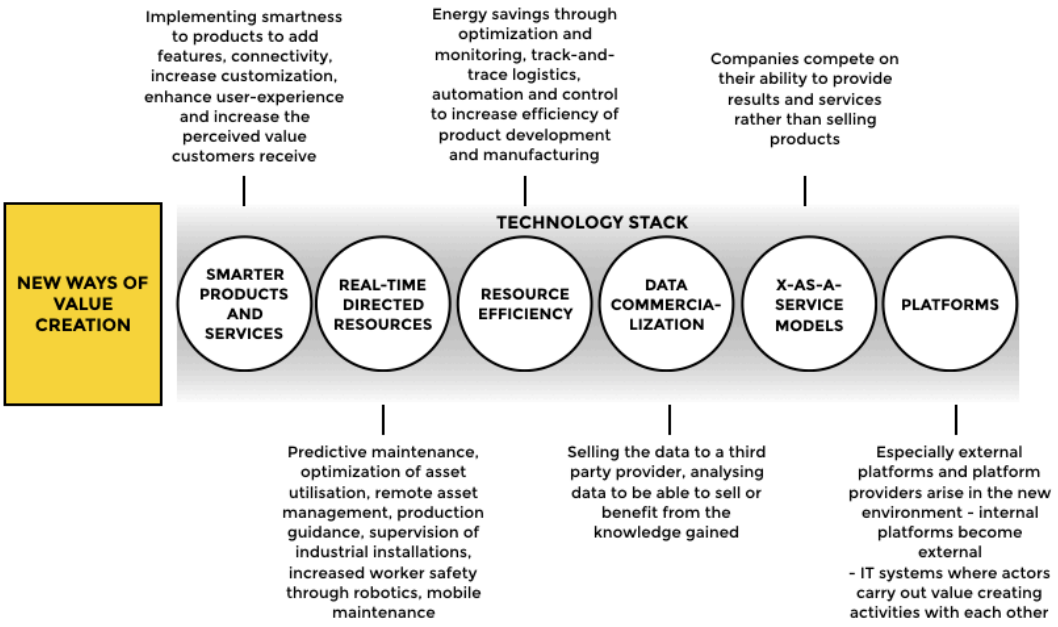
The theoretical contribution of the study is thus this: to have redefined and cleared definitions that do not have unified form of defining them among a complex field yet undefined and badly understood. The proposed frameworks and definitions give the reader the understanding of the currently used definitions, what they mean and how they relate to each other – which have been by some studies, yet unified understanding of the terms are not in place. Whether the framework proposed here is one that should be used in general can naturally be questioned, but hopefully it provides a better understanding of the field. **Essentially, all terms relate to the same development and the possibilities it offers, even if describing it from different perspectives and slightly differing terms.**

5.1.2. Value Creation through Hyperconnectivity

From the point of view of value creation and business models theory, the research only combines parts of them without many modifications considering how strategy, strategic choices are made and how business models form from value creation models. The basics of strategy, business models and value creation in principle are based on theory which is not modified or expanded beyond its scope in the research. What is different though, and where the research sheds new light is by formulating a new framework and finding distinctive categories of value creation in Hyperconnected World in addition to related opportunities of strategic choices and business development.

The main finding on the value creation models through Hyperconnectivity is the theoretical framework formulated based on the literature review and honed through the empirical findings. This framework proposes that **the underlying technology stack allows six categories of value creation that have distinguished definitions and differences, yet arising from the same technological development**. This is shown in figure 40, with the definitions of what kind of value is created through these value creation models. The technology stack is not discussed in-depth on this study as it was deemed to be too wide of a scope to be able to construct research on it as well even if the descriptions show what the technology stack allows for companies.

Figure 40. The Six Value Creation Models and the underlying Technology Stack



There have been many studies mapping out the field of value creation through Hyperconnectivity. Yet, the theoretical framework comprised here is new and unseen, even if a simplification of a complex world with complex technologies.

What the empirical findings and used examples also support that the value creation models have clear synergies and companies rarely only use one, but rather try to combine many of them into their business models. In fact, some of the value creation models are even requirements for something else to happen, as we saw for example in the case discussed throughout the study (Cargotec, Kone, Enevo etc.) **The synergies between the value creation models show, that to really benefit from the development, it might be more important for companies to address the development holistically, try to understand its different areas and how they link together rather than focusing on one area only**. This could be researched even further and hypothesized that the value creation models in fact depend on each other and are just forming, or are part of some new form of value creation that will arise in few years. For example, the way that data is gathered and how the field is organized is still not yet standardized, resulting a variety of

applications that compete with each other (Vermesan & Friess 2013). The race is on for example over the industry standard on 5g-networks between large companies such as Nokia, Ericsson, and Samsung (Image 2016). Whomever comes up with the dominant design and first standardizes the industry will reap the largest benefits as a company, but what is more interesting is how the standardization will affect the society and the way companies work entirely in the long run.

5.1.3. Strategic Development Focus

From strategy development focus and its relation to value creation models, the research proposed a classical growth vector matrix edited to apply to the context to be the basis of understanding value creation models and strategy. Yet, as the strategic framework itself was applicable to the research and showed some interesting conclusions to be drawn, the proposed relation of the strategic framework of each value creation model was proved to be not very useful. This was shown in the combination of the classic Growth Vector matrix with recent literature on value creation through industrial internet (figure 13 on section 2.3.2., Ansoff 1965, Juhanko et al. 2015).

Considering that the framework highlighted the focus of the new technologies on either new markets or new products or both, hypothesis can be drawn that as an emergent market, the actors and technologies are so new that they are perceived as new opportunities to challenge industries themselves and most companies see the opportunities as something new and disrupting. In addition to these characteristics, it can be hypothesized rather than using the classical strategy frameworks that seemed not to work so well, an approach from of the Blue Ocean Strategy (Kim & Mauborgne 2005) could be applied better to the context – yet this would call for additional research so that theoretical conclusions could be made out of the strategic literature and its application on this specific context.

Clear problems related to the Growth Vector matrix arise if looked at the perspectives that different companies can have and the development of R&D currently, which calls in questions if the framework should be just ditched. The discussed perspective matters of

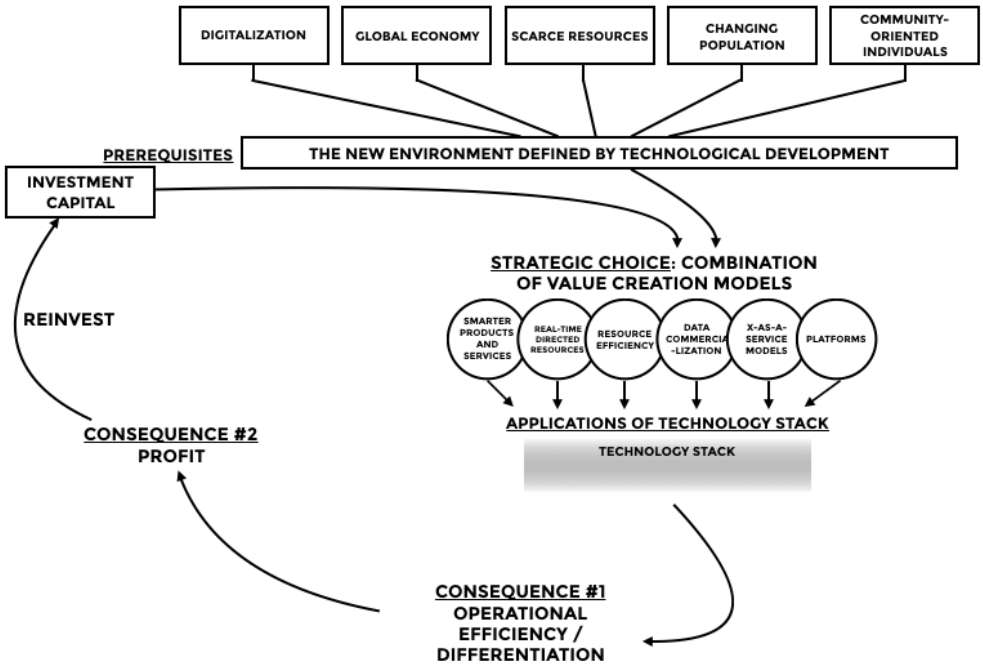
strategic focus areas describe the problems with the use of the framework and give a hint that in the current day and strategic thinking, maybe more advanced frameworks could be applied.

Relating the value creation models to the strategic areas seemed not to be proved by the study and the companies did not certainly adhere to the strategic framework proposed. This was probably due as the field is so new and the development of the different tools shake up the environment so much that the old markets and old products are so transformed that they are not distinguishable as what they were before.

5.1.4. Strategy, Value Creation and Virtuous Cycles

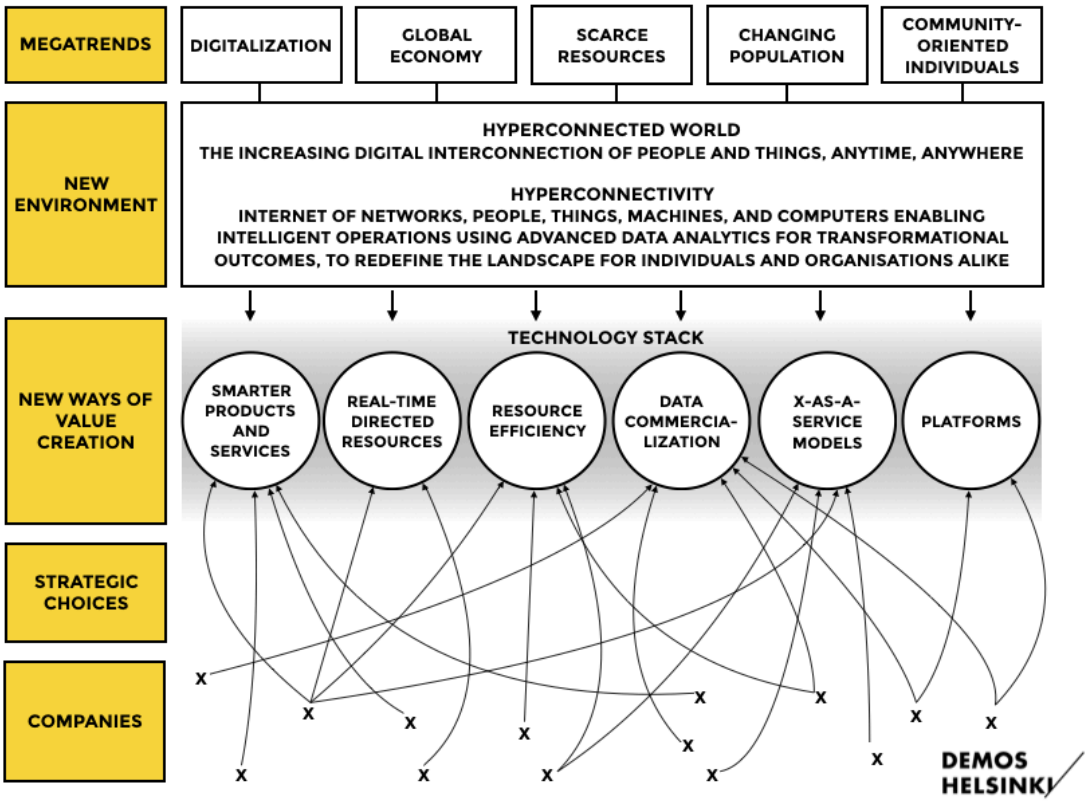
As one of the main theoretical contributions of the study, a combination of strategy, value creation models and virtuous cycles in business models was done. This was formulated by combining the thinking through understanding strategy and business models through choices and consequences (Casadesus-Masanell & Ricart 2009 and 2010), implementing the understanding to the arising value creation and creating virtuous cycles to form a figure of virtuous cycles related to the value creation through Hyperconnectivity. Thus, the main theoretical contribution was to apply the literature review theory to the context of the research as well as to understand the drivers of strategic choices underlying in the megatrends driving the development of the world (figure 41). This theoretical contribution is thus interesting as there are not too many studies that apply the framework and understanding of Casadesus-Masanell and Ricart (2009 and 2010) further to different fields – even if a simplification rather than extensive case research was done in this study.

Figure 41. Virtuous cycles through Hyperconnectivity



5.1.5. The Big Picture and Link to Sustainability

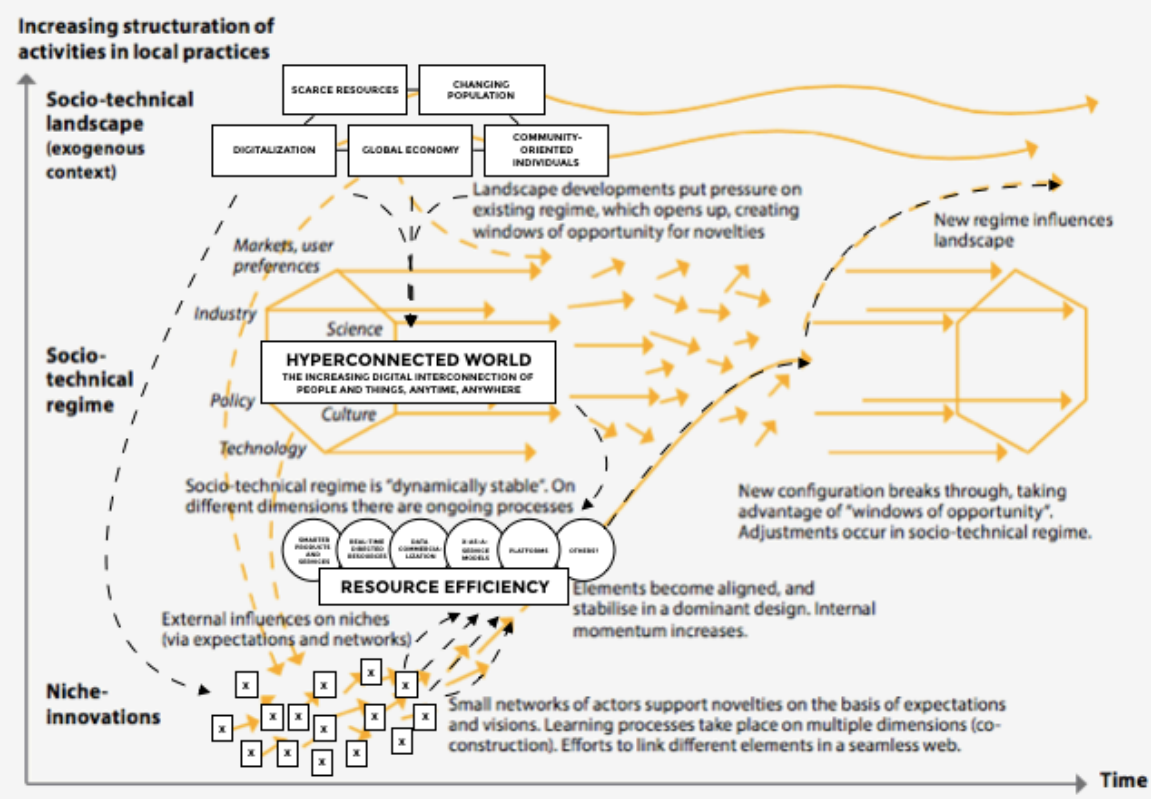
Figure 42. The Big Picture



One of the main theoretical contributions of the research was to map out **the big picture of the whole development area, spanning from the driving megatrends, to the definition of the new environment, what kind of opportunities it creates to understanding the strategic choices of the companies**. The construction is as such a unique way to look at the development in this particular context, and offers a framework and way to pick out further research topics as well as looking at the situation at the moment. It also gave out snapshots of the Finnish companies ecosystem that are benefitting from the development and some ideas what kind of companies in Finland are in the field, yet in this further research and comparisons with other geographical areas would be needed to understand the main distinguishes qualities of the Finnish ecosystem in terms of the global development.

As for the one of the most interesting discussion points arising around sustainability, earlier was discussed the sustainability understood as environmental efficiency in the value creation models. Yet, **the theoretical framework opens also the discussion that how the megatrends do affect the development in the long term and what will be the impact of them in shaping where the environment and the value creation models are used.** This could be further taken into the context of how Geels (2011) describes the socio-technical change (show in figure 43). In short, this means that to understand the larger context and the role of an organization to create value in the long term, the ways to do this must be chosen in the light of the larger development driven by megatrends and the changing regime.

Figure 43. The Big Picture adapted to Geels (2011) "Describing the role and change of socio-technical regime"



In theory, the study did not research this point of view further than the understanding of the megatrends how they are understood as affecting our world and discussing their relation to the regime level change and how the megatrends affect niche innovation. Yet, this opens up the question of what kind of development and strategy is wise and relevant, especially when looked at from the practical point of view of decision-maker in the managerial implications of the study.

5.2. Managerial Implications

The findings of the study and theoretical contributions form the base for the managerial implications and conclusions drawn in the sections below. The most interesting questions seem to arise, not only from what the results show, but also from the points of discussion and suggestions for further studies made along the way.

5.2.1. Definitions of the New Environment driven by Megatrends

To have defined the field such as presented the on section 5.1.1, the research has clear practical implications for managers and anyone discussing, interested or wondering about the development. **The practical implication naturally being that to have defined a common language for the whole field, it is easier for people to discuss about the development from different points of view**. The framework and definitions also provide framework to look at and use as a reference point when something is unclear related to the development. The practical implication of finding new language where to frame the discussion and how to use the terms could be a major practical implication, but whether majority of people will understand the development in the same way as here can of course be called to question.

Another major viewpoint is to look the new environment through the megatrends that drive the development. To understand the drivers that affect the world in the long term is a requirement for anyone whose work relates to strategic planning and by describing the development of digitalization and other megatrends, the shaping of the new environment and what possibilities it can offer are more easily revealed. This is especially in relation to the strategy, value creation models and sustainability, which are discussed in the later sections of the managerial implications.

5.2.2. Value Creation Models through Hyperconnectivity

From the viewpoint of decision-makers in companies, to understand the realm of possibilities through **the framework that describes the options through six different, coherent value creation models offers a way to be able to identify choices**. The six value creation models offer a realm of clear opportunities that can be used by the companies to benefit from the development, apply it to their own context and understand better. Even if, somewhat macro-level descriptions of how value is created, the examples in the research should provide managers also with clear ways to apply the thinking to

their own context, thus helping to understand what this development means for them and their company's future.

In addition to the framework, the study revealed through the **case examples discussed on the literature review as well as the later on the empirical analysis a lot about the nature of value creation in the field.** What was found that these value creation models and many companies do not only use one, rather look for a combination of areas that support each other. These combinations can be formed with the emphasis on different parts of the identified value creation models and it could be even hypothesized that the list of six value creation models are the key ingredients of value creation in the field in the future. The value creation models clearly have synergies between them and understanding the development holistically by understanding the right combination of the value creation models in each company's context might be the key to benefit from it the most. **This opens up a discussion for managers in their respective businesses or business areas that what are the most interesting value creation models to your company, what are currently in use and what could be implemented to support and develop the business further?** Also, another point would be that considering that the study only was focused on the present best practices, it lacked real visionary understanding what can be – often the most interesting question for companies that plan for further than the next quarter.

5.2.3. Strategic Development Focus

The most practical implication of the findings for strategy developers and where the focus of strategic development lies in the new environment is hardly a breakthrough thinking. After all, technological development opens up new possibilities, for any part of Growth Vector areas, but especially for new markets and/or products – for the companies to be able to do things more efficient, but also in totally new ways. Understanding where the real growth and potential is, is vital for anyone looking to benefit from the development.

From this, a practical managerial implication can be drawn and recommendation be formulated: **companies should seek what kind of possibilities the development offers**

in their context and if possible, focus on either creating new products, take the current products to new markets by adding functionalities in them or create new products for new products. These are the focus areas where the biggest potential can be found. By it's nature, smart solutions offer new ways to create value and as an emergent market, the first-mover benefits are large as the whole field has not yet experienced a vast standardization as discussed earlier (Vermesan & Friess 2013).

5.2.4. Strategy, Value Creation and Virtuous Cycles

The relationship between strategy, value creation models and virtuous cycles is one of the most interesting discussion point arising from the whole research. When the concepts were applied this way, it offers decision-makers a new framework to look at both strategy, their own business model and the sources of value creation that drive their business – in the context of the driving forces of the world in megatrends.

The practical contribution of the framework (figure 41 on section 5.1.4.) is that it offers **new perspective to thinking of development of business**. In addition, it provides a strategic framework that can be applied to the companies own context – thus being useful in developing business, not only in the context of Hyperconnectivity and technological development, but considering strategic planning at large. The framework shows direct options, the decision points and the nature of relativity between choices and their consequences – thus in its simplification adding a way of thinking to strategic planning and business development processes.

5.2.5. The Big Picture and Link to Sustainability

The managerial implications of findings and information provided related to the Finnish Ecosystem of companies is, if nothing else, showing that there is a lot happening in the field and many companies of any different sizes are benefitting from the development. How the ecosystem in practice works and how it could be developed to direct and hustle the development at large in Finland and among Finnish organizations are interesting questions to consider.

Another very practical point of view is that how the development in general links with sustainability as it is directed by the megatrends that shape our world. The question then is: if one understands the whole big picture and the implications of the megatrends, are the only viable options for any organization in the long run to apply any kind of value creation, strategy or business model in a way other than being more efficient in terms of resources than what is currently in use? From the understanding gained from the study, authors personal response would be yes, as the humanity itself is facing with many yet unsolved problems that are directly related to our survival as a species. **As the challenges related for example climate change, resource scarcity and population growth are understood, the organizations that create and operate our everyday lives must change so that they account for the solving of these problems at the same time, when they fulfil our daily needs.** So the conclusion being, that if one understands the big picture, the only real option for organizations in the long run is to apply any kind of value creation, strategy or business model in sustainable way. Of course, further research could be done is this in principle true in the long run and whether sustainable development is in fact inevitable, yet this was more than this research could reveal as a discussion point.

This leads to the major practical implication on current day strategy that rises from understanding the big picture. Considering the development of our world the nature of companies can not just be that they make profits for their owners, but rather that they in doing so, solve the worlds biggest problems. This is probably the more philosophical discussion that surrounds the topic, the big picture and our current world.

So author's personal note for any decision-maker would be that considering what we know of our world, one should apply long-term thinking and global perspective to your own context, apply the framework in practice, find the right combination of strategy and value creation models and hope that your decision lead to a better world. This discussion could be taken even further as a step of action points, which is a fitting end for the thesis – at least on author's personal opinion.

So what now? You are responsible of your company's strategic development, but how would you address everything from your point of view – what you should do?

1. Look at the megatrends – understand what are the most important in your context and how they shape your business environment. Pay attention to their effects at large, for example what kind of business models will be acceptable in the future and what will not be.
2. Look how the competition changes and the environment changes through the new technologies – understand what this means to the competitive environment and position you are in.
3. Look few decades further in to the future and try to understand how the megatrends and technological development will shape the competitive environment – understand how you can react and shape your current day strategy in relation with this
4. Use the frameworks provided and understand your current situation, business model, virtuous cycles in your business model, your strategy and where you create value for your stakeholders as well as what are the development possibilities in these
5. Use the frameworks to understand the possibilities of strategic choices and pick the right ones for your context out of the mapped possibilities
6. Do it and create value in sustainable way. Use the frameworks to communicate to larger audiences both internally and externally about the change you see as important in driving your business to the right direction.

5.3. Evaluation of the Study

The study is evaluated by discussing about the validity and reliability of the study as well as discussing the limitations of the study.

5.3.1. Validation and Reliability of the Study

Validation of the study was done by looking at construct validity, external validity and internal validity as well as reliability according to the criteria developed for general business research (Ghauri & Kronhauq 2005).

The construct validity is the degree to which the actual description holds true, theoretical validity in a sense (Ghauri & Kronhauq 2005). What is looked to estimate the construct validity are the conclusions related to the definitions of the environment, the big picture as a whole, the virtuous cycles of value creation and value creation models more specifically themselves. The constructs developed and honed were, according to the results and supporting literature review understood properly and the framework itself describe from a perspective how things are at the moment. One aspect of the constructs was understood quite wrongly, which was the definition of different value creation methods to certain strategy development focus areas, but it also gave an interesting insight for further research despite some assumptions being made without enough supporting evidence based on the literature review.

Internal validity can be looked how the constructs include causality and are understood to produce simple and easy-to-use constructions (Ghauri & Kronhauq 2005). Thus, the internal validity of the study is mainly formed through the understanding of the relationships between business models, strategy and value creation. As the study itself was not heavily in constructing many internal sources of causality. Based on the examples used, the frameworks were applied in a way that also describe reality at least in theory – whether the frameworks would be beneficial in real life would require more testing and applying to different cases.

External validity can be looked through how interpretative the study is, how generalizable are the results and how the theory actually supports the interpretation. When looking at the framework, the literature review and the empirical analysis, a conclusion can be drawn that on a certain perspective, the interpretation supports the current knowledge in the field and adds into it. The results are generalizable only to some extent due the small

sample size, yet they still offer a fresh perspective to look at the development. The theoretical parts also support the interpretation made.

Reliability of the study is tested through understanding how generalizable and repeatable the research process is. The research process itself can be applied to different context, yet with the macro-level approach, it has to be understood as such and applied as such. The framework itself could be applied as well as repeated in this and other context as well. It could also be repeated as such, with providing same statistical measures and with same results. Naturally, there are some interpretative parts in the study, where decisions of the frameworks are not made based on numbers, but rather on the perspective of the author and as described earlier – the research philosophy of interpretivism certainly can always affect the results somehow. This, and the other many limitations are discussed in the next section.

5.3.2. Limitations of the Study

The limitations of the study have been discussed throughout the whole process, yet here are all of the main ones put discussed on separate paragraphs.

First, there are some limitations related to the nature of the study. Even if quantitative methods are used, both exploratory and explanatory aspects of research add to the complexity of the process and the lack of some mathematical functions used, such as correlations for example. The data itself was not considered to be very detailed to make very extensive numerical analysis, thus even if some done in the study, these are not considered to be representative of the whole Finnish ecosystem of companies – rather used just to give the reader new perspectives. Considering the relatively straightforward approach of standardized data analysis, the lack of larger sample and more advanced numerical analysis was only a minor limitation of the study.

Some issues arise from the simple method of data collection. Primary data was collected through online-survey, which has its own disadvantages as discussed earlier. The largest limitation on this point of view being of course not having the possibility of being able to

comment, clarify and explain any of the sections and questions of the survey. In addition, depending on the person, whom respondent on the survey and their knowledge, it might have been hard for especially the respondents of larger companies to understand all aspects of business. In practice, this could have meant that people were not aware of all aspects of their business. For example, even if an anecdotal one, there were two companies from which two persons answered the survey. In these cases, there were minor differences in the answers, showing that strategy and value creation are also a matter of perception as well as showing the disadvantage of online-survey and the limitation it brings on understanding concepts it is about.

Another limitation was that the study set some boundaries in it, through the theoretical framework created and used as the basis of the survey. Due this, there is a possibility that the survey and the research has missed something relevant to the companies' value creation models in this field. Limitation come also through the fact that the study did not go deeper into the value creation models than macro-level categories. Behind these macro-level value creation models is a huge amount of, in this context, technological tools such as sensors, network connectivity, software and hardware. This clearly poses a limitation on what level these value creation models can be understood and even if technology stack is mentioned in many places in the study, its further research and combination to the value creation models was not in the focus of this research – and should probably be done by someone more advanced and skilled in the technological areas of the field than the author himself.

Sample and primary data had its limitation in size as well as the focus of the companies being only the forerunners in the field – in this not being a representative sample of any certain industry. Sample also has many different types of companies and for example the analysis is not made based on the industry sector of the companies, which of course limits how representative the results can be taken for each individual industry. For example, focusing only on manufacturing companies or IT vendors could have been possible to form more precise understanding of the field. Similar approach could have been also introduced regarding the company sizes by focusing only on certain size(s) of companies.

Yet, to understand the development at large the research approach was chosen to be this, even if acknowledging its limitations. Primary and secondary data differed from each other and only primary data was used in some questions (which are discussed whenever the question was analysed). This clearly offers a limitation to the analysis of those questions, thus resulting in worse representativeness or even the lack of it.

As the research was focused on specific theoretical framework to discuss this specific issue, its transferability to other contexts can be called to question. A rough framework could be transferred in the way of searching value creation models among a certain development, yet the frameworks' contents would have to be researched on their own. In general, the research approach can be adjusted and transferred to a different context, if the aim of the research would be similar as in this one.

By fixing a certain framework and testing it, the research is very much focused on the current applications and the best practices of the field at the moment. As an emerging market and novel field, this poses a limitation what could have been missed by the study. There are ways the technological development benefits companies that will emerge and most likely will be totally different from the ones described here – something that was not on the focus of the study, but does pose interesting questions for further research.

Researcher bias, if any, was pointed out earlier when discussed about the research philosophy and the approach of interpretivism. I as a researcher understand social contexts like the business world to be always interpreted through the lens of the researcher and this is also the understanding of how I approached this research. Whether this offers any more bias than any researcher has towards their topic, I leave that to be on the judgment of the reader, even if I have tried to remain as unbiased as possible. Considering the data and how it was analysed, similar results would be expected by other researchers if looked at the development from the same perspective.

There was no large language or cultural barriers that affected the study. Language was considered not an issue even if the survey was conducted in English, as most Finnish

people have good skills in English. On the other hand, there might have been some people whom have not answered the survey because of the language, which might have gone unnoticed by the researcher. No cultural barriers were in place in this study as the digitalization field itself is global as well as the focus and sample was on Finland and Finnish companies.

5.4. Suggestions for Future Research

As the last section, some suggestions for further research are discussed, even if these have been mentioned and revealed already throughout the thesis. Most of them relate to the development of Hyperconnected World and Hyperconnectivity, but some also to testing the framework in different contexts as well as applying it and taking it further.

First, the whole framework proposed and the different value creation models could be tested with further studies. In addition, if more in-depth look of the value creation in the field would be in the interest of someone, for example case studies and interviews on the best practice companies could be in order to reveal more about the developing field.

The value creation models themselves open up many further research questions. For example, their nature and what they can offer could be studied separately and in-depth as well as the technology stack itself (and studies on all of these are in fact in progress, even if not based on the frameworks presented here). For example, just looking different kinds of platforms and what does the external and platform providers do, not for only shaping the value creation, but for the society at large poses an interesting research question that could be studied in the future. Also, the applicability outside of the context of companies to any organization could be interesting topic to study further on as public sector is also among one of the major actors that will benefit from the development (IIC 2015).

On the other hand, further research topic could be the synergies between the value creation models, what are the most successful combinations and how they relate to each other. Considering the big picture, the combinations with resource efficiency models and

all other five identified sources as well as the unidentified group of other value creation models.

By fixing a certain framework and testing it, the research also was focused on the current applications and the best practices of the field at the moment. As an emerging market and novel field, more studies could be done to the new ways how technology shapes the value creation in the future – something this study itself could not reveal. It could be hypothesized that the identified ways of value creation are merely just defining the requirements what all organizations use in the future, not actually showing strategic options, but the defining characters of all value creation in few years.

More studies could also be done about the differences between geographical areas. Finnish ecosystem is alive and kicking, yet this study offers little to represent about the nature of its qualities compared to other areas – or how well advanced Finland is in the first place. What should be done in Finland and what should not be done in Finland is for example very concrete problem that companies are facing and have to decide on with little studies done on it.

On the other hand, when thinking of strategic decision-making, more applied strategy studies could be conducted in the context of the research. Some hints of the traditional strategy frameworks applicability in the field were acquired, but more studies with more strategic approach to the context would shed light on more practical level of the possibilities and development paths available for managers. Applying the frameworks of strategy, value creation and virtuous cycles – despite being an insightful theoretical framework here – were not taken very far in the context and more research would definitely be interesting relating these concepts to Hyperconnected World.

Lastly, technology's role in creating more sustainable world and more sustainable ways to create value and wellbeing is a development and research path that should be continued to be studied on author's personal opinion. In the world of constant, rapid change, to be able to built flexible systems that sustain human societies is important –

especially in the context where we live today with the driving megatrends being what they are. To understands the long term implications of the change would be in order to be able to create more sustainable ways to create value – an area where research could help to boost the actual development to be faster.

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In addition to the listed references, data was gathered from primary sample company websites, but the list is anonymous as chosen by the participants. For empirical research, the survey data and the Slush participant data was used as well.

APPENDICES

Appendix 1. List of identified ways of business model value creation elements through Industrial Internet and Internet of Things

VALUE CREATION MODEL	STRATEGIC BUSINESS AREA	SOURCE	CATEGORY OF VALUE CREATION BASED ON ANALYSIS
Creation of new markets	New business	Ailisto et al. 2015	Other
Commercialization of data analytics	New business	Ailisto et al. 2015	Data Commercialization
From product sales to x-as-a-service models	New business	Ailisto et al. 2015	X-as-a-servide models
Commercialization of data analytics	New business	Juhanko et al. 2015	Data Commercialization
From product sales to x-as-a-service models	New business	Juhanko et al. 2015	X-as-a-servide models
Cloud services	New business	Juhanko et al. 2015	Other
Create new renevue streams through new products and services	New business	WEF 2015	Smarter Products and Services
Platforms	New business	Porter & Heppelmann 2014	Platforms
Platforms	New business	WEF 2015	Platforms
Outcome economy	New business	WEF 2015	X-as-a-servide models
Smart, connected products, services, platforms	Increasing turnover	Ailisto et al. 2015	Smarter Products and Services
Increasing the experienced value received by customer	Increasing turnover	Ailisto et al. 2015	Smarter Products and Services
Creation of new demand	Increasing turnover	Ailisto et al. 2015	Smarter Products and Services
Enhance customer experience / Increasing the experienced value received by customer	Increasing turnover	WEF 2015	Smarter Products and Services
Smart, connected products, services, platforms	Increasing the value of current products	Juhanko et al. 2015	Smarter Products and Services
Connected platforms	Increasing the value of current products	Juhanko et al. 2015	Platforms
Mobile maintenance	Increasing the value of current products	Vermesan & Friess 2013	Real-time directed resources
Automation and control	Increasing the value of current products	Vermesan & Friess 2013	Real-time directed resources
Real-time directed resources	Increasing performance of current operations	Ailisto et al. 2015	Real-time directed resources
Efficiency of product development and manufacturing	Increasing performance of current operations	Ailisto et al. 2015	Resource Efficiency
Energy savings	Increasing performance of current operations	Ailisto et al. 2015	Resource Efficiency

Efficiency of product development and manufacturing	Increasing performance of current operations	Juhanko et al. 2015	Resource Efficiency
Energy savings	Increasing performance of current operations	Juhanko et al. 2015	Resource Efficiency
Decrease of tied up capital	Increasing performance of current operations	Juhanko et al. 2015	Other
Predictive maintenance / real-time directed resources	Increasing performance of current operations	Juhanko et al. 2015	Real-time directed resources
Systems collaboration	Increasing performance of current operations	Juhanko et al. 2015	Other
Optimize asset utilization / real-time directed resources / predictive maintenance and remote asset management	Increasing performance of current operations	WEF 2015	Real-time directed resources
Reduce operational costs / efficiency of product development and manufacturing	Increasing performance of current operations	WEF 2015	Resource Efficiency
Improve worker productivity	Increasing performance of current operations	WEF 2015	Real-time directed resources
Enhance worker safety	Increasing performance of current operations	WEF 2015	Real-time directed resources
Improve sustainability / energy savings	Increasing performance of current operations	WEF 2015	Resource Efficiency
Logistic applications / track and trace	Increasing performance of current operations	Vermesan & Friess 2013	Resource Efficiency
Production guidance	Increasing performance of current operations	Vermesan & Friess 2013	Real-time directed resources
Supervision of industrial installations	Increasing performance of current operations	Vermesan & Friess 2013	Real-time directed resources
Energy optimization and monitoring / energy savings	Increasing performance of current operations	Vermesan & Friess 2013	Resource Efficiency
Tied up capital and investment needs change	Balance implications	Ailisto et al. 2015	Other
Intangible assets value	Balance implications	Ailisto et al. 2015	Other
Balance value of data	Balance implications	Ailisto et al. 2015	Other

Appendix 2. The list of all Finnish Industrial Internet Forum members listed on their website 17.12.2015.

1	3 Step IT Group Oy	120	Laurea University of Applied Sciences
2	3DTech Oy	121	Lewel Group Oy
3	65 Security Oy	122	Lukoton Experience Oy
4	Aalto University	123	Lunni Oy
5	Aalto Ventures Program	124	Luonnonvarakeskus (Luke)
6	ABB Marine Oy	125	Maatalouden Lasekentakeskus Oy
7	Absent Oy	126	MacGregor Finland Oy
8	Accenture Oy	127	M-Components Oy
9	Adminotech Oy	128	Metropolia
10	Aeronos Oy	129	Microsoft Oy
11	Affecto Finland Oy	130	Midagon Oy
12	Agiler Oy	131	Miktech Oy
13	Aidon Oy	132	Ministry of Transport and Communication
14	Aikumo Oy	133	Miradore Oy
15	A-Insinöörit Oy	134	Montoma Oy
16	Ajat Oy Ltd.	135	Moonsoft Oy
17	Ambientia Group Oy	136	Murata Electronics Oy
18	Analytics Cloud Oy	137	myinfomonitor
19	Arctic Power	138	Neste Oil Oyj
20	Avarea Oy	139	Nestholma Oy
21	Avexor Oy	140	Nixu Oyj
22	Avoin.Systems	141	No Emission Monday Oy
23	BaseN	142	Nodeon Oy
24	Bero Innovations	143	Normet Oy
25	Bilot Consulting Oy	144	Nortal Oy
26	Bittium Wireless Ltd,	145	Nortio Consulting
27	Bofo Solutions Oy¨.	146	Novotek
28	Bookndo	147	Oliotalo Oy
29	Boyden Oy	148	Orange Business Finland Oy
30	Cap Data Solutions	149	Oulun Ammattikorkeakoulu Oy
31	Cargotec Oyj	150	Oy Halton Group Ltd.
32	CGI Suomi Oy	151	Oy Santa Margarita Ab
33	CLEEN Oy	152	Oy Testant Ab
34	CleWorks Oy	153	Padio Oy
35	CLS-Engineering Oy	154	Patria
36	Codenex Oy	155	PCC StroyServis
37	Collapick Company Oy	156	Pesmel Oy
38	Confidex Oy	157	Petrozavodsk State University
39	ControlThings Oy Ab	158	Planmeca Oy
40	Creole Oy	159	Plaza Consulting Oy
41	CSC - IT Center for Science Ltd /	160	Ponsse
42	CSC - Tieteen tietotekniikan keskus Oy	161	Pooki Oy
43	Cybercom Finland Oy	162	Potra-NIS Oy
44	CyberLightning Oy	163	Process Genius Oy
45	Data Rangers Oy	164	Production Software Finland Ky
46	Datapultti Oy	165	Prosys PMS Ltd
47	Devoca Oy	166	Quva Oy
48	DIGILE	167	Ramentor Oy
49	Digitalent Oy	168	Raute Oyj

50	DLO Productions	169	Rejlers Oy
51	Easy LED Oy	170	Remion Oy
52	Eatech Oy	171	Residentia Oy
53	Eaton Electrical	172	Roima Intelligence
54	Econocap	173	Santa Monica Networks Oy
55	Eficode	174	sara media Oy
56	El-Brix Oy	175	Saranen Consulting
57	Elinkeinoelämän Keskusliitto EK	176	Sarlin Oy Ab
58	Elisa OyJ	177	Savonlinna Works Oy
59	Enfo	178	SC5 ONLINE
60	Epec Oy	179	SC-Research, Vaasan yliopisto
61	Espotel Oy	180	Seinäjoki Universtiy of Applied Sciences
62	Esri Finland Oy	181	Siemens Osakeyhtiö
63	Etsimo Oy	182	Simanalytics
64	Exertus Oy	183	Softability Group Oy
65	EY (formerly Ernst&Young)	184	Solita Oy
66	Fastems Oy Ab	185	Solteq Oy
67	FiCom ry	186	Sova 3d
68	Ficonic Solutions	187	Sovelto Oyj
69	Fimecc Oy / MemsCat program	188	SpectraCloud
70	Fingertip Ltd	189	Spellpoint
71	Finn Electric Oy	190	Spinverse Group
72	Finnsea Oy	191	Stera Technologies Oy
73	Fortum Oyj	192	StoneCrew Ltd
74	Fujitsu Finland oy	193	StormCloud
75	Gateway Technolabs Finland Oy	194	Sweco Industry Oy
76	Glaston Finland Oy	195	Taganize
77	GlobalSign Ubisecure	196	Tamlink Oy
78	Good Sign Oy	197	Tampere University of Applied Sciences
79	Gordionpro Oy	198	Tampere University of Technology
80	GreenLab Finland Oy	199	Tana Oy
81	HAAGA-HELIA	200	Teamit Oy
82	Hanken & SSE Executive Education	201	Technia PLM Oy
83	HEC Oy, Ceccom IoT	202	Technion Oy
84	Helsingin Radiopalvelu Tmi	203	Tekes
85	Hermia Group	204	Teknologiateollisuus ry
86	Huurre Group Oy	205	TeliaSonera Finland Oyj
87	Hydroline Oy	206	TestLab Oy
88	Ibisense Oy	207	The Local Word S.r.l. Finland
89	Idean Enterprises Oy	208	The Nordic Frugal Innovation Society ry
90	IGL-Technologies Oy	209	THTH ry
91	Innofactor Oyj	210	Tieto Industrial Internet
92	Innopinion Ltd	211	TIVIA Tieto- ja viestintätekniikan ammattilaiset
93	Invest in Finland	212	Tosibox Oy
94	IoE Finland Oy	213	TreLab Oy
95	ionSign Oy	214	TTY, Kone- ja tuotantotekniikan laitos
96	IT department, University of Turku	215	Turku University of Applied Sciences
97	ite wiki Oy	216	UK Areena
98	ITS Finland	217	Unigraf Oy
99	Iwa Labs	218	University of Oulu
100	Ixonos Oyj	219	University of Tampere
101	Jalecon Oy	220	University of Vaasa/SC-Research
102	John Deere Forestry	221	UPM
103	Joppl Oy	222	Uponor Oyj
104	K. Hartwall Oy Ab	223	Vacon

105	Kajaani University of Applied Sciences	224	Vaisala Oyj
106	Kaltio Technologies Oy	225	Valaquanta
107	Kemppi Oy	226	Valopaa Oy
108	Kii Oy	227	Valuemotive
109	Klinkmann Oy	228	Wapice Oy
110	KONE Oyj	229	Verkotan Oy
111	K-Patents Oy	230	Viima Solutions Oy
112	Kuopio Innovation Oy	231	Vilike
113	Kyberias Oy	232	Wirepas Oy
114	Kymenlaakso University of Applied Sciences	233	VTT Oy
115	Kymenlaakson Ammattikorkeakoulu	234	YIT OYj
116	Lahden 4G-Service Oy	235	Youredi Ltd
117	Lapioworks Oy	236	ZigSys Oy
118	Lapland University off Applied Sciences	237	Åbo Akademi University
119	Lappeenranta University off Technology		

Appendix 3. The survey used for primary data collection and the introduction email for it.

Dear recipient,

We at think tank Demos Helsinki are surveying FIIF member companies for Tekes strategic research opening "The Naked Approach- Nordic perspective to gadget-free hyperconnected environments". To accelerate the development of frontrunner markets in Finland, we are focusing our current research on the best practices and business development on the field.

The research will provide valuable information about Finnish companies approaches to implement and ways to benefit from technological development. We will send you the results after the analysis.

Answering the survey takes 3 minutes. The answers are anonymous. Open the survey from this link http://goo.gl/forms/kTybBvQsCg!

Thanks for participating and helping out!

THE NAKED APPROACH

A Nordic perspective to gadget-free hyperconnected environments

DEMOS HELSINKI

FIIF Members Technological Development in Business -Survey

This survey is about companies ways to develop their business through "SMART SOLUTIONS". These mean the opportunities that electronics, software, sensors, data and network connectivity offer to companies.

The research will provide valuable information about Finnish companies ways to benefit from technological development. You will be briefed about the results once they are analysed. Research is part of Tekes strategic research opening "the Naked Approach".

Answering the survey takes 3 minutes. The answers are anonymous. If you have any questions regarding the survey, please contact risto.latti@demoseffect.fi.

1. When you talk about the opportunities created by "smart solutions", what terms do you use?

Different terms have slightly different meanings, even if they relate to the same phenomenon. We'd like to know what do you consider the most relevant terms.

- [ ] We don't talk about these terms in our company
- [ ] Hyperconnectivity
- [ ] Digitalisation
- [ ] Internet of Everything
- [ ] Internet of Things
- [ ] Industrial Internet
- [ ] Industrial Internet of Things
- [ ] Other:

2. What for ARE "smart solutions" currently used in your company?

- [ ] We don't have any applications related to this development
- [ ] To create more efficient operations
- [ ] To increase the value of current products/services
- [ ] To create new products/services to serve CURRENT markets
- [ ] To create new products/services to serve NEW markets

3. In your opinion, what SHOULD BE the main development focus for "smart solutions" in your company?

- ( ) This development is not relevant to our company
- ( ) To create more efficient operations
- ( ) To increase the value of current products/services
- ( ) To create new products/services to serve CURRENT markets
- ( ) To create new products/services to serve NEW markets

4. At the moment, how are "smart solutions" APPLIED in your company?

Give a concrete example what kind of applications are currently in operation.

5. How are "smart solutions" IMPORTANT in your business?

Irrelevant, or Interesting, but Under

	not applicable for us	no actions taken	development	Existing business area
Making existing products and services "smart" (e.g. adding features, connectivity and enhancing customer experience)	○	○	○	○
Real-time directed resources (e.g. predictive maintenance, optimisation of assets)	○	○	○	○
Resource Efficiency (e.g. energy savings through optimisation and monitoring, track-and-trace logistics, automation and control, product development and manufacturing)	○	○	○	○
Services instead of products (e.g. X-as-a-service business models)	○	○	○	○
Commercialization of Data Analytics (e.g. using and selling data or knowledge gained from analytics)	○	○	○	○
Acting as a Platform Provider (e.g. offering platform where other companies can operate)	○	○	○	○

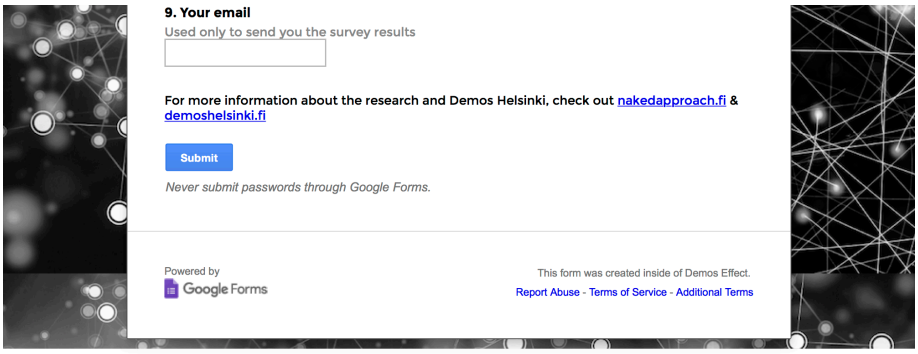
6. Size of your company

- ○ Micro-enterprise (less than 10 employees, with annual turnover less than 2 million €)
- ○ Small Enterprise (less than 50 employees, with annual turnover less than 10 million €)
- ○ SME (Small and Medium-Sized Enterprise. Less than 250 employees, with annual turnover less than 50 million €)
- ○ Large Enterprise (larger than above)

7. Your company's industry sector

8. Can we use the name of your company on the research when new business models are discussed? (Only information on questions 4 and 5)

Benefit for your company would be free publicity and helping the development of the field by spreading knowledge about best practices. If yes, please write down company name.


9. Your email
Used only to send you the survey results
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