Nina Tura

VALUE CREATION FOR SUSTAINABILITY-ORIENTED INNOVATIONS: CHALLENGES AND SUPPORTING METHODS
VALUE CREATION FOR
SUSTAINABILITY-ORIENTED INNOVATIONS:
CHALLENGES AND SUPPORTING METHODS

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Abstract

Nina Tura

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Sustainability has become a primary, global-level development target, as the need to balance economic prosperity, looking after the planet and the environment, and social equality have become more evident. To respond to their stakeholders’ sustainability demands, firms are increasingly seeking sustainability-oriented innovations that may simultaneously provide environmental and social benefits, new business opportunities and economic gains. Value creation for sustainability-oriented innovations is not easy, however, as the high levels of uncertainty and complexity in the business environment require repositioning of innovative activities, focusing on system-level impacts and balancing value creation between multiple network actors.

This study focuses on the challenges of value creation for sustainability-oriented innovations and introduces supporting methods to cope with the challenges. The study comprises multiple case studies including semi-structured interviews of informants from 29 different organizations, focus groups with 33 business experts, and content analysis of learning diaries of 17 managers with expertise in innovation management.

The study identifies challenges in value creation for sustainability-oriented innovations related to increased complexity, system-level value creation, tensions in business networks and utilization of sustainable knowledge. It also recognizes the characteristics of sustainable value creation in the novel market settings of sharing economy and platform-based economy and emphasizes the challenges of the lacking skill and capability levels of current decision-makers. The study introduces intermediate (research-based) tools and two supporting methods to cope with these challenges. Furthermore, the findings identify the importance of linking the building of different levels of dynamic capabilities to the development of sustainability-oriented innovations for system-level value creation. Based on these, the study presents also steps of a process for researchers to follow when aiming at creating research-based managerial methods to facilitate value creation for sustainability-oriented innovations. The findings guide managers to invest in collaboration and the development of specific skills and capabilities to help in coping with value creation for sustainability-oriented innovations.

Keywords: sustainability-oriented innovation, sustainability, sustainable development, value creation, innovation management, dynamic capabilities, supporting method
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Thank you, Emil Aaltosen Säätiö and Tekniikan Edistämissäätiö for providing financial support to help me on the road.

Thank you, my family and friends for believing in me.

Nina Tura
May 2018
Lappeenranta, Finland
First, think.
Second, believe.
Third, dream.
And finally,
Dare.

— Walt Disney
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List of publications

The thesis comprises an introductory part and six individual publications. The publications are listed below, together with a description of their role in the thesis and the author’s contribution to each publication. The rights have been kindly granted by publishers to include the papers in the thesis.

PUBLICATION I


Nina Tura was the principal author and investigator in the paper. The author made the research plan, collected and analyzed the data, and coordinated the research and writing of the paper. The author was responsible for the literature review, methodology and results. The analysis and conclusions were created in collaboration with the co-authors. The paper has been accepted for publication following a double-blind review of the full paper.

PUBLICATION II


Nina Tura was the principal author and investigator in the paper. The author was responsible for planning and coordinating the research process, as well as the data collection. Analyzing the findings, the writing and review process was done in collaboration with the co-authors.

PUBLICATION III


Nina Tura was the principal author and investigator in the paper. The author was responsible of the research plan, design, data collection and analysis. The conclusions were done in collaboration with the co-authors. The author coordinated the writing of the paper. The paper has been accepted for publication following a double-blind review of the full paper.
**PUBLICATION IV**


Nina Tura was the principal author and investigator in the paper. The author coordinated the research and writing process of the paper, and was responsible for the literature review and the conceptual model. Analysis, writing the mathematical model and conclusions were done in collaboration with the co-authors. The paper was published following a double-blind review of the full paper.

**PUBLICATION V**


Nina Tura was the principal author and investigator in the paper. The author coordinated the research and the writing process of the paper. The author was also responsible for the conceptual framework. The research design, data analysis and conclusions were created in cooperation with the co-authors. One of the co-authors was also involved in the data collection. The paper was published following a double-blind review of the full paper.

**PUBLICATION VI**


Nina Tura was the principal author and investigator in the paper. The author was responsible for the research plan and the writing process. The data collection, analyzing the findings and drawing conclusions were done jointly together with the co-authors. The paper was written jointly with the co-authors. The paper was accepted for the conference proceedings following a double-blind review of a shortened version of the article.
PART I: OVERVIEW OF THE THESIS
1 Introduction

1.1 Research background and motivation

Achieving sustainability is one of the main challenges of our era, affecting people from all over the world. Different organizations across various industries, including for example energy, forest, metal, food, and fashion industries, have set their targets and made agreements to reduce negative environmental impacts and enhance the birth of more environment-friendly and socially accepted solutions. Multiple regulations have been set by governmental decision-makers e.g. for waste water treatment, addressing resource scarcity and reducing emissions to the air. In addition, non-governmental organizations (NGOs), such as WWF, have set their own voluntary targets and incentives for firms and societal actors to pursue. Sustainability has become a part of corporate-, nation- and global -level strategies, and for example within the European Union sustainable development has been defined as a major development priority (see e.g. Council of the European Union, 2006; European Union, 2016).

Sustainability has gained much media attention, which has increased people’s concerns about the state of the environment, limited resources and social equity. Business organizations are seen to hold a key position in meeting with complex sustainability challenges which are driven by global megatrends, such as deeper globalization, persistent inequalities, demographic diversity, and environmental degradation (United Nations, 2013). In order to maintain the level of development and economic well-being while dealing with the sustainability crisis, there is a need for major system-level changes, radical approaches and innovations in various areas, such as sustainable energy, infrastructure, health and well-being, climate action, and responsible consumption and production (see the sustainable development goals by the United Nations, 2015). This involves reconsideration of firms’ production processes and operations, development of supporting regulations, and above all, global collaboration between firms, authorities, individuals, and societies as a whole. Special attention should be paid to new value creation sources, which means the development of new types of products, services, processes, and entire business models, i.e., more environment-friendly, socially accepted solutions with good economic performance.

The strong external pressure by various stakeholders of firms, such as customers, investors, suppliers and governmental authorities is driving firms to integrate sustainability as part of their attempts to make profits (Lozano, 2013; Whiteman et al., 2013). In addition, the internal business development motives such as the aim to differentiate themselves from others, and to create business benefits and competitive advantage (Schaltegger and Wagner, 2011) are driving firms to implement different sustainability initiatives. These include for example extensive sustainability-related strategies, environmental and safety management policies, and implementation of new technologies and operational processes. In addition to strategic changes, firms have started to look for possibilities to create new products, technologies and services to
answer the changing customer needs. For example, many forest industry companies have started to develop wood- and bio-products (such as biofuel and renewable packaging for food products) to replace non-renewable materials, such as plastics. All these initiatives rely on the attempts to create economic, social and environmental value, i.e., to develop innovations for sustainability (academic definitions for such innovations are discussed in closer detail in chapters 1.4.4 and 2.1). This study applies the concept introduced by Adams et al. (2016) of *sustainability-oriented innovation (SOI)*, which by their definition, means a company’s intentional changes to its operations, values and actions that aim at economic, environmental and social value creation. These innovations range from technologies, products and services to changes in processes and entire business models. Meeting global sustainability challenges requires moving beyond incremental improvements to radical innovations with significant impacts on markets and society.

In addition to managerial interest, sustainable development has increased academic discussion in various research and industry fields, and it has been acknowledged as one of the main drivers for business development and innovation (Nidumolu et al., 2009; Adams et al. 2016). Despite the fact that interest towards SOI exists, the development and implementation of such innovations has been relatively slow, and the private sector has made only little progress towards sustainable development goals (Globescan and SustainAbility, 2017). As the findings of a survey of the perceptions of more than 500 experienced sustainability professionals highlight, there is a need for new leadership forms, systems, business models, and redefinitions of value to support business development towards sustainability (ibid.). More research is needed to facilitate value creation for SOI.

For firms, sustainable development can open up significant new business opportunities, but realizing them requires understanding of the firms’ internal processes and knowledge base, as well as the resources and knowledge available outside the firm (Zollo et al., 2013). Executing SOI is not easy, as it requires firms to manage the balance between environmental, social and economic impacts and varying stakeholder demands. Furthermore, solving complex sustainability challenges require solutions with radical, disruptive and systemic characteristics (Szekely and Strebel, 2013; Gazilusoy, et al., 2013), the resolution of which require collaboration across companies, industries and nations, emphasizing also the importance of open innovation actions (Goodman et al., 2017). The previous literature has also acknowledged that there exist different types of sustainable business models (Bocken et al., 2016) that are enabled by the development of new technologies, digital solutions and platform-based business (Boncheck and Choudary, 2016; Van Álstyne et al., 2016), as well as increased collaboration and the emergence of novel market settings, such as sharing economy (e.g. Belk, 2014) and circular economy (Geissdoerfer et al., 2017). These provide promising avenues for SOI.

Although the previous academic literature has linked the impact of SOI and firms’ competitiveness (e.g. Ameer and Othman, 2012; Nidumolu et al., 2009), the value of sustainability is still difficult to understand, and SOIs are seen to face multiple challenges. Innovation processes themselves involve a number of risks, costs and uncertainties,
causing challenges for decision-making and management. In addition, sustainability brings along a variety of uncertainties and challenges, as different sustainability perspectives: social capita, economic responsibility and taking care of the environment, all contribute to the value creation of sustainability-related solutions. Furthermore, special challenges for managing SOI are caused by potential value-destroying elements (including e.g. additional costs) and negative trade-offs, along with conflicting objectives among different stakeholders (Hahn et al., 2010; 2015).

The focus of the thesis is on addressing the challenges in value creation for sustainability-oriented innovations and supporting methods to help in coping with these challenges. The study has been motivated by the practical importance and increasing relevance of SOI. This introductory section continues with the presentation of the identified research gaps, elaborating the theoretical importance of the topic.

1.2 Research gaps

The existing literature on sustainability-oriented innovations has focused strongly on demonstrating the importance of innovation actions in making sustainable change. The mainstream literature has traditionally focused on the positive impacts of sustainable development, thus encouraging firms to execute different sustainability initiatives (Doganova and Karnøe, 2015; Patala et al., 2016). As is common with new theories, the emerging literature of SOI has mainly explored the positive effects and relatively familiar contexts. Negative effects and new market extensions have received comparatively little attention, as they have been seen to be more difficult to study.

The SOI literature emphasizes many sustainability-related business benefits and guides organizations to pursue win-win situations (e.g., Ameer and Othman, 2012; Hilke and Bos-Brouwers, 2010; Kurapatskie and Darnall, 2013), where positive environmental and social performance is seen to lead to economic gains. SOIs are for example argued to lead to increased competitiveness and secure business in the long term. The research has focused on convincing firms of the potential benefits of SOI due to the need to find commercializable solutions for sustainability challenges. Also the strong external demand by authorities, policy makers and customers has not only driven firms to seek for innovations for sustainability, but also guided the research to this direction (see e.g., Goodman et al., 2017). Rather less attention has been paid to the possible negative impacts of organizations’ sustainability-related business practices.

Recent literature acknowledges that sustainability may have positive, but also negative consequences (e.g., Ameer and Othman, 2012), such as possible trade-offs, conflicts between economic, environmental and social impacts, as well as potential tensions between network partners (Hahn et al., 2010; 2015). Some of these may appear as less threatening and can be handled easily, but some of them may have significant critical and far-reaching consequences. SOIs address wide networks of actors with different goals and expectations, which makes the evaluation and anticipation of the possible consequences and value creation very challenging. Furthermore, many of the SOI benefits are realized
only in the long term, which is often contradictory to business approaches relying on short-term benefits. SOIs are also acknowledged to require high investments and involve high risks and uncertainty about their commercialization potential (Hall and Wagner, 2012; Geels et al., 2008; Dangelico and Pujari, 2010). Despite the fact that recognizing these possible negative impacts is critical, the research of this particular issue is surprisingly limited, and comprehensive understanding of the negative effects in delivering SOI is missing.

Sustainable development relies strongly on innovations. Thus, also the innovation management literature has evolved to address the impacts of sustainability on innovation research. However, this literature stream has not found a consensus of the definition of innovations addressing sustainability, nor the value creation for these innovations. Furthermore, achieving true sustainability impacts remains still uncertain, as previous literature, especially considering sustainable and environmental management, has tended to overlook the social sustainability dimension (Adams et al., 2016). This causes challenges to managing SOI, seeing and measuring the overall sustainability-driven value. Achieving a major change towards a more sustainable world is widely acknowledged to require system-level changes, i.e., seeking SOI with system-level impacts. From the firm’s perspective, these innovations require updates in firm practices to be able to cope with complex environments and multiple stakeholders (e.g., Gaziulhusoy and Brezet, 2015). In addition to system-level change, sustainability is acknowledged to require innovations beyond incremental improvements (e.g., Szekely and Strebel, 2013). However, companies are seen to face significant challenges in executing innovations with radical and systemic impacts. This is due to the high uncertainty levels and problems in addressing sustainability-related value creation. Although the importance of this issue is recognized, research of the challenges of executing SOI is still inadequate.

Furthermore, sustainability has driven companies to focus on new types of business models and to seek innovations beyond traditional products and operations. This development has resulted in the emergence of novel market settings with strong focus on digital technologies and services, including e.g. platform economy and sharing economy. For example, new types of business models that are based on sharing resources are seen to provide future opportunities for SOI, as they aim at addressing issues such as overconsumption and resource scarcity. In addition, companies have also started to pay more attention to efficient utilization of resources and seek new business models that are based on slowing and closing resource loops and narrowing resource flows. These models challenge the traditional linear business models of production (take-make-use-dispose) by shifting the focus of value creation to material and product circulation. (Bocken et al., 2017). These new types of businesses have changed the rules of decision-making, requiring new models for managing value creation. However, research of the challenges associated with sustainability value creation within these contexts is lacking.

The thesis addresses the research gaps described above concerning the negative effects of delivering SOI and the challenges in sustainable value creation in this context. The first research gap concerns the challenges and troubles in delivering SOI. The second research
gap rises from the insufficient understanding of the complexity of sustainability-oriented innovations and the changes that it causes to value creation. In order to turn the direction of our development paths towards a more sustainable future, more comprehensive research of value creation for SOI and the challenges associated with it is needed.

As the understanding of challenges of value creation for SOI has been incomplete, also the supporting methods for value creation for SOI are limited. More specifically, there exist no specific guidelines to follow in designing research-based supporting methods. Creating understanding of the challenges allows also the development of targeted supporting methods. The development of SOI requires decisions made at various levels of organizational activities (for example related to products, processes, business development, and value propositions), as well as strong collaboration with multiple stakeholders (Nidumolu et al., 2009). In order to create successful SOI, there is a need to create understanding about the value creation and capturing activities within all involved stakeholders, such as the customers, shareholders, suppliers, and governmental authorities. Value management plays a crucial role in finding the balance between a firm’s innovation actions and business and environmental goals, as well as the social and stakeholders’ demands. In facilitating this, also research on supporting methods for value creation for SOI is needed. Recent literature has acknowledged the importance of this specific issue, and some supporting tools have been developed (see, e.g., Patala et al., 2016; Bocken, 2014; 2016; Seebode et al., 2012). However, also these researchers call for further research on this topic and the development of complementing tools to link sustainable value creation with innovation activities. This is especially highlighted in terms of capturing the opportunities of digital development and novel market settings, such as sharing economy and circular economy. This study concentrates on this gap by first determining the challenges and then seeking the tools and methods to overcome these challenges and to guide in value creation for SOI. In addition, the study aims at examining the process that could help future researchers in building research-based supporting methods to facilitate value creation for SOI.

1.3 The objective of the research and the research questions

The main objective of the thesis is to increase the understanding of the challenges in value creation for sustainability-oriented innovations and to provide supporting methods to cope with these challenges. The study addresses research gaps concerning the negative effects of delivering innovations for sustainability, challenges in sustainable value creation and supporting methods in this context. Given the objective of the study, the research question guiding the research is:

\[ \text{How to cope with the challenges in value creation for sustainability-oriented innovations?} \]

In closer detail, this question concerns the issues of how the challenges in value creation for SOI can be identified, managed, reduced, or removed. To facilitate and structure the research efforts and analysis, two sub-themes are formulated. The first theme focuses on
the challenges in the value creation for SOI. It addresses the possible negative consequences and challenges that arise from implementing and developing sustainability-oriented innovations. The second theme concerns the supporting methods to influence the value creation for SOI.

To make the research subject easier to approach and understand, the research has been divided further into six different research objectives having separate guiding research questions. These have been addressed in different research projects and are considered in closer detail in the second part of the thesis, consisting of the individual publications.

1) Exploring the challenges of delivering systemic innovations for sustainability
2) Understanding the tensions associated with sustainable business practices in business networks
3) Identifying the challenges related to sustainability knowledge utilization and what opportunities digitalization could offer to overcoming these challenges
4) Understanding how sustainability value can be created in multi-sided markets within sharing economy
5) Understanding how sustainability value can be created in platform-based business
6) Exploring the role of the lacking skills of current innovation managers in delivering sustainability-oriented innovations and what educational needs there exist

The objectives, research questions and publication information, and how they are related to the overall two sub-research areas are shown in table 1.
### Table 1. Research topics, objectives and questions

<table>
<thead>
<tr>
<th>Research subtopic</th>
<th>Research question</th>
<th>Objectives</th>
<th>Method</th>
<th>Publication</th>
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<tbody>
<tr>
<td><strong>Challenges in value creation for SOI</strong></td>
<td>1) What are the main challenges in delivering systemic innovations for sustainability?</td>
<td>To identify the challenges in executing systemic innovations for sustainability.</td>
<td>Case study</td>
<td>I</td>
</tr>
<tr>
<td><strong>Challenges in value creation for SOI</strong></td>
<td>2) What kind of tensions may emerge when implementing sustainable business practices (SBPs) in business networks, and how are they experienced by different stakeholders?</td>
<td>To explore the potential tensions that result from sustainable business practices and how they are experienced by different network actors. Understanding what effect they have on value creation for SOI.</td>
<td>Case study</td>
<td>II</td>
</tr>
<tr>
<td><strong>Challenges in value creation for SOI Supporting methods for SOI</strong></td>
<td>3) What are the reasons of inadequate utilization of sustainability knowledge in management? 4) How to enhance innovations for sustainability by utilizing digital assets?</td>
<td>Identifying the challenges in utilizing sustainability-related knowledge. Defining the role of digitalization in managing the challenges and enhancing the development of SOI.</td>
<td>Case study</td>
<td>III</td>
</tr>
<tr>
<td><strong>Challenges in value creation for SOI Supporting methods for SOI</strong></td>
<td>5) How to create a sustainable business model for a taxi sharing service?</td>
<td>To understand the value creation for SOI in sharing economy business environment. Creation of a conceptual framework and mathematical model for value creation in taxi sharing.</td>
<td>Literature review</td>
<td>IV</td>
</tr>
<tr>
<td><strong>Supporting methods for SOI</strong></td>
<td>6) How is platform value designed, and what are the key design challenges, processes, and outcomes?</td>
<td>To understand value creation for SOI in platform-based business. Creation of a conceptual framework for value creation in platform-based business.</td>
<td>Design science research</td>
<td>V</td>
</tr>
<tr>
<td><strong>Challenges in value creation for SOI Supporting methods for SOI</strong></td>
<td>7) Which educational needs are faced by current innovation managers in dealing with innovations for sustainability?</td>
<td>To understand the challenges related to the lacking skills of current decision-makers in managing SOI.</td>
<td>Case study</td>
<td>VI</td>
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</table>

The thesis consists of altogether six separate research projects and related research questions, as presented in table 1 above. A summary of the findings of these publications and their contributions to the overall research topic of value creation for SOI is presented.
in this introductory part of the thesis (chapter 4). The research questions of these individual publications have slightly different emphasis areas. The first question seeks to address the challenges in pursuing systemic innovations for sustainability. There exists a strong pressure for moving from incremental product and service innovations into more impactful solutions that advance system-level sustainability. However, these types of innovations increase also the challenges in value creation for SOI. The second question considers the potential tensions of implementing sustainable business practices. This publication pays attention to the negative consequences that hamper the overall motivation to develop and create value for SOI. The third research question takes the perspective of challenges in utilizing sustainability knowledge in creating SOI, and the fourth question seeks to address the role of digitalization in answering these challenges. Thus, this individual publication addresses both the challenges in value creation and provides insights into possible supporting methods. The fifth and sixth research questions focus on the challenges in value creation for SOI and supporting methods in different novel market settings of sharing economy and platform-based business. These types of businesses are seen to provide multiple benefits and opportunities for value creation for SOI with a great sustainability impact. The seventh research question pays attention to the challenges related to the lacking skills and capabilities of current decision-makers in executing and managing SOI. It addresses the educational needs of current innovation managers, thus representing an important viewpoint on building capabilities to support the value creation for SOI. The answers for these research questions are considered in closer detail in the individual publications.

1.4 Key concepts and scope of the study

In this chapter, central constructs of the thesis are defined. Furthermore, the chapter clarifies their scope, conditions and interrelations. The key concepts of the study include innovation, sustainability and sustainable development, sustainability-oriented innovation, and value creation. The thesis also addresses the terms dynamic capabilities, sharing economy, platform-based business and circular economy, which are introduced shortly.

1.4.1 Scope of the study

Innovation is especially concerned in the innovation management research area, which has also links to strategic management theories. In general, innovation management can be defined as planning, arrangement, control, and execution of activities that lead to innovation (Hansen and Birkinshaw, 2007). Another related term is the innovation process, which refers to the process of development and selection of ideas, and transformation these ideas to innovation. The literature stream of innovation management is relatively young (Eveleens, 2010), but covers multiple focus areas, such as new product development, service innovation, innovation processes (e.g., Van de Ven and Poole, 1990, Rothwell, 1994) and innovation diffusion (Rogers, 2010), innovation policies and instruments (Tödtling and Trippl, 2005), creativity (Martins and Terblanche, 2003),
methods and measurement for innovation (Adams et al., 2006), open innovation (Chesbrough, 2017), and business models (Osterwalder et al., 2005). Lately, the innovation management literature has also increasingly addressed sustainability issues, ranging from environmental and social innovation to a more comprehensive perspective of sustainability-oriented innovation (Adams et al., 2016).

As technologies have evolved, also sustainability has increased its importance in relation to innovation management. The development path of innovations addressing sustainability has its roots at component and inter-organizational levels, with a focus on cleaner technologies, such as end-of-pipe technologies addressing companies’ emissions. Recently, the focus has moved towards the systemic perspective and setting interest on innovating entire production and consumption systems. Sustainability has been addressed for example in the context of open innovation (Lopes et al., 2017), business models (e.g., Bocken et al. 2013), system innovations (e.g., Gaziulusoy et al., 2013), and radical and disruptive innovations (Szekely and Strebel, 2013).

Figure 1 illustrates the conceptual positioning of the research. The thesis builds upon a theoretical background of strategic innovation management, which is part of the wider theoretical doctrine of organizational and management studies. More specifically, as the thesis focuses on value creation for SOI, the focus is especially on the early phases of innovation processes, i.e., the identification of possibilities for innovations and the planning and designing phases. While value creation means consideration of the process of how to combine expertise and offerings, value capture means the consideration of how to earn revenues (Teece, 2010; Peltola et al., 2016). Although value capture is closely linked to value creation, the focus of value capture is on the later stages of innovation processes, i.e., testing, validating and launching innovations to the market. This thesis does not focus on the challenges of value capture for SOI, which, however, provides an interesting avenue for future research.

One of the main theoretical paradigms under the strategic innovation management theory is the research area focusing on competencies (Prahalad and Hamel, 1990) and dynamic capabilities (Teece and Pisano, 1994). Dynamic capabilities can be even seen as one of the cornerstones in strategic and innovation management literature. In this thesis, dynamic capabilities are understood as the organization’s ability to integrate, build, modify, and utilize its internal and external resources to create value in changing environments (Teece et al., 1997, p. 516; Noori et al. 2012).

The existing research has increasingly addressed the importance of capability development (especially dynamic capabilities) in meeting sustainability challenges. An increasing number of studies address the importance and links of dynamic capabilities with business sustainability (e.g., Chen and Chang, 2013; Dangelico et al, 2017; Strauss et al., 2017; Wu et al., 2012; Amui et al., 2017). Some researchers have linked also dynamic capabilities more closely to the development of innovations addressing sustainability (e.g., Castiaux, 2012). The development of dynamic capabilities allows companies to adapt themselves to fast-changing business environments, which is seen to
be especially crucial in terms of developing SOI (e.g., Seebode et al., 2012). Although the interest in the role of dynamic capabilities in addressing SOI-related challenges is increasing, the research of this particular issue is still in its infancy.

As depicted in Figure 1, this thesis builds also upon previous theoretical understanding of sustainability-oriented innovations. Although sustainability has been already addressed in various streams of literature, the SOI theory has lately evolved as its own research area. As the area is relatively new, the focus has been much on defining the concepts (e.g., Schiederig et al., 2012; Adams et al., 2016), and encouraging companies to seek for SOI (e.g., Nidumolu et al., 2009). Recent research has addressed SOI especially through the need to move towards collaborative innovations with system level impacts. In this thesis, the special focus is especially on the impacts of sustainability on value creation for innovations. This theoretical background is also related to the literature of corporate sustainability, where the focus is especially on the creation of long-term stakeholder value by combining economic, environmental and social business activities. This perspective is not a key consideration in this thesis, but it is discussed in relation to SOI literature. Furthermore, also the measurement of sustainability is one of the ongoing concerns in corporate sustainability research. Despite the fact that several tools and indicators have been developed for sustainability measurement purposes, such as the Global reporting initiative, Environmental Sustainability Index and Ecological footprint (e.g. Parris and Kates, 2003), there are still many unresolved topics. Although measurement presents one of the challenges in value creation for SOI, this thesis does not focus on certain indicators or measurement tools. Measurement of sustainability presents a relatively wide research entity, which is not a key consideration in the scope of this thesis. To summarize, this thesis seeks to connect innovation management with the theoretical background of SOI. Although SOI literature is naturally linked to innovation management research, this thesis sees dynamic capabilities as an essential part of linking these two research areas to create knowledge of the topic.
1.4.2 Innovation

The term *innovation* is widely used in different contexts and disciplines (Damanpour and Schneider, 2006; Adams et al., 2006), and it is strongly linked to the competitiveness of firms, networks, nations, economy, and the society as a whole (Tidd et al., 2005). It is present in several academic research areas, as well as in the managerial world. Although the term has different definitions with a slightly different focus in different contexts (see e.g., Baregheh et al., 2009), there are a few characteristics that are generally agreed on. First, an organization can operate in a wide innovation space, run innovation products to processes, position or paradigm innovations, and have innovations with incremental or radical characteristics (Tidd et al., 2005). Secondly, innovations are used as tools to influence the changes in organizations’ internal and external business environments (Damanpour, 1991). As Tidd et al. (2005, p.3) acknowledge, “innovation is driven by the ability to see connections, spot opportunities and take advantage of them”. Furthermore, innovations do not only refer to technological products, but also intangible applications, such as development of operations and business models are ways to structure and manage value creation and capture processes. Innovations refer to a process from changing the need to success from idea to commercialization (ibid.), i.e., “a successful introduction of an invention in society” (Vollenbroek, 2002, p. 216). Thirdly, innovation in general is linked to novelty. It can be related to opening new markets (by radical innovations), but also to identifying new ways of competing in established and mature markets. Although technologies play an important role in enabling radical innovations, the forms of innovations vary depending on the organization’s resources, capabilities, strategies, and requirements (Baregheh et al., 2009). Innovations are related to knowledge and creating new possibilities utilizing sets of knowledge (Tidd et al., 2005). In the context of SOI, it is important to address innovation from a broad viewpoint. As specified later, SOI may range from products, services and technologies to process enhancement and business models.
1.4.3 Sustainability

*Sustainability* as a concept is not new, but was used already in 1713 in the context of harvesting forests (Wiersum, 2000). However, sustainability gained mainstream attention much later, after the introduction of the report of the UN World Commission on Environment and Development in 1987, known as the Brundtland report. In this report, *sustainable development* was defined as “a development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 37).

Sustainability and sustainable development are concepts that have met with a lot of criticism, and there is no holistic definition for these concepts. However, in mainstream discussion, *sustainability* is understood as the humanity’s target goal of human ecosystem equilibrium, while sustainable development means a holistic approach and temporal processes leading towards sustainability (Shaker, 2015).

Since the publishing of the Brundtland report, the concept of sustainability has been developed further to comprise three different dimensions: economic, social and environmental. These dimensions of people (social), the planet (environment) and profit (economic) are known as a triple bottom line (Elkington, 1994). Sustainability means finding a balance between these dimensions. In business this means taking care of the environment and social welfare while aiming at profitability. However, there have been also critical voices concerning this definition. For example, Kuhlman and Farrington (2010) propose that the term well-being should be used to correspond to the social and economic dimensions of the triple bottom line, whereas the term sustainability would consider more the environmental dimension. They also agree with the aspects of dividing sustainability into weak and strong sustainability (Ayres et al., 1998), but highlight the aspect that these two should complement each other. According to Pearce et al. (1989, p. 34), the idea of weak sustainability means that “the next generation should inherit a stock of wealth, which comprises man-made and environmental assets, no less than the stock inherited by the previous generation”. Thus, human capital may substitute natural capital. The strong sustainability ideology, on the other hand, means that these two types of assets are complementary but not interchangeable. According to Pearce et al. (ibid., p. 34), strong sustainability means that “the next generation should inherit a stock of environmental assets no less than the stock inherited by the previous generation.”

Furthermore, a close concept to sustainability and sustainable development is the concept of *corporate sustainability*. This means the development of business strategies to consider the long-term impacts of corporate actions on the society and the environment. The aim of corporate sustainability is to incorporate environmental, social and economic aspects into a firm’s decision-making processes to improve systems as a whole and to create collective value (Donaldson and Walsh, 2015; Greenwood and Freeman, 2017).
1.4.4 Sustainability-oriented innovation

The academic literature has introduced many definitions for innovations that address sustainability. The terms include for example sustainable innovation, eco-innovation, environmental innovation, and green innovation (Quist and Tukker, 2013; Carillo-Hermosilla et al., 2010; Franceschini et al., 2016). Especially in the early definitions, the focus has been on the environmental perspective. Lately the literature has focused more also on social perspectives, introducing terms such as social innovation. In general, innovations for sustainability are inventions providing essential progress concerning social, economic and ecological concerns (Seebode et al., 2012). They are a tool to have a positive effect on the overall capital stock (economic, environmental and social) of a firm (Hansen et al., 2009).

A very recent definition of innovations addressing sustainability is the concept of *sustainability-oriented innovation* (Adams et al., 2016). This is defined as a concept meaning a company’s intentional changes to its operations, values and actions that aim at economic, environmental and social value creation. Sustainability-oriented innovations range from products and services to improvements in processes and entire business models. This presents a relatively new stream of literature, which is highly linked to the literature streams of *corporate sustainability* and *innovation management*.

1.4.5 Value creation

*Value creation* is a complex process, and there is no ultimate definition for it (Lepak et al. 2007). Traditionally, value creation has been understood as a flow from costs to revenue (Eisenmann et al., 2006). Value is associated to monetary trade-offs between a customer’s perceived benefits and costs (e.g., Ulaga and Eggert, 2006) or quality and price (e.g., Bolton and Drew, 1991; Grewal et al., 1998). This approach is, however, relatively limited, and value creation in today’s networked business environments should be considered more broadly (Keränen, 2017). Value is increasingly experienced and created by diverse sets of stakeholders, networks and ecosystems (Reypens et al. 2016). Furthermore, in addition to economic outcomes and monetary value, consumers, businesses, governments, and the society also pay increasing attention to environmental and social value elements (Peltola et al., 2016). In addition to tangible value elements (such as technical and monetary value), the consumer behavior literature focuses on value creation from the perspectives of psychological, emotional and cognitive factors through benefits and sacrifices (e.g., Cronin et al., 2000; Graf and Maas, 2008). Besides monetary benefits and costs, value is seen in this thesis to include also intangible factors – additional benefits and sacrifices (i.e., value-reducing elements). In addition, special attention is paid to sustainable value creation. This is understood as “the economic, environmental and social benefits that a firm’s offerings deliver to customers and society at large” (Patala et al., 2016, p. 144). Following this, economic value is understood in this thesis as a value (or profits, usually measurable in monetary terms) that organization derives from an asset (product, service etc.). Environmental value (or environmental value added) consists of the positive impacts that an organization’s activities have on the environment. Social
value is understood to include elements that are valued by the society in general or people in the society, including issues such as wellbeing, health, happiness, inclusion and empowerment. Especially measuring social value is challenging as it is greatly context-, people-, community- or organization-dependent.

1.4.6 Other relevant concepts

As the forms of SOI range from single products and operational improvements to entire business models, also the contextual background of this thesis is relatively broad. The increasing awareness of and interest in SOI (e.g. Boons et al., 2013) have led companies to start looking for opportunities beyond their traditional business areas. The research focuses on examining the traditional resource-intensive industries and their attempts to create e.g. circular business, but also novel market settings of sharing economy and platform economy. These types of businesses are seen to have a significant effect on the value creation models, providing multiple opportunities, but also creating new challenges. More importantly, they are seen as tools to address wider society-level sustainability challenges.

**Sharing economy** is understood as an umbrella term for collaborative consumption and peer-to-peer activities that are based on sharing resources (goods, services) (Botsman and Rogers, 2010). Value creation in sharing economy includes multiple forms of value, ranging from financial (monetary) value to soft value streams including also social and environmental rewards. Value creation activities in sharing economy are usually coordinated through digital platforms and online technologies (Albinsson and Perera, 2012; Belk, 2014; Botsman and Rogers, 2010). These types of technological platforms enable the actors to connect their resources across markets, creating value through complementarities and network effects, i.e., creating *platform economy*.

**Circular economy** (CE) is a relatively new concept, which has attracted attention increasingly in relation to sustainability-oriented business. In this thesis, circular economy is understood as a a system in which value is created by minimizing waste and the use of energy and natural resources (Geissdoerfer et al., 2017; Bocken et al., 2017). This is done by utilizing models for slowing, closing and narrowing loops of material and energy flows regeneratively (Bocken et al., 2016). Furthermore, circular business refers to solutions (including both products and services) and business models that aim at enhancing CE and respond to resource scarcity, minimizing environmental impacts and producing short- and long-term economic benefits (Loiseau et al. 2016).

1.5 Outline of the study

The thesis comprises two parts, an introduction and six individual, complementary publications. The introductory part presents the foundation for the thesis, introducing the scope, position, target and background of the study. The first part summarizes the research
findings and contributions of the six publications, included in the second part of the thesis. The structure of the introduction is presented with an input-output scheme in figure 2.

The first chapter discusses the purpose of the study, identifies the research gaps, presents the research questions, and introduces the context and key concepts of the thesis. In the second chapter the focus is on background knowledge. Chapter three introduces the methodological choices of the research and the design of the study. In the fourth chapter, the individual publications are summarized. The focus is on the key findings creating a foundation for the contributions. These contributions, theoretical and managerial implications, together with the concluding remarks are presented in chapter five. This chapter completes the first part of the thesis by providing suggestions for future research. The second part of the thesis comprises the publications, each having separate research questions and providing different perspectives on the main research topic.

**Figure 2. Outline of the thesis**
2 Theoretical background

This section describes the theoretical background of the thesis. The section consists of two main subsections, the first one focuses on the theory of sustainability-oriented innovation (SOI) and the second on innovation management theories. The first subsection starts by paying attention to the drivers for SOI and the need to achieve system-level change towards sustainability. More specifically, this section analyzes the role of innovations in achieving sustainable change. The section is continued by paying special attention to value creation for SOI and finalized by a summary of the current literature of supporting methods for value creation for SOI. The second subsection describes the evolution of innovation management theories and sets the focus more closely on the theoretical paradigms of innovation management and their influence on the research topic. This subsection is continued by the description of innovation and dynamic capabilities and their relationship to sustainable development.

Figure 3 is an illustration of the context of the study. The figure presents the positioning of the research sub-areas in the context of the publications. The theoretical fields of SOI and innovation management are present in all publications of this thesis, having slightly different points of emphasis. In general, the process of sustainable value creation is not well understood. There exist multiple challenges in value creation for SOI, and although there have been some promising attempts to support sustainable value creation, more understanding of the novel ways of creating value for SOI are needed. For instance, interest towards platform-based business and sharing business is increasing also in the context of SOI as they provide multiple opportunities for sustainable value creation. However, they both have certain characteristics that create challenges for sustainable value creation, which are not yet fully understood by current decision-makers.
### Theoretical background

The need for SOI with system-level impacts through new types of business creating sustainability value

Value creation in platform-based business

Value creation in sharing business

Challenges in sustainable value creation

- Innovation management challenges in delivering system-level innovations
- Challenges in coping with complex systems related to sustainability
- Possible tensions and negative consequences of implementing sustainable business practices and SOI
- Challenges in building dynamic capabilities for SOI
- Barriers for new sustainable business models in emerging markets
- Challenges in sustainability knowledge utilization
- Challenges on the level of individual decision-makers: lack of education, skills and know-how for SOI

Tools and methods to support sustainable value creation

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Figure 3. Positioning the research sub-areas in the context of the publications

#### 2.1 Sustainability-oriented innovation

Although the theory and the concept of sustainability-oriented innovation (SOI) is relatively new, this approach has its roots in the acknowledgement of the limits of planetary resources. Sustainability is strongly driven by the concerns of the impacts of human actions on the state of our planet and environment. The planet has its boundaries, some of which have already reached crucial limits. These include categories such as resource scarcity, biodiversity loss, climate change and the nitrogen cycle. In addition, planetary boundaries are acknowledged to include also the phosphorus cycle, global freshwater use, ocean acidification, change in land use, stratospheric ozone depletion (already quantified negative impacts exist), and atmospheric aerosol loading and chemical pollution (whose impacts are not yet quantified) (Rockström et al., 2009). In addition to environmental concerns, also social objectives drive sustainable development. Social norms and values are related to human dignity and rights, the sense of identity and citizenship, commitment to social justice, fairness and equality, inclusivity, tolerance and
solidarity, and respect for diversity and the environment. These are acknowledged to be critical in the transition to a sustainable future (Dugarova and Utting, 2013).

In 2015, the United Nations established a new sustainable development agenda, the set of goals of which were adopted by various countries. The basic aim behind these goals is to end poverty, protect the planet and ensure prosperity for all. Global sustainability-related challenges require significant system-level changes in societies, and achieving these goals requires not only innovations but collaboration and commitment of actors on various levels (United Nations, 2015). The requirements for the management of environmental and social needs drive also firms to consider their sustainability impacts (Whiteman et al., 2013). There exists a strong external pressure by regulatory bodies, customers and other stakeholders for firms to implement sustainability into their business, as firms are seen to play a key role in driving major sustainability-related changes (Schaltegger and Wagner, 2011). To foster this (and as voluntarily actions are not seen to provide sufficient enough results), multiple regulatory and educational actions by various authorities and organizations have been set to drive the transition of businesses to sustainability (Nidumolu et al., 2009). However, getting companies truly committed to sustainable development requires linking sustainability into business opportunities and economic growth. To achieve this, there is need for innovations driving sustainable change (Hall and Wagner, 2002; OECD, 2010; Adams et al., 2016; Nidumolu et al., 2009; Boons et al., 2013). The interest towards these types of innovations is increasing among managerial, policy-level and academic audiences (e.g., Klewitz and Hansen, 2014; Iñigo and Albareda, 2016).

Sustainability-related innovations have been addressed with different terms, such as green innovation, eco-innovation, environmental innovation and sustainable innovation (Schiederig et al., 2012; Quist and Tukker, 2013; Carillo-Hermosilla et al., 2010; Hansen et al., 2009; Franceschini et al., 2016). There exists no specific definition for these terms as they have slightly different meanings in different scientific communities from different traditions (Franceschini et al., 2016). On a very general level, eco- and environmental innovations can be understood as innovations that benefit the environment and thus contribute especially to environmental sustainability. Green innovation is also used in this meaning, but it is also seen to be more related to management and competition objectives to address sustainable development. Sustainable innovation is more system-oriented and emphasizes the social dimension in addition to economic and environmental innovation objectives. (Schiederig et al., 2012; Franceschini et al., 2016). These innovations can be categorized according to their historical development, starting from the inter-organizational level and simple technical improvements (including, e.g., end-of-pipe pollution control techniques and cleaner production strategies) (e.g., Carillo-Hermosilla et al., 2010), and moving towards wider-scale systems, i.e., innovating entire production and consumption systems (such as circular economy business models) (Nidumolu et al., 2009; Adams et al., 2016; Quist and Tukker, 2013; Bocken et al., 2016).

More precisely, innovations may exist at micro-, meso- or macro-levels. Micro-level innovations concerning sustainability are related to the products, services and processes
of an organization. Meso-level innovations concern for example a sector, region, supply chain, business ecosystem, or a product system. Macro-level innovations for sustainability impact entire nations, countries and markets, or may concern the global economy (Castiaux, 2012). As sustainable development requires paying attention to long-term and system-level impacts of business, also innovations for sustainability require shifting the business mindset increasingly towards systems building (Adams et al., 2016). The aim is to achieve macro-level impacts, and the shift towards sustainable society requires innovations with radical and systemic characteristics (Boons et al., 2013; Jacobsson and Bergek, 2011). These types of innovations answering the sustainability call, can be referred to as Sustainability-Oriented Innovations (SOI). According to Adams et al. (2016, p. 2): “Sustainability-Oriented Innovations (SOI) involve making intentional changes to an organization’s philosophy and values, as well as to its products, processes or practices to serve the specific purpose of creating and realizing social and environmental value in addition to economic returns.” The SOI literature plays an important role in all the individual publications included in this study.

2.1.1 Different forms of SOI

In prior literature, SOIs have been identified to appear in many forms. Many researchers have acknowledged that SOIs exists at different levels, ranging from operational optimization to organizational transformation and finally to systems building (Nidumolu et al., 2009; Adams et al., 2016; Lubin and Esty, 2010). The focus of the first level SOIs is much on making efficiency improvements and thus reducing environmental and social harms of firm’s operations (Nidumolu, 2009). Although these types of SOIs provide a good starting point for sustainable development, they often encompass incremental improvements and have thus also a limited positive sustainability impact (Lubin and Esty, 2010). The second level SOIs concern the development of sustainability-oriented products and services to capture new business opportunities and to create shared value (Adams et al., 2016; Nidumolu et al., 2009). These products and services may also vary in their sustainability impact, and more radical and impactful solutions require also increased collaboration activities with the firm’s stakeholders (Nidumolu et al., 2009). The most challenging level of SOI is systems building, in which the focus is on new business models and wide collaboration to create positive sustainable value (Adams et al., 2016). The requirements for this type of value creation are considered in detail in chapter 2.1.2 below.

Different focus areas for SOIs have also been identified in the literature. SOIs may focus on technological change to improve sustainability. These innovations may aim at the creation of new products and services (e.g. electric car), improve processes (e.g. less polluting production processes) or infrastructures (e.g. infrastructure for electric cars) with improvements to environmental and/or social performance. SOIs with an organizational innovation focus include changes to a firm’s functions (such as research and development, marketing, safety issues and communication relations) and can complement technological innovations. An example of this type of SOI is the Zipcar model of car-sharing, presenting a model for sustainable mobility. Finally, SOIs also exist
with institutional/social focus. These types of SOIs change the public sector or social sphere, including for instance regulation changes (e.g. setting taxes for carbon emissions) and consumer preference changes (e.g. changing consumer behavior to support plastics recycling through advertising and education). (Jay and Gerard, 2015)

Furthermore, the SOI literature includes also a stream of research in which the focus is especially on sustainable business model innovations (e.g. Bocken et al., 2013; 2014; Boons and Lüdeke-Freund, 2013). Bocken et al. (2014, p. 44) define business model innovations for sustainability as: “Innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organization and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions.” Thus, this stream of research sees sustainable business models as tools to implement sustainability into the firm’s operational logic. Although according to this definition business model innovation can be seen to include many forms of SOI, they can also be categorized as organizational innovations (Jay and Gerard, 2015). In general, SOIs may exist in different forms, with different focus, scale and impact. As Jay and Gerard (ibid.) state, many, especially more impactful SOIs incorporate multiple innovation types supporting each other. In other words, system changes can be achieved through combining and coordinating different types of SOI.

2.1.2 Value creation for SOI

Not only sustainable development calls for innovations, but sustainability is also seen as a tool to boost innovation and create business value and first-mover and competitive advantage (Carillo-Hermosilla et al., 2010; Nidumolu et al. 2009). Sustainable development requires innovations and entrepreneurs who combine environmental and social aspects with economically successful products, services, processes, and business models and thus increase the quality of life (Schaltegger and Wagner, 2011). In other words, the creation of SOI is related to shared value creation (Porter and Kramer, 2011), i.e., the simultaneous creation of economic, environmental and societal benefits.

According to Hart and Millstein (2003), the creation of sustainable value for firms means the creation of business strategies and practices that consider the global sustainability challenges, in addition to shareholder value. From the perspective of shared value creation, value is understood as benefits relative to costs, not just doing good or pursuing benefits alone. This value creation is linked to competing, growth and business innovations by paying simultaneous attention to value creation from company and community perspectives (Porter and Kramer, 2011).

Innovations are often produced by individual firms, and their success is related much to the firm’s capability to combine its technology and market competences. Firms aim at creating business value by producing for example green or eco products, using new materials or establishing clean technologies. However, as noted by Castiaux (2012), although the creation of SOI (called sustainable innovations by the author) is related much
to coping with regulative and other governmental actions, beyond purely responding to regulations, firms can create value by implementing sustainability into their strategies. Sustainability can be integrated at various degrees (scope, goals and means), and the level of actions in integrating sustainability into the firm’s operations can vary from light process adaptions to huge investments. Especially larger-scale changes require not only investments, but also a cultural change, a review of the capabilities needed in the innovation processes, as well as collaboration with multiple stakeholders (e.g., Castiaux, 2012; Iñigo et al., 2017). As shown in Figure 4, implementing SOI practices into a firm’s business actions often starts from implementing incremental firm-level improvements. However, the goal of SOI is to achieve more radical, system-level changes which require collaboration with multiple actors as well as changes in organizational cultures and individual mind-sets (Adams et al., 2016).

Figure 4. Sustainable-oriented innovations (modified from Adams et al., 2016)

SOIs provide opportunities in creating sustainable business value (Bocken et al., 2014) and positive environmental and social impacts on the entire systems (Hansen et al., 2009). System innovations (or systems building as depicted in the figure above) are seen to work as drivers for sustainability transitions, shifting established socio-technical systems towards more sustainable production and consumption (Markad et al., 2012). They may exist at product, service or process level (Dooley, 2017), but include also wider society-level changes concerning for example market and user practices, policy, regulations, culture, technologies, or firm management practices (Gaziulosoy et al., 2013; Gaziulosoy and Brezet, 2015). Figure 5 presents the steps towards transformative systemic innovation for sustainability, providing examples of the classification of SOI as companies take a systems perspective (Eco-innovation observatory, 2013; Nidumolu et al., 2009; Quist and Tukker, 2013; Adams et al., 2016). This aspect is especially addressed in publication I. As Figure 5 suggest, by applying systemic innovations for sustainability, firms are able to develop and deliver innovation better, particularly game-changing or ‘radical’ innovation (Quist and Tukker, 2013).
Recent discussion among academics, policy makers and business has focused increasingly on the concept of circular economy as an approach to create sustainable business value (Ellen MacArthur Foundation, 2012; European Commission, 2016). Circular economy represents a radical approach through which value creation is based on collaboration (Witjes and Lozano, 2016) and the aim is in achieving system-level change (Sauvé et al., 2016). Thus mainstreaming circular economy is acknowledged to require radical and systemic innovations (Antikainen and Valkokari, 2016), changing the value creation premises of companies’ business models (Stahel, 2014). In circular economy,
value is created by minimizing waste and the use of energy and natural resources (e.g. Geissdoerfer et al., 2017; Bocken et al., 2016). Value creation through circular business models is based on the principles of reduce, reuse and recycle, i.e. using materials and products as long as possible and eliminating the amount of waste (Geissdoerfer et al., 2017) and thus creating positive economic, environmental and social impacts (Kraaijenhagen et al., 2016). Companies can create sustainable value through circular approaches in many ways for example by designing long-life products, extending product value, (slowing loops), or by extending resource value by turning wasted materials into new forms of value (closing loops) (Bocken et al., 2017).

2.1.3 Negative and positive outcomes of SOI

As shown in Figure 5, SOIs may exists at multiple levels. Naturally, the value creation approaches at the different micro-, macro-, and meso-levels vary. Moving beyond incremental innovations and changes in system components (such as product, services and technologies) requires consideration of multiple additional factors and wider networks of actors. This means considering first the sustainability impacts on the value chain and then reconsideration of the entire value chain relationships. In practice, this means paying attention to the value proposition of the firm around which new business models can be developed. This brings also many additional challenges to the management of value creation over such networks.

Investments in SOI are highly appreciated by the society and across a variety of stakeholders of firms. These investments are seen to generate goodwill towards the firm. Previous literature has identified that stakeholders appreciate especially the firm’s efforts to advance positive environmental and social effects (Chang and Chen, 2013). Introducing SOI can bring image benefits that do not only increase the public image of the firm, but can also increase the firm’s attractiveness from the employee perspective and enhance internal motivation (Branco and Rodrigues, 2005). SOI is identified also as being linked to increased competitiveness. Innovations focusing on improving e.g. resource efficiency can also decrease costs and improve the firm’s profitability (Ambec and Lanoie, 2008; Nidumolu et al., 2009). SOI can also bring forth new business opportunities, and help in long-term planning and setting future goals (e.g., Ameer and Othman, 2012; Hile and Bos-Brouwers 2010; Ambec and Lanoie, 2008). Finally, also the possibility to lower risks (e.g. related to environmental accidents and employee health) has been identified as a positive impact of implementing SOI (Hockerts, 2015).

From the perspective of business value creation, SOI is seen to have certain characteristics causing struggle for decision-makers in identifying possibilities and promoting their emergence (Geels et al., 2004). Previous management studies have identified SOIs to be expensive projects with increased complexity and including high risk and (market) uncertainty (Hall and Wagner, 2012; Geels et al., 2008; Dangelico and Pujari, 2010). In addition, including sustainability into innovation actions may also increase the costs and reflect to customers as higher prices, as SOI may involve also hidden costs, such as extra costs and resources needed for changes in production design or waste disposal (Konar
and Cohen, 2001). In addition to high economical risks, SOI may also involve uncertainty in terms of the total effects of environmental and social sustainability (Hansen et al., 2009). For instance, innovation projects with positive environmental results may underperform from the social perspective. These types of risks (i.e., "directional risks") create challenges for value creation for SOI (e.g., Rennings and Zwick, 2002). Many firms consider sustainability only through environmental and economic effects and lack of perspectives on social aspects (Lee et al., 2012). In business development, in order to find balanced fulfillment of customer needs, there is a need to understand both the optimal performance of SOI (such as quality and costs), as well as the social and environmental impacts of SOI (Boons et al., 2013). This requires knowledge creation in terms of positive and negative outcomes of SOI.

As discussed above, SOI requires co-evolutionary development, collaboration with multiple actors from various levels (such as policy makers, companies and their stakeholders, non-governmental organizations) (Markad et al., 2012), as well as well-planned governance and guidance actions (Smith et al., 2010). Value creation for SOI comprises multiple dimensions with complex linkages and interactions with the surrounding environment. This complicates the overall value creation for SOI. To sum up, although the previous literature has identified many value creation possibilities for SOI, there exist also challenges and value-destroying elements that hamper the process of value creation. These negative impacts are often underestimated (Konar and Cohen, 2001) and not understood. Managing value creation successfully requires forming a balanced view of positive and negative impacts. Although the general interest and awareness towards SOI is increasing among executives there are also views that sustainability is a burden to a firm. In addition, there are also beliefs that pioneering in green innovations will bring success and positive benefits automatically (Ameer and Othman, 2012). The understanding in previous literature on the possibilities for SOI to create positive and negative value is summarized in Figure 6. Publication II sets the focus especially on the tensions (presenting negative consequences) that implementing sustainable business practices can cause. In addition, publications I, III, IV, VI and VII highlight different types of challenges in value creation for SOI.
Recently, many firms, governments and nations have started to look for more impactful SOIs and new ways to create sustainability value. At the same time the technologies (especially digital technologies) have developed rapidly, which has also brought forward multiple new opportunities. Together these have resulted in the emergence of multiple new types of business, addressing also strongly sustainability-related issues. As discussed briefly in the introduction chapter, the emergence of novel market settings, such as sharing economy and platform-based business have paid attention to sustainable value creation with higher society-level impacts. Thus, there is an increasing interest for business models and SOI on these markets. However, as the development of these types of businesses is at a relatively early stage, there are also multiple challenges which are especially related to sustainable value creation. For instance, the development of sharing economy business requires understanding of working in two- or multi-sided markets and paying attention to the network effects (e.g., Cohen and Kietzmann, 2014; Eloranta and Turunen, 2016). For the same reasons, also the supporting methods are just emerging.

To conclude, we can say that there is a significant need for paying attention to systemic innovations for sustainability. These innovations present a demanding form of SOI, requiring radical perspectives on innovation management and an urge to deal with complex problems in uncertain environments. In order to create interconnected products, processes and practices that push sustainable system-level change, sustainability-related intentional changes to philosophies and values (combining social and ecological aspects with economic benefits) are required from multiple types of actors, This path, aiming at finding solutions to complex sustainability challenges, is not easy, but necessary.

**Figure 6.** Summarized view of opportunities and challenges for value creation for SOI
2.1.4 Supporting methods for sustainable value creation

As the literature on SOI is relatively new, the focus has been much on defining SOI and seeking for guidance to achieve these innovations. In this chapter, the focus is especially on the prior literature regarding support methods for sustainable value creation. The previous literature has introduced only a few actual methods to help in value creation for SOI, but some helpful “intermediate” research-based tools have been developed that may resemble e.g. summaries of relevant issues that companies should be prepared for, or decompositions of complex problems to manageable-size components. These tools have not been developed into actual supporting methods yet, but they can help managers to structure and divide bigger challenges into manageable entities. These types of intermediate tools create a basis for the development of simple and easy-to-use managerial supporting methods.

Maybe the best known attempt to actually set business attention on sustainable value creation has been the introduction of a sustainable value framework by Hart and Millstein (2003). In the framework, they present different drivers of sustainability and business strategies, and practices related to them, as well as how these correspond to the shareholder value. This framework aims at helping managers taking a first step towards sustainable value creation for the corporation, by paying attention to the challenges and opportunities. Since the introduction of this sustainable value framework (ibid.), there has been some research aiming especially at guiding businesses to find SOI and create sustainable value. Previous literature has focused mainly on providing tools to assess and estimate the links between sustainable value creation and economic performance of an organization (e.g., Hahn et al., 2002; Ambec and Lanoie, 2008; Ameer and Othman, 2012; Kurapatskie and Darnall, 2013). Some studies have also concentrated specifically on providing guidelines to add sustainability into the company strategy and thus increase SOI (e.g., Hahn et al., 2002). SOI has also been linked to the processes of knowledge management and learning (e.g., Lozano et al., 2013), and the development of information systems has been seen to provide new tools to facilitate these processes (e.g., Jorna et al., 2009). Some research has also focused especially on the success factors for SOI (e.g., Dangelico et al., 2013) but the research has been much on (green) product innovations and launching SOI into the market, as well as on demand factors (e.g., Anttonen et al., 2013; Ceschin, 2013).

There exist also some supporting methods and tools focusing on the assessment of and finding sources for SOI. One of these is the sustainability innovation cube by Hansen et al. (2009) (see Figure 7). The authors introduce a generic model for structuring the innovations’ sustainability in order to inform corporate decision-makers better about how to minimize the directional risks of SOI. The model consists of the three dimensions of innovation target (ecological, social and economic effects), life cycle (manufacture, use and end-of-life) and type (technology, product-service system or business model). The model is especially focused on depicting the areas of sustainability potential, but it does not focus much on the design and development phases of SOI, i.e., the early phases of innovation processes. Although the model puts some light on the possible risks and
benefits of SOI, the focus is strongly on the product level. This limitation is also highlighted by the authors, who call for more research on different types of SOI focusing especially on developing entire business models (ibid.).

Later on, the literature has focused much on business models for sustainability (e.g., Stubbs and Cocklin, 2008; Boons et al., 2013; Boos and Lüdeke-Freund, 2013; Bocken et al., 2013). However, as Bocken et al. (2013) note, there are only a few tools to actually assist in sustainable business modeling. One of the few is a value mapping tool (ibid.), which has been particularly developed to help firms to create better value propositions that consider sustainability. The tool is especially targeted at the primary step of business modeling by raising awareness of conflicting values and negative outcomes of business, the understanding of which can support the creation of SOI. This specific tool promising for supporting value creation for SOI, but due to its simplicity and relatively general level, in order to enhance the development and implementation of SOI, complementing tools are needed. Especially the individual publications III, IV, V and VI seek to address this call.

One recently introduced tool to support value creation for SOI is the framework of Patala et al. (2016) designed for the development of sustainable value propositions. This framework consists of different stages: 1) identification of potential impacts, 2) identification of the customer value creation mechanisms, 3) choosing the key indicators, 4) life cycle value modelling, and 5) demonstration of life cycle value (see Figure 8). Although the framework highlights some relatively important issues and considers also some possible negative impacts on value creation, it has been developed especially to provide guidelines for creating sustainable value propositions for industrial products.
Bocken et al. (2014) have introduced a framework of sustainable business model archetypes (see Table 2). This framework consists of three groups of technological, social and organizational business model archetypes, and it is a good example of intermediate tools for value creation for SOI. To help in advancing managerial understanding, the authors provide examples of each eight types of business model archetypes. This categorization is based on previous understanding of business models according to which business models can be described through the three elements of value proposition, value creation, delivery and capture.

Table 2. Sustainable business model archetypes (Bocken et al., 2014)

<table>
<thead>
<tr>
<th>Group</th>
<th>Technological</th>
<th>Social</th>
<th>Organizational</th>
</tr>
</thead>
<tbody>
<tr>
<td>archetypes</td>
<td>2. Creating value from ‘waste’</td>
<td>5. Adopting a stewardship role</td>
<td>8. Developing sale-up solutions</td>
</tr>
</tbody>
</table>

Although this categorization increases the understanding of SOI, the authors acknowledge that their study is based on historical examples of innovation and does not predict entirely new approaches. Furthermore, the emphasis in the provided examples is
much on environmental innovations, while the presence of social innovations is limited. Because of these limitations, updating the understanding regarding value creation and business models for sustainability and SOI in general are needed.

Recently, researchers have introduced also some methods and tools that address especially value creation through circular business model innovation (e.g. Bocken et al., 2017). For instance, Antikainen and Valkokari (2016) introduce a framework for sustainable circular business model innovation with the aim to support the development of more radical and systemic innovations. In addition to business model canvas elements (Osterwalder and Pigneur, 2010), the framework pays attention to the business ecosystem level (considering trends, drivers, and stakeholder involvement) and consideration of sustainability impact (requirements and benefits). Importantly, the framework proposes also the idea of continuous iteration with sustainability and circularity evaluation of the business model.

Some research setting the focus especially on the innovation management perspective on SOI also exists. The research by Seebode et al. (2012) highlights the key innovation management challenges associated with SOI (called sustainability-linked innovation by the authors). These challenges are listed in table 3.

Table 3. Key innovation management challenges associated with SOI (modified from Seebode et al., 2012, p. 203).

<table>
<thead>
<tr>
<th>Innovation activity</th>
<th>Challenges</th>
</tr>
</thead>
</table>
| Search              | • Peripheral vision – searching in unfamiliar fields (sectors, technologies, markets etc.)  
                      • Reframing  
                      • Finding, forming, performing new networks |
| Selection           | • Resource allocation under high uncertainty  
                      • Cognitive dissonance  
                      • Not invented here |
| Implementation      | • Internal mobilization – new skills, structures etc.  
                      • Crossing the chasm and the diffusion problem  
                      • New appropriate language |
| Innovation strategy | • Need for a clear framework within which to locate, search, select, implement a ‘roadmap for the future’  
                      • New corporate paradigm – criteria based on sustainability: people, profit, the planet etc. |

The authors suggest that much of the innovation actions related to sustainability happen in by re-framing the business (incremental innovations) and co-evolving in a complex environment (radical innovations with new frames). Furthermore, the authors highlight the impact of dynamic capabilities in advancing SOI. SOI forces firms to move beyond their traditional approaches in core search, select and implementation actions related to innovations. These innovations require adoption of new knowledge related for instance
to technologies, markets, the business environment, and regulations. As the authors acknowledge: “firms need capability (and enabling tools and methods) to acquire, assimilate and exploit new knowledge and to work at system level.” (Seebode et al., 2012, p. 197).

Importantly, due to the rapid development of digital and informational technologies, also new opportunities to create sustainable business models, SOI in particular, have appeared. For example, sharing economy and circular economy–based business models provide promising avenues for sustainable value creation (e.g., Bocken et al., 2016), but many current decision-makers lack knowledge, tools and methods to assess and design such value. These new types of businesses are growing in importance also in terms of developing SOI, and that is why more research is needed.

2.2 Innovation management

The theoretical field of innovation management has evolved in close connection with strategic management theories. In general, as an independent research field, it can be seen to have evolved from the 1950s technology push approach to the 2010s open digital innovation ecosystems, progressing from linear to coupled, and to collaborative and systemic innovation models (Rothwell, 1994; Xu et al., 2007). During the 2000s, innovation management research has moved the focus increasingly to innovation systems, ecosystems and open innovation (e.g., Chesbrough, 2006), investigating the interactions between corporate innovation systems, their environment and networks. Lately, especially the digital transformation and the emergence of digital platforms have influenced the development of innovation management research theories. The theories have evolved towards open digital innovation ecosystems, highlighting the importance of the possibilities of digital solutions, collaboration and opening up firms’ boundaries.

Within the innovation management research field, there exist certain innovation management theory paradigms that have been recognized widely. These include, e.g., the research on corporate competencies and capabilities (e.g., Prahalad and Hamel, 1990; Teece and Pisano, 1994; Xu et al., 2007; Bouwer, 2017), value innovation (Kim and Mauborge, 1999), diffusion of innovation (Rogers, 1962), and innovation as a system (Drucker, 1997; Xu et al., 2007; Taylor and Wagner, 2014). Furthermore, the focus has shifted lately more to open innovation ecosystems (e.g., Chesbrough and Appleyard 2007; Gassman et al., 2010) and open platform ecosystems (Adner, 2016; Altman and Tushman, 2017). These paradigms and their impact on this thesis are discussed next.

2.2.1 Innovation theory paradigms

The first widely recognized innovation theory paradigm is the theory of innovation competence and capability (e.g., Prahalad and Hamel, 1990; Teece and Pisano, 1994). In addition to setting specific focus on the theoretical background of sustainability-oriented innovations, the thesis is grounded on this specific theoretical perspective on innovation
management. Innovation competence and the capability paradigm have their roots in strategic management research and the resource-based view (Wernerfelt, 1984; Barney, 1991), expanded by the theory of dynamic capabilities (Teece and Pisano, 1994). Later on, the researchers focusing on organizational competencies and capabilities have introduced many innovation frameworks, setting special focus also on the implementation of these frameworks and identification of organizations’ critical success factors. The research in this area covers also multiple practical frameworks that have been developed to help companies in examining their innovation portfolios, as well as the competitiveness and maturity of innovations. Recently, the research under this theoretical paradigm has addressed also the special theme of the role of dynamic capabilities in achieving corporate sustainability (e.g., Chen and Chang, 2013; Dangelico et al., 2017; Strauss et al., 2017; Wu et al., 2012). The dynamic capability perspective in supporting value creation for SOI is addressed especially in individual publications I and VI.

From the competence and capability perspective, the innovation management theories include the theory paradigm of value innovation (e.g., Kim and Maugborne, 2004) and innovation diffusion (Rogers, 1962). The theories under this paradigm introduce, e.g., a variety of tools and methods to facilitate the process of launching innovations to the market (e.g., Porter, 1979; Rogers, 1962; Moore, 1999), which largely explain value capture. However, from the perspective of this thesis, one of the theories developed under this paradigm which also affects value creation for SOI is the disruptive innovation theory (Christensen et al., 2015; Christensen 1997; Bower and Christensen, 1996), as SOIs are seen to have a potential to disrupt entire markets. Based on existing understanding, disruptive innovations create new markets and new value networks by combining new sets of values, which ultimately disrupts the existing market. The discussion started from disruptive technologies (Bower and Christensen, 1995) but it was evolved when it was recognized that it is the business model that creates the disruptive impact (e.g., Christensen and Raynor, 2003; Christensen et al., 2006; Pisano, 2015). Many well-known and significant disruptive innovations (such as Wikipedia, Facebook, Bitcoin, AirBnB, Amazon) (e.g., Guttenag, 2015) are based on collaborative actions and networks. Although (digital) technologies may work as enablers for these innovations, they require strong collaboration and value management abilities from coordinating partners. Especially finding innovations to answer sustainability challenges requires paying attention to business models and innovations disrupting markets and industries and causing social change (e.g., Christensen et al., 2006). This aspect is in the background of this thesis and all individual publications.

Innovation theory paradigms include also the theory of innovation as a system (Drucker, 1997; Xu et al., 2007; Taylor and Wagner, 2014). According to this system perspective, innovation as a system means a combination of individual and multidisciplinary capabilities that are integrated to provide new solutions which create customer value but also benefits the firm, its employees and stakeholders. Thus, capabilities (such as knowledge, skills and resources) are combined to create core competency, which results in competitive advantage. The management of an innovation system requires paying attention also to the innovation strategy and multiple actions of coordination,
communication and collaboration. The aim of innovation systems is in developing capabilities that will turn into valuable offerings to the market (e.g. Fagerberg and Srholec, 2008; Botta et al., 2015; Cooke, 2010). From the perspective of the thesis, this topic is important, as innovations aiming at addressing sustainability are seen to require a special set of skills, capabilities and resources. This issue is considered more specifically in publications I and VI. In order to drive sustainability-oriented innovations, the focus should be set on typical innovation problems as well as problems that are linked to environment-related market failures (Botta et al., 2015), which is interesting not only from the value capture perspective, but also from the perspective of designing value propositions.

Since the 1990s, market development has been fast, and companies have been forced to cope with dynamic and turbulent changes in the business environment. The level of competition has risen, and also stakeholders (including customers, suppliers, authorities etc.) have become more demanding. The shift to consumer-demand economy has worked as a trigger for innovation management theories of innovation ecosystems (Adner, 2017; Adner and Kapoor, 2010; 2016; Xu et al., 2007), open innovation (Chesbrough, 2006; 2017; West et al., 2014), and business model innovation (Osterwalder and Pigneur, 2010; Osterwalder et al., 2005; Chesbrough, 2010). This research paradigm sets the focus more and more on networking, co-creation, co-development, and collaboration as tools to build new capabilities for innovation. These research directions play an important role in this thesis, as SOIs require paying attention to value creation from multiple perspectives over various stakeholder groups. They require utilization of multidisciplinary knowledge, capabilities and various resources. These issues are present in all individual publications, with slightly different areas of emphasis.

Also the digital transformation, including the development of for example the Internet of Things, big data and cloud computing, has affected the development paths of innovation management theories. The increased digitalization has worked as a trigger for the development of digital platforms, which has also affected the research in the discipline of innovation management (Parker and Van Alstyne, 2017; Van Alstyne et al., 2016; Parker et al., 2016). This has advanced the research of open innovation ecosystems to cover also digital platforms and ecosystems (Adner, 2016; Rangan and Adner, 2001). The individual publications III, IV and V of the thesis concern especially the development of platforms and digital solutions to support the development of SOI. These perspectives present novel ways of executing innovations and provide new opportunities also from the perspective of sustainable development.

### 2.2.2 Capabilities in innovation management research

As briefly mentioned above, one of the main theoretical views in the history of innovation management has its roots in the resource-based view (Wernerfelt, 1984; Barney, 1991) and the dynamic capability theories (Teece and Pisano, 1994). According to this organizational capability perspective on innovation, the management and utilization of the combination of a firm’s unique resources and capabilities holds a key position in the
creation of competitive advantage (Liao et al., 2009). This is because these capabilities are often highly firm-specific and less transferable, as they rely on dynamic interaction between multiple sources of knowledge (Peng et al., 2008).

According to Breznik and Hirsrich (2014 p. 374, based on Johansson, 2004) “innovation is a process that allows adapting and capability-building, and has to be sustainable.” According to Drucker (1997), if a firm wants to aim at continuous promotion of innovation, it needs the application of knowledge to knowledge itself. Innovation is seen to depend on the evolution of knowledge (Carneiro, 2000). Minzberg et al. (2003) state that a firm needs innovations to be and remain flexible, which means breaking away from, changing and improving established patterns. In relation to this, innovation capability is argued to be the most important capability of a firm (Birchall and Tovstiga, 2005). As noted by Breznik and Hirsrich (2014), many scholars see innovation capability as a synthesis of capabilities (Parashar and Singh, 2005; Tidd and Bessant, 2009). Innovation capability has several definitions with slightly different focus areas (e.g., Lawson and Sampson, 2001; Kogut and Zandler, 1992). In this study, following the definitions of Bullinger et al. (2007) and Ngo and O’Cass (2013), innovation capability is understood as a holistic, corporate-wide potential of a firm to generate new and unique value by combining the knowledge and skills embedded within the routines and processes of the firm to perform innovation. It is influenced by different internal and external factors of the organization.

In the adaption to the changes in business environments, dynamic capabilities play a crucial role by allowing reconfiguration of the organization’s resources and knowledge capacities (Teece et al., 1997; Teece, 2007; Helfat et al., 2007; Ambrosini and Bowman, 2009). Although dynamic capabilities have slightly different definitions, maybe the most well-known definition was introduced by Teece et al. (1997, p. 516): “dynamic capability refers to firm’s ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments”. In addition to enabling a firm to respond to environmental changes, dynamic capabilities are a tool for organization to create, modify and extend its resources and capabilities purposefully (Winter, 2003; Helfat et al., 2007; Ambrosini and Bowman, 2009), and utilize them to create value in a changing environment (Noori et al., 2012). According to the definition by Helfat et al. (2007) dynamic capabilities include both tangible and intangible assets and capabilities. This definition of dynamic capabilities guides also the present study.

Dynamic capabilities can have a role in many organizational activities and functions as tools to respond to higher-level challenges, seeking opportunities for knowledge transfer and development, as well as interacting with the environment. Dynamic capabilities can also be a source of disruptive change (Eisenhardt and Martin, 2000). They have an impact on resource allocation, developing and updating organizational processes and in decision-making (Easterby-Smith et al., 2009). Previous literature acknowledges that there exist different types of dynamic capabilities that can be linked e.g. to idea generation, new product or process development, or marketing (Easterby-Smith and Prieto, 2008). According to Teece (2007), dynamic capabilities also involve capacity to sensing (and
sharing) opportunities and threats, seizing opportunities and transforming them, i.e., maintaining competitiveness through enhancing, combining, protecting and reconfiguring intangible and tangible assets.

Various classifications for dynamic capabilities have been presented in the literature. At the general level, dynamic capabilities can be categorized into four dimensions: the resource base, modification of the resource base, creation and extension of the resource base, and higher order capabilities, referring to learning-to-learn capabilities (Collins, 1994). This categorization was further developed by Ambrosini et al. (2009) by dividing dynamic capabilities into three levels, incremental, renewing and regenerative. At the incremental level, dynamic capabilities refer to continuous improvement and updating of resources and competences to cope with challenges in a relatively stable environment. These capabilities are often also relatively simple and iterative. The second level refers to renewing the resource-based advantages of a firm, eroded by environmental changes. This requires the creation of new resources and their combinations, as well as their implementation through the accumulation of experience. Finally, the regenerative level of dynamic capabilities has to do with re-thinking the processes used to create, extend and recombine resources. This means situations where the existing dynamic capabilities are no more relevant to renew the resource base (Castiaux, 2012). At this level, new dynamic capabilities are created in order to fit to new (turbulent) environmental conditions. The creation of such capabilities may require extending the organizational boundaries and seeking assets and capabilities outside the organization (Ambrosini et al., 2009). Figure 9 illustrates the different levels of dynamic capabilities and the relationships between resources, competences, dynamic capabilities, and competitiveness.

![Figure 9](image_url)

Figure 9. Resources, competences, the hierarchy of dynamic capabilities and competitiveness (adapted from Castiaux, 2012; based on Ambrosini et al., 2009)
The top management and their beliefs play a crucial role in building and forming dynamic capabilities (Rindova and Kotha, 2001; Zahra et al., 2006; Easterby-Smith et al., 2009). The allocation and orchestration of resources, as well as the realization of opportunities and movements in competitive situations is highly dependent on the decisions made by these managers. The role of management is especially linked to the selection and development of routines, investment choices and orchestration of assets, which are crucial for the appropriation of returns from innovation and for operational efficiency (Augier and Teece, 2009). Sometimes the management will view the opportunities as negative, which may lead to the demise of a potential dynamic capability (Newey and Zahra, 2009). Furthermore, managers may also for example fail in assessing environmental conditions, resulting in the development of inadequate dynamic capabilities (Barrales-Molina et al., 2010). Managers’ skills, motivation and experience affect their abilities to drive the development of the firm’s dynamic capabilities (Zahra et al., 2006; Adner and Helfat, 2003).

Although innovation capability and dynamic capability have evolved as separate concepts, the link between these two has raised discussion among researchers. Some researchers see innovation capability as a dynamic capability (e.g., Helfat et al., 2007), while some understand dynamic capability as an outcome of innovation capabilities, or innovation capability as a component of dynamic capability (in addition to, e.g., adaptive and absorptive capabilities (Wang and Ahmed, 2007)). Furthermore, dynamic capability can also be understood as a precondition for innovation capability (e.g., Rothaermel and Hess, 1997; Parashar and Singh, 2005). In addition, some researchers also see that innovation capability is not a dynamic capability at all (e.g., Tidd and Bessant, 2009), but it needs to be adjusted and developed constantly with the help of dynamic capabilities.

According to Breznik and Hirsrich (2014), there is a clear link between the two concepts. First, both concepts earn and transform knowledge. They are also strategy-oriented, focusing on continuous search, sensing, scanning, and exploring of new opportunities. The main characteristics of both dynamic capabilities and innovation capabilities are firm-specific and heterogeneous, and also highlight the important role and responsibilities of the management. Finally, they also involve a similar nature of development, focusing on change, configuration, improvements, renewal and differentiation (ibid.)

### 2.2.3 Dynamic capabilities supporting the creation of SOI

Sustainability is recognized as a dynamic concept and complex process of change (Voss et al., 2005). There are no certain guidelines for sustainability, and as O’Neil and Ucbarasan (2016) note, the beliefs, requirements and institutions for sustainability are constantly changing. The literature is increasingly addressing the importance of applying dynamic capabilities in the context of sustainability strategies, as linking sustainability into business requires actions to deal with complex situations involving rapid and unpredictable change (Hart and Dowell, 2012; Wu et al., 2012). Dynamic capabilities are argued to help firms in changing and modifying their resources to adapt to changes in sustainable business environments, i.e., achieving flexibility and the ability to deal with
increased dynamism and complexity (e.g., Arend, 2014; Eikelenboom and de Jong, 2017). Following this, sustainability is linked with the ability for adaptive flexibility, i.e., ability to address changing conditions through a process of continuous adaptive learning, change, improvement, and development.

Recent literature has introduced special 'sustainability dynamic capabilities', referring to a firm’s ability to adapt to the changing sustainability environment by integrating, building and reconfiguring competencies and resources to balance economic, social and environmental business objectives (Chen and Chang, 2013; Dangelico et al, 2017; Strauss et al., 2017; Wu et al., 2012). Furthermore, previous literature has also addressed the specific ethics-focused dynamic capability, i.e., the skills and resources that a firm needs to obtain synergies between ethics and performance over time (Arend, 2014). In relation to all these, the leader characteristics (e.g., transformational leadership behavior and leader’s interpretation of sustainability), are argued to be especially important in driving dynamic capabilities for sustainability (Eikelenboom and de Jong, 2017).

As discussed above, the development of SOI requires cooperative actions and integration of internal and external stakeholders, and thus also various levels of sensing capabilities. For example, as Castiaux (2012) presents, the development of green energy solutions requires capabilities to sense the opportunities and threats at the technological, market and environmental levels. They are solutions that need to comply with the regulatory environment, insights of technology suppliers, energy providers and distributors, as well as the requirements and environmental awareness of markets and the entire society.

From the perspective of SOI, the aim in product and business model innovation is to capture economic, environmental and social value. The seizing capabilities for sustainability play an important role for example in the selection of product architectures and business models (e.g., Iñigo et al., 2017), setting company boundaries and decision-making protocols, as well as in building loyalty and commitment. Furthermore, as SOIs are often complex solutions involving multiple actors, these capabilities play a crucial role in managing complements and controlling platforms and ecosystems. Seizing capabilities also helps in decision-making related to complying with trade-offs of different sustainability criteria and managing collective decision-making (Castiaux, 2012; Amui et al., 2017). Furthermore, transforming dynamic capabilities are required for SOI, as they refer to capabilities related to de-centralizing, co-specializing, adequate governance, and knowledge management (Teece, 2007). These play a crucial role in finding coherence between the firm’s sustainability-oriented strategy and new assets (Castiaux, 2012).
3 Methodology and research design

This section describes the methodological and philosophical background of the research. The chapter begins with a discussion of methodological approaches, including the philosophical assumptions guiding the research. Next, the chapter discusses the methodological choices and introduces the selected research methods. This is continued by introduction of the data collection and analysis methods. Finally, the chapter ends with an analysis of the overall research quality.

3.1 Methodological approaches

Choosing the appropriate methodological approaches for a certain research topic requires first creation of understanding of the philosophical orientation of doing research. In general, the philosophy of science is a system of beliefs and assumptions about the world and the development of knowledge (Saunders et al., 2016; Creswell, 2014; Creswell and Poth, 2017). In social research, the key philosophical concepts include ontology, epistemology, axiology and methodology (Creswell and Poth, 2017). These together shape the research choices and design, including the researcher’s understanding of the research question, chosen methodologies and interpretation of the findings (Crotty, 1998; Saunders et al., 2016; Creswell, 2014).

Ontology refers to assumptions about the realities and determines the choices regarding what to research (Creswell and Poth, 2017). It shapes the way of seeing and studying research objects such as organizations, management and organizational artefacts, and how the researcher sees the world of business (Saunders et al., 2016). Ontological considerations are based on the question of the nature of social entities, ranging from realist to subjectivist approaches (Creswell, 2014). Objectivism is a realist approach, where social phenomena are seen as objective entities that have a reality independent of social actors beyond research or influence (Bryman, 2012). In contrast, constructionism is a subjective approach, according to which social phenomena are seen as social constructions built from the perceptions and actions of social actors (ibid.).

Epistemology refers to making assumptions about human knowledge; its acceptability, validity and legitimacy and how this knowledge can be communicated (Creswell and Poth, 2017; Saunders et al., 2016). The central issue in epistemology is the consideration of the nature of the relationship between the researcher and the reality (Symon and Casell, 2012). As ontological positions, they vary from objectivistic to subjectivist views. According to the objectivist perspective, there exists an external world which is neutral. Thus, there exist true, observable facts. In contrast, from the subjectivist view, the world is built on observations and interpretations of individuals (Eriksson and Kovalainen, 2008). In the discussions between business economists, the basic themes of epistemological positions have followed especially the categories of positivist,
interpretive and critical research (Bryman, 2012; Eriksson and Kovalainen, 2008). Different epistemological assumptions have different implications in relation to the chosen methods, as well as the strengths and limitations of research findings (Saunders et al., 2016).

Axiology means assumptions regarding the extent and ways that the researcher’s own values influence the research process (Saunders et al., 2016; Hartman, 2011). They characterize qualitative research, as they usually influence the choices made regarding the research methodology (Creswell, 2014; Creswell and Poth, 2017). Understanding the role of values and ethics within the research process is important, in order to increase the credibility of the research results.

Methodological assumptions refer to choices regarding the research logic, strategy, methods and research data, i.e., the “organizing principles guiding the research” (Eriksson and Kovalainen, 2008, p. 16). The methodological assumptions are influenced by the above mentioned aspects of epistemological, ontological and axiological assumptions (Creswell and Poth, 2017). The methodological choices of the thesis are discussed in detail in the next section.

As van Maanen, et al. (2007) note, the focus of organizational and management research is on discovering, speculating, documenting, explaining, ordering, and predicting observable social processes and structures that characterize an organization's behaviour. Business and management studies is a multidimensional discipline, which adopts philosophies from natural and social sciences, and that is why also the research philosophies range between objectivistic and subjectivist approaches (Saunders et al., 2016). In business studies, the much-discussed philosophical orientations of researchers include positivism, post-positivism, interpretivism (also the related term of social constructionism), and pragmatism. Table 4 summarizes epistemological, ontological, axiological, and methodological assumptions related to these positions.
Table 4. Summary of the key philosophical positions (modified from Saunders et al., 2016; Creswell, 2014; Guba and Lincoln, 2005, Creswell and Poth, 2017).

<table>
<thead>
<tr>
<th></th>
<th>Positivism (explaining)</th>
<th>Postpositivism</th>
<th>Social constructionism (understanding)</th>
<th>Pragmatism</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ontology</strong></td>
<td>Realism: reality is real but apprehensible</td>
<td>Critical realism: reality is real, but imperfectly understood</td>
<td>Subjectivism: reality is constructed and co-constructed by the subjective views of individuals</td>
<td>Actions, situations and consequences</td>
</tr>
<tr>
<td>What is the form and nature of reality?</td>
<td>External, one true reality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is the world like?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Epistemology</strong></td>
<td>Objectivist: Findings are true - observable facts</td>
<td>Modified objectivist: findings are probably true – objective reality, shaped by the subjective views of individuals</td>
<td>Subjective: findings are constructed – individual meanings and actions</td>
<td></td>
</tr>
<tr>
<td>What is the nature of the relationship between the researcher and reality?</td>
<td></td>
<td></td>
<td></td>
<td>The world is not an absolute unity: truth is what works at the time</td>
</tr>
<tr>
<td>How do we know what we know?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Axiology</strong></td>
<td>Value-free: universal principles and facts</td>
<td>Facts about social reality are inseparable from values</td>
<td>Value-bound: interpretations, meanings, motivations and values of social actors, structures and patterns</td>
<td></td>
</tr>
<tr>
<td>What is the role of values in research?</td>
<td></td>
<td></td>
<td></td>
<td>Research based on intended consequences</td>
</tr>
<tr>
<td>How should we deal with the values of the researcher and research participants?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Methodology</strong></td>
<td>Quantitative methods</td>
<td>Quantitative and qualitative methods</td>
<td>Qualitative methods, Hermeneutical, interpretivism</td>
<td>Mixed methods</td>
</tr>
<tr>
<td>How can knowledge about the reality be obtained?</td>
<td>Hypotheses testing, measurements, experiments, surveys, statistical analyses</td>
<td>Critical multiplicity, falsification of hypotheses</td>
<td>Using all approaches available to understand the problem</td>
<td></td>
</tr>
</tbody>
</table>

The two best known philosophical positions are positivism and (social) constructionism, the latter of which is often combined with interpretivism. Positivism is quite often related to quantitative data, where the data is based on facts, numbers and large research data, and the research inquiry is seen to be value-free. It advocates the application of methods used in natural science in the context of social life (Bryman, 2012). From the point of view of positivism, qualitative research, where the data is typically collected by interviews and observations, can be problematic because of the nature of the testing methods. Instead, constructivism or social constructionism are often linked to qualitative research. The social world is seen to be constructed and reinforced by humans through their actions and interactions. These individuals then develop subjective meanings of their
This perspective is based on the idea that the subject matter of social science (people and institutions) differs from natural sciences (Bryman, 2012). Thus, studying the social world requires a different logic, and the researcher’s beliefs, values and assumptions are seen to have an effect on the studied area.

There exists also a pragmatist philosophical position in which the focus is on actions, situations and consequences (Creswell, 2014). The research following the pragmatist view uses all available approaches to find the best available solution to the problem in consideration (Patton, 1990). Thus, the key focus is on the problem and deriving knowledge regarding it. Pragmatists are not committed to any specific philosophy or reality, but their research is based on intended consequences. Pragmatists may use a mix of quantitative and qualitative research methods, techniques and procedures, selecting them according to their needs and research purposes (Creswell, 2014).

Falling between the positivist and constructivist positions is the position of postpositivism. The philosophical positioning of this thesis is in postpositivism, although the thesis falls closer to the constructivist than the positivist perspective. From the ontological perspective, the postpositivist approach follows the perspective of critical realism, where the reality is real and objective, but imperfectly understood and shaped by the subjective views of individuals (Guba and Lincoln, 2005). Furthermore, it acknowledges the existence of independent structures that constrain and enable these actors to pursue certain actions in particular setting (Wynn and Williams, 2012). As stated by Creswell (2014), this recognition of the fact that in studying humans, that we cannot be certain about their claims and knowledge, is the main issue separating postpositivism from positivism. In the postpositivist position, humans are seen to create the social reality, but the facts of social reality are seen to be unbound from values. Knowledge creation is based on careful observation and measurement of the objective reality, based on which the researcher seeks to develop statements that explain the phenomenon (Creswell, 2014).

Critical realism suits well especially for case research (Ackroyd, 2010; Easton, 2010; Wynn and Williams, 2014). The methodological approaches following critical realism are seen to provide more detailed causal explanations of complex phenomena and entities, such as organizations (Wynn and Williams, 2012). In critical research, attention is paid to the interacting structural entities, components, conditions and mechanisms that explain a given set of events (Bhaskar, 2008). The explanations are also drawn on actors’ interpretations (Wynn and Williams, 2012). As Wynn and Williams note, this positioning is applies multimethod and multilevel approaches to causal analysis, thus making it possible to address the rigor-relevance gap in management research (Hodgkinson and Rousseau, 2009; Syed et al., 2009).

3.2 Research design choices and data collection

This section introduces the research design choices of the empirical part of the thesis, summarized in tables 6-8. The main research designs include qualitative, quantitative and mixed approaches (Creswell, 2014). Generally, quantitative research approaches are
based on examining the relationships among variables with the aim to test objective theories. The research is often based on statistical analysis of numerical data and testing hypotheses and theories deductively (Creswell, 2014; Bryman, 2012). Qualitative approaches, on the other hand, are applied when the aim is to look at social and human problems and explore and understand the meaning that individuals or groups ascribe to them (Creswell, 2014). In qualitative research, the data is often based on words and emerging (open-ended) questions, analyzed inductively (Bryman, 2012). The researcher makes interpretations of data which is typically based on observations of a setting. The emphasis is on theory generation, whereas in quantitative research it is more on theory testing (ibid.). In qualitative research, also the abductive approach is used for theory development, which includes iterative development of inductive and testing of deductive inferences (Saunders et al., 2016). Somewhere in the middle of these two approaches there is the approach of mixed methods. It applies both quantitative and qualitative data collection and analysis methods with the general assumption of that these two approaches complete each other (Creswell, 2014). Table 5 summarizes the key methods and research practices commonly used in these research approaches.

<table>
<thead>
<tr>
<th>Commonly used</th>
<th>Quantitative approach</th>
<th>Qualitative approach</th>
<th>Mixed methods approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philosophical assumptions Strategies of inquiry</td>
<td>• Positivist (postpositivist) knowledge</td>
<td>• Constructivist, transformative knowledge</td>
<td>• Pragmatic knowledge</td>
</tr>
<tr>
<td></td>
<td>• Surveys and experiments</td>
<td>• Phenomenology, grounded theory, ethnography, case study and narrative</td>
<td>• Sequential, concurrent and transformative</td>
</tr>
<tr>
<td>Employed methods</td>
<td>• Closed-ended questions, predetermined approaches, numeric data</td>
<td>• Open-ended questions, emerging approaches, text or image data</td>
<td>• Open- and closed-ended questions, emerging and predetermined approaches, quantitative and qualitative data and analysis</td>
</tr>
<tr>
<td>Research practices</td>
<td>• Tests or verifies theories or explanations</td>
<td>• The researcher positions her/himself</td>
<td>• Collection of quantitative and qualitative data</td>
</tr>
<tr>
<td></td>
<td>• Identifies variables to study</td>
<td>• Collection of participants’ meanings</td>
<td>• Develops a rationale for mixing</td>
</tr>
<tr>
<td></td>
<td>• Related variables in questions or hypotheses</td>
<td>• Focus on a single concept or phenomenon</td>
<td>• Integrates the data of different stakes of inquiry</td>
</tr>
<tr>
<td></td>
<td>• Uses standards of validity and reliability</td>
<td>• Personal values involved</td>
<td>• Presents visual pictures of the procedures in the study</td>
</tr>
<tr>
<td></td>
<td>• Observes and measures information numerically</td>
<td>• Study in the context or setting of participants</td>
<td>• Employs the practices of both qualitative and quantitative research</td>
</tr>
<tr>
<td></td>
<td>• Uses unbiased approaches</td>
<td>• Validation of the accuracy of the findings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Employs statistical procedures</td>
<td>• Interpretations of the data</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Creation of an agenda for change or reform</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Collaboration with participants</td>
<td></td>
</tr>
</tbody>
</table>
All the individual studies of the thesis follow the qualitative research approach. The specific research methods include a variety of data collection, analysis and interpretation techniques. In qualitative studies, the most commonly used methods include emerging methods, open-end questions, interview data, observation data, documentary and audio-visual data, text and image analysis, and interpretation of themes and patterns (Creswell, 2014). The selection of the specific research methods has based on careful consideration of the best methods to support the aim and scope of each individual study. Triangulation of methods, investigators and data sources has been used to create comprehensive understanding of the research topic and validity (Patton, 1990; Carter et al., 2014). The empirical research methods used in the research include case study (I, II, III, VI) and design science research (V). In addition, publication IV is based on a literature review to form a conceptual model, which is further combined with a mathematical model. The use of these models is illustrated in an empirical context. Table 6 summarizes the research design choices of each individual publication, which are discussed next. Section 3.3 concerns the details of the data analysis.

**Table 6. Research design in the individual publications**

<table>
<thead>
<tr>
<th>Publication</th>
<th>Research objective</th>
<th>Reasoning logic</th>
<th>Research methods and analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>To examine the challenges that hinder the development of SOI with system-level impacts</td>
<td>Induction: from specific to generalization</td>
<td>Conceptual literature-based framework development, Case study, Qualitative data analysis</td>
</tr>
<tr>
<td>II</td>
<td>To examine the potential tensions rising from the implementation of sustainable business practices and their impact on different network actors</td>
<td>Induction: from specific to generalization</td>
<td>Case study, Qualitative data analysis</td>
</tr>
<tr>
<td>III</td>
<td>To examine the challenges of sustainability knowledge utilization and their relationship with the development of SOI.</td>
<td>Induction: from specific to generalization</td>
<td>Case study, Qualitative data analysis</td>
</tr>
<tr>
<td>IV</td>
<td>To identify the basic requirements for value creation in multi-sided markets in the context of sharing economy</td>
<td>Abduction: inference to best explanation</td>
<td>Conceptual literature-based framework development, Illustrative case</td>
</tr>
<tr>
<td>V</td>
<td>To identify the key design problems and choices to be made in designing platform-based business advancing sustainability</td>
<td>Induction: from specific to generalization</td>
<td>Conceptual literature-based framework development, Design science research</td>
</tr>
<tr>
<td>VI</td>
<td>To explore the level of SOI knowledge among current decision-makers and identify the special skills required for the development of SOI. Understanding the importance of continuing education in advancing SOI.</td>
<td>Abduction: inference to best explanation Induction: from specific to generalization</td>
<td>Case study, Qualitative data analysis</td>
</tr>
</tbody>
</table>
3.2.1 Reasoning

Most of the individual publications rely on inductive reasoning (I, II, III, V). Publication IV is based on abductive reasoning, and publication VI combines these two. In general, reasoning can be understood as a research process of drawing conclusions and explanations and constructing models and predictions. There are three types of reasoning, inductive, abductive and deductive, which all have different philosophical premises for argumentation (Saunders et al., 2016). In deductive reasoning the reasoning is based on using general rules to find a specific conclusion to a specific application. Inductive reasoning starts from observations of specific (limited) applications and moves towards a general conclusion and explanations (Thomas, 2006). However, in real life research, a clear distinction between the two can be difficult to make, as both approaches are seen to entail elements from the other (e.g. Bryman, 2012). For example, new theoretical ideas may be published during the (deductive) research process having an impact on the findings of the research. Abductive reasoning is common in everyday decision-making, where the best compatible explanations are drawn from a (incomplete) set of observations available. Both the evidence and the explanation may be incomplete, as abductive reasoning lacks completeness. However, this process allows creativity and it is argued to be intuitive and even revolutionary, involving imagination and visualization (Saunders et al., 2016).

3.2.2 Case study

Most of the individual publications of the thesis follow the multiple-case study approach (I, II, III, VI). Collecting the data from multiple organizations made it possible to compare insights across cases and increased the generalizability of the results. The details of the data collection and analysis for each individual study are described in section 3.3.

Case study is a research method commonly used in qualitative business studies, where the focus is on examining a complex social phenomenon (Halinen and Törnroos, 2005; Yin, 2009). The phenomenon is explored from multiple lenses and using a variety of data sources, allowing a creation of deep understanding of the phenomenon in its real-life context (Creswell, 2014; Yin, 2009). The case is a unit of analysis, a phenomenon occurring in an abounded context (Miles and Huberman, 1994). As this definition is relatively broad, it is important to place the boundaries on a case (Yin, 2009; Stake, 1995). As Baxter and Jack (2008) note, this binding a case, e.g., by time and place (Creswell, 2014), time and activity (Stake, 1995), or by definition and context (Miles and Huberman, 1994) can help in keeping the study context reasonable.

There is also a variety of case study types focusing, e.g., on exploring a phenomenon, comparing cases, or providing a deep description about a case (Baxter and Jack, 2008). In addition, case studies vary from single in-depth cases to multiple-case approaches (Yin, 2009). A descriptive case study describes the phenomenon and the context of its occurrence, whereas an exploratory case study is used when there is no clear, single set of outcomes in the situation. The selection between single or multiple-case study is related
to the aim of the study, whether it is in describing an existence of a phenomenon or illustrating a theory (Sigglekov, 2007) or in building a more generalizable theory (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). Especially multiple case-studies provide a great standpoint for exploratory research, allowing analysis within each individual case setting, as well as comparison between cases (Yin, 2009).

Determining the case study setting and its boundaries is followed by the consideration of the case proposition (Yin, 2009; Miles and Huberman, 1994), application of a conceptual framework (Miles and Huberman, 1994), research question(s), logic of creating links between data and propositions, and criteria for the interpretation of the findings (Yin, 2009; Baxter and Jack, 2008). In case studies, the conceptual frameworks are a kind of research guides that are drawn on proposals. They can be based on the literature or, e.g., on the researcher’s experiences, and will be completed by the research findings (including the themes arriving from data analysis). As Miles and Huberman (1994) note, conceptual frameworks help in: identifying who to add to the study, describing the relationships between logic, theory and experience, and gathering and forming general constructs.

As in multiple-case study the goal is to replicate findings across cases, careful case selection is especially important (Baxter and Jack, 2008). There are different methods to guide in the case selection. For cross-case research, the case selection can be based on selecting, e.g., the most typical, diverse, extreme, deviant, influential, similar, or different cases (Seawright and Gerring, 2008). Maybe the best known case selection method is theoretical sampling (Eisenhardt, 1989; Eisenhardt and Gaebner, 2007). In this approach the selection of cases is based on theoretical reasons, e.g., selecting the cases that are most likely to replicate or extend the theory or fill certain theoretical categories (Eisenhardt, 1989). Especially in qualitative case studies, the case selection is based on purposive sampling, and the selected cases are studied intensively, including a lot of information. The selection of cases is conceptually driven and designed to allow analytic generalizations (Curtis, et al. 2000). According to Curtis et al. (ibid.), citing Miles and Huberman (1994), qualitative sampling can provide opportunities to select and examine observations of processes which are a key to our understanding of a new or an existing theory about the phenomenon being studied. Following this, the case sampling can be evaluated by the six attributes of:

- relevancy to the conceptual framework and the research questions;
- generation of rich information on the type of studied phenomena;
- the sample enhances the generalizability of the findings;
- the sample produces believable descriptions or explanations;
- ethicality of the sample strategy, and
- feasibility of the sampling.

(Miles and Huberman, 1994; Curtis et al., 2000)
3.2.3 Design science research

Design science research (DSR) is an approach where knowledge and understanding of the phenomenon is created by designing an artefact (Jelinek et al., 2008). The aim is to solve a managerial problem. The DSR process can be divided into three phases: considering the relevancy of the research, the design cycle, and the rigor cycle (Hevner, 2007). The first phase includes the activities for bridging the conceptual environment and design science activities (ibid.). This includes specifying the problem and motivation for the research and creation of an objective definition. In the second phase the focus is set on building and evaluating the research process and the designed artefact. The last phase includes the activities of connecting the research with existing knowledge and experiences (Peffers et al., 2008). Although the use of the DSR approach is relatively new in management studies, it is widely utilized in information system (IS) research (Iivari, 2007) and seen to provide a valuable research method also for solving management problems (Jelinek et al., 2008; van Aken and Romme, 2009; Sein et al., 2011).

3.3 Data collection and analysis

The data collection and analysis of this thesis was done by following the qualitative research approach. The main research method for data collection was semi-structured interviews (publications I, II, III and VI). Empirical data was also collected by organizing focus groups with expert participants (publications III, V, VI), surveys (V), and learning diaries (VI). All the interview data was carefully recorded and transcribed. In addition, the data included field notes of the interviews and focus group sessions.

Interviews and focus groups are examples of researcher-provoked data, where the data is created actively, including the researcher’s intervention. In contrast, naturally occurring data refers to data not affected by the researcher, and the data can be thus observed in its natural form. However, as Silverman (2005) acknowledges, the identification of interesting or relevant naturally occurring data may be challenging. On the other hand, researcher-provoked data has been criticized due to the influence of words used by the researcher or questions to the respondents. Despite this, especially interviews are seen as valuable research methods in management studies, as they enable the researcher to set the focus straight to the key issues of the phenomenon and create deep understanding of the issue (Silverman, 2005; 2006). This thesis utilizes mainly researcher-provoked data. However, to increase the validity of the research, additional data sources included the organizations’ webpages, sustainability reports, and existing theoretical and managerial literature, which present naturally-occurring data.

The data analysis was executed by following the guidelines of qualitative data analysis, including data reduction, data display, drawing of conclusions and verification (Miles and Huberman, 1994). The main research analysis method was content analysis, which has been described to provide a flexible method for analysing textual data (Cavanagh, 1997). Data reduction was done by utilizing the NVivo 10 software, designed especially for qualitative data analysis purposes (Bazeley and Jackson, 2013). In general, this means
going through the textual data, selecting the key parts and simplifying and abstracting the meanings (Hsieh and Shannon, 2004). This was followed by data display, which means an organized presentation of the reduced data, e.g., through graphs, pictures, matrixes, or tables. Careful data display allows drawing conclusions and verification, i.e., the production of meanings of the analysis (Miles and Huberman, 1994). As Miles and Huberman (ibid.) note, these conclusions can include for example theoretical propositions, explanations, causal flows, and patterns.

Studies I, II, III and VI, where the main data was gathered by semi-structured interviews, were based on content analysis of the textual data. These studies followed conventional content analysis. This approach is particularly appropriate in situations where the existing theory or research literature is limited (Hsieh and Shannon, 2004). The data analysis started with coding the data to highlight the core issues. This was continued by an initial analysis of the data, the researcher forming initial categories and writing down her notes and thoughts. These were analyzed further to form categories of multiple ideas from the data, and to see the links and relationships between these categories. The emergent categories were used to form meaningful clusters (Patton, 1990). Another type of content analysis is directed content analysis, where previous literature or empirical research is utilized to guide the first level of coding (Hsieh and Shannon, 2004). This was the method for studies I, IV and V. The main strengths of directed content analysis include the possibility to support and extend existing theory. For example, for publication I, a conceptual literature-based framework was used as the starting point for the analysis of the data. Also in publication V, the data of the surveys and focus groups was analyzed by using directional content analysis. More details about the design science research methodology used to collect and analyze the data for study V is presented in section 3.3.2.

A major amount of the research data was collected during two separate research projects. The research data for publications I, II, III was collected during the research project StraSus (Strategic business models and governance for sustainable solutions) funded by the Finnish Funding Agency for Technology and Innovation. In this project the focus was especially on service concepts and business models which support the development of new business based on sustainable production and energy and material efficiency. The project involved four research organizations and four major company partners. The research data for publication V was collected within the ‘Door to Door Information for Airports and Airlines’ (DORA) project, funded by the European Union’s Horizon 2020 research and innovation program. This research project involved 13 participants from five countries. The main focus was on optimizing the travelling of air passengers by integrating information about private and public air- and land transport service providers, transport disruptions, airport navigation, etc. In addition to creating benefits for the passenger, the ultimate aim was to create social and environmental benefits by increasing the efficiency of traveling across Europe.

Table 7 summarizes the data collection and analysis methods of each publication. The overall process of data collection and analysis within each individual publication is discussed next. The companies that were involved in the research came from industries
that process natural resources, work as development organizations, or provide supporting services for companies working with sustainability issues. A majority of the companies were linked to the cleantech field, which comprises various industries, such as water and waste management, renewable energy and sustainable transportation. The companies in this field execute various types of sustainable business practices and innovations that aim at creating sustainable value, such as green products and technologies that aim at improving environmental efficiency. More details, e.g., of the industries and the expertise areas of the informants are presented in the second part of the thesis, consisting of the individual publications.

### Table 7. Data collection and analysis of the individual publications

<table>
<thead>
<tr>
<th>Publication</th>
<th>Data collection</th>
<th>Data analysis</th>
</tr>
</thead>
</table>
| I           | • 27 semi-structured interviews: 40 experts from 13 industrial organizations  
• UN Global-Compact – Accenture research reports: CEO Study on sustainability and Special edition: a Call to Climate Action | Conventional content analysis (interviews)  
Directed content analysis (reports) |
| II          | • 30 semi-structured interviews: 43 experts from 17 organizations from a regional network | Conventional content analysis |
| III         | • 12 semi-structured interviews: 27 experts from four industrial organizations  
• Focus group: 16 expert participants from four industrial and four research organizations. | Qualitative data analysis:  
Conventional content analysis |
| IV          | • Existing theoretical and empirical research on sharing economy, business models and value co-creation.  
• Case of New York Taxi | Literature review and conceptual framework development  
Directed content analysis (illustrative case) |
| V           | • Existing theoretical and empirical research on platform-based business and value creation.  
• Case of DORA Mobility-as-a-Service platform:  
  • Survey for 25 experts  
  • Four global focus groups of 22, 19, 17 and 8 experts presenting the key stakeholders of DORA | Literature review and conceptual framework development  
Directed content analysis (focus groups and surveys) |
| VI          | • 17 learning diaries and a survey for experts from 13 industrial organizations  
• Focus group of 17 experts  
• 7 semi-structured interviews with 11 regional decision-makers | Conventional content analysis (learning diaries, surveys, focus group) |
3.3.1 Data collection and analysis of the case studies

In publication I, where the focus was on examining the challenges in delivering systemic innovations for sustainability, the data was gathered by executing 27 interviews in 13 organizations. The study introduced a conceptual, literature-based framework, which was further examined and developed on the basis of the findings from the cases. Involving multiple cases was seen necessary to increase the generalizability of the results. The case selection was based on theoretical sampling (Eisenhardt and Graebner, 2007) and on the criteria of focus on sustainability development, B2B market and the industry context. All the companies involved had a long history on sustainability reporting, and many of the companies had introduced sustainability-oriented products, such as bio-oil. The study was executed in the Finnish context, as sustainable development has a mature role in Finnish companies, authorities, consumers, and the society as a whole. In addition to the interview data, an additional, secondary data source included the UN Global Compact – Accenture CEO Study on sustainability and the Special edition: a Call to Climate Action. These reports presented research results of 1000 and 750 experts from member companies of the UN Global Compact Sustainability Initiative. The data analysis followed the content analysis method with the aim of analyzing meaning from textual data. The data analysis was inductive by nature, moving from observations to a conclusion.

Publication II focused on the tensions of sustainable business practices in business networks. Theoretical sampling was used to identify firms that had been adopting and developing sustainable business practices. The study drew on 30 interviews in 17 organizations. These organizations formed a regional cluster with a strong history of collaboration and ongoing sustainability initiatives. The organizations involved also regional development organizations that facilitate the development and implementation of regional sustainability initiatives. From the conceptual perspective, this network is akin to an industrial symbiosis network, including multiple industries with a collective aim to enhance sustainability in a socially embedded and regionally constrained system. Selecting case study as the research method was identified especially valuable, as it provided an opportunity to create deep understanding of the issue in its natural context. As sustainable business practices aim at creating environmental, social and economic value, they influence also the (regional) network of actors. Thus, gathering data from multiple organizations within a regional network made it possible to deepen the understanding of this complex phenomenon. The data analysis followed the content analysis method, and the inductive analysis of the empirical data revealed multiple potential tensions of sustainable business practices in business networks.

Publication III focused on the challenges in utilizing sustainability-related knowledge for innovation. The goal was to understand the complexity of this business-related phenomena and to produce new knowledge in a real business-life context. Thus, case study was selected as the research approach. To create comprehensive understanding of the issue, data source triangulation was used (Patton, 1990). In this study, there were four different case organizations and the data was collected by conducting 12 interviews with 27 informants. The selection of companies was based on their involvement in a national
research project with the focus on strategic business models for sustainability and common interest on developing innovations for sustainability. The analysis of the data followed the inductive approach and was executed by utilizing the content analysis method (Miles and Huberman, 1994). The data analysis revealed multiple challenges that these companies had faced in identifying and utilizing relevant sustainability information hampering sustainable value creation. On the basis of the findings, a second data collection round was executed by organizing an expert workshop. This workshop represented a facilitated focus group session, which is considered especially suitable for research exploring people’s feelings and experiences (Kandola, 2012). The 16 focus group participants were knowledgeable experts of the issue from the case organizations and the academia. In publication III, the case studies served various purposes. To start with, in the first data collection phase, the cases provided empirical input on the challenges in executing sustainable business and how companies see the value of sustainability as a part of their business. Inductive analysis of the data revealed the challenges to be especially linked with the utilization of sustainability knowledge, which was further examined in the focus group session. The focus group was used to deepen the understanding of the challenges in sustainability knowledge utilization and to identify ways of dealing with them. The multiple cases and the variety of participants’ backgrounds made it possible to deepen the understanding of the research area of the development of SOI, which is partially dependent on industry-specific factors and the organization’s position in the value chain. The findings of the focus group revealed the possibilities of digital solutions as tools to reduce the identified challenges. To deepen the understanding of this specific issue, the analysis was continued by arranging a workshop with external experts with special expertise in the issue.

Publication IV was a theory-based study of value creation for the sharing business model for ridesharing. To help in the understanding the conceptual and mathematical model, the study introduced the models in the case context of New York Taxi. This context was selected because several empirical studies have shown (e.g., Santi et al. 2014; d’Orey et al. 2012) that taxi ridesharing presents a business model in sharing economy that shows significant potential for cost efficiency and positive environmental and social outcomes, i.e., value creation for SOI. The case provided empirical input to abductive development of the framework as well as to illustrate value creation in multi-sided markets. Literature review was used to form a conceptual model of the benefits and sacrifices from the perspectives of the supplier and the passenger (customer) involved in ridesharing. Based on the elements presented in this model, the researchers formed a mathematical formula to calculate value creation for this type of a business model. The model was further utilized to study the context of New York Taxi and to create understanding of value creation for combining taxi services in this context. The analysis of the empirical context followed directed content analysis, where the conceptual model was utilized to examine the empirical phenomenon.

In publication VI the focus was on deepening the understanding of skills required for decision-making for SOI. The data comprised insights from various data sources, including surveys, focus group discussion, learning diaries, and interviews. This data
source triangulation was used to increase the validity of the research (Patton, 1990). The main data comprised the insights of 17 business experts, working for 13 different organizations in 10 different industries. The case selection followed purposive sampling, and the experts were selected due to their participation in an innovation management course organized for business purposes. This course is a part of a fully accredited university-level continuing education program in innovation management in Finland. It represents high-level adult education in Finland, which is also ranked among top countries in sustainability as well as in educational rankings. The course focuses on developing the participants’ knowledge on the topic of innovation management and especially on the development of skills and knowledge related to sustainability-oriented innovations. Thus, the context was seen especially relevant for studying the phenomenon in question. The data included survey responses concerning topics of how the informants saw their own and their firm’s current status of SOI. This survey served the special purpose of providing empirical insights into the companies’ current status and the informants’ experience of the topic. The analysis of the survey results followed the abductive approach, in which the data was analyzed by combining the results with the existing theories in the areas of Education for Sustainable Development (ESD), SOI and capacity development in innovation management. The data analysis, informed with these theories revealed that decision-making concerning sustainability decisions requires the creation and development of special skills and capabilities, especially among current decision-makers. The data collection was continued by facilitated focus group discussion and gathering learning diaries from the participants. The aim of the learning diaries was to identify the informants’ feelings, experiences, level of previous education and knowledge, competence, and skills that help them making decisions related to SOI. Furthermore, the learning diaries concerned the informants’ knowledge gaps and desired skills and competences to improve their SOI-related decision-making. The analysis of the learning diaries applied the content analysis method, going through the pre-expectations that the experts had on the management of SOI, and observing the lacking competences, skills and knowledge related to this. These insights were further combined with the insights from seven interviews with 11 additional municipality-level decision-makers across Finland. Executing these interviews provided additional and supporting insights into the requirements for developing competencies and skills for SOI decision-making and the role of continuing education in facilitating the development of these. The interviews of regional-level decision-makers provided an opportunity to complement the study with perspectives outside the continuing education program.

1 Continuing education (or further education) means complementary education and different types of qualifications (such as certificates, diplomas, credits and competency-based qualifications) aiming at providing people with skills or knowledge to deepen the expertise on various subjects. It is separate from higher education, presenting the final stage of formal learning after secondary education, although it may be provided by universities (Jarvis, 2012).
3.3.2 Data collection and analysis for design science research

Publication V followed the design science research (DSR) approach, in which the focus is on designing an artefact – a specific framework for platform design. This platform design framework introduced the core design problems of four categories: platform architecture, value creation logic, governance, and platform competition. The theory-based framework was combined with empirical research of the development of the DORA (Door-to-Door Information for Airports and Airlines) platform. DORA is an information system (IS) for the integration and exploitation of mobility information. This information is organized through DORA and used for optimizing door-to-door travelling experiences, connecting different mobility business actors and facilitating value creation for networked actors. In addition to optimizing the travelling experience of a passenger, the aim of DORA is to answer the trends of green and efficient transportation and the challenges of urbanization. DORA aims at creating value for a variety of stakeholders, including environmental and social benefits (such as lowering energy usage and emissions through increased shared and public transportation), business benefits (optimization of transportation resources), and personal user benefits (easy travel definition and travel optimization). In DSR, the core aim is to create knowledge and understanding by building and applying a designed artefact to be utilized in solving a managerial problems (Jelinek et al., 2008). Thus, this research approach was seen especially applicable for this specific study. The background and purpose of the design science research is described in the following, and a more detailed description of the DORA case can be found in publication V.

The DSR approach is especially appropriate for understanding platform design for two reasons. First, a design artefact is a broad concept, including models, methods, construct design theories, social innovations, and previously unknown properties of resources. This approach provides a possibility for future-oriented research, which is crucial for studying an area which is just emerging. Secondly, DSR offers a possibility for making managerial design propositions and creating new academic knowledge (Gregor and Hevner 2013). Thus, the approach is particularly suitable for creating theoretical and practical understanding of the platform design (Jelinek et al., 2008).

The research for publication V was executed by following the guidelines for DSR (Hevner, 2004; Peffers et al, 2008; Sein et al., 2011). Based on the DSR guidelines, the research started with problem and motivation specification and defining the research objective (Peffers et al., 2008). In the study context, this meant a need for a more efficient process of designing a value-based business model of a platform-based ecosystem, and the development of a normative framework for platform design. This was continued with the building and evaluation of the designed artefact. In practice, this phase included first the creation of a literature-based framework combining product design, organizational design and platform ecosystem research. The use of this literature-based framework was then demonstrated in the empirical DORA context. The experiences of the key stakeholders and experts were used to validate the framework. The test and evaluation of the theory-based framework was conducted within four international workshops,
participated by experienced representatives of the key stakeholders of the platform. Data triangulation was used to increase the validity of the study (Carter et al., 2014), combining data from field notes and questionnaires as well as other additional sources, such as airport websites in the analysis. The final, important part of the DSR process is the connection of the research with existing knowledge and experiences (Peffers et al., 2008). In addition to evaluation of the framework with the DORA consortium, the framework was presented in a workshop of technological and academic experts. Furthermore, a summary of the research was presented in an academic conference and through the individual publication V included in this thesis. This increases the credibility and confirmability of the results (Miles and Huberman, 1994).

3.4 Quality of the research

For any research, it is especially important to consider the issues of research reliability and validity, as well as trustworthiness, quality and rigor. Especially in qualitative studies these issues cannot be determined in the same way as in the case of quantitative research, which is traditionally judged by the criteria of internal validity, external validity, reliability, and objectivity. Maybe the best-known evaluation criteria for the evaluation of the quality of academic research are reliability, validity and generalizability (Miles and Huberman, 1994; Patton, 1990; Erikson and Kovalainen, 2008), which are, however, seen to be more suitable for the positivist and realist approaches. To get better criteria for the evaluation of qualitative study, Lincoln and Guba (1985) have proposed the categories of credibility, transferability, dependability and confirmability, to address especially the trustworthiness of the research. The purpose is to evaluate the validity of the finished study with these criteria.

To fulfil the criteria of trustworthiness, rigor and quality, the thesis has been compiled of high-quality peer-reviewed international articles. To enhance the reliability and validity of the study, several actions have been conducted. The key actions are summarized in table 8 and discussed in detail below.
Table 8. Summary of the key actions to improve the research quality of the current study

<table>
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<tr>
<th>Criterion</th>
<th>Key actions</th>
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| Credibility    | • Close interaction with case organizations, including presentations and discussions of the researcher’s interpretations with case firm representatives  
|                | • Close interaction with research project partners                           
|                | • Data triangulation: multiple data types and sources                        
|                | • Presenting the results for academic audiences in conferences and through peer-reviewed journal articles |
| Transferability| • Careful selection of cases (theoretical sampling)                          
|                | • Cases represent multiple industries and organization types                  
|                | • Informants represent multiple expertise areas relevant to the research topic|
|                | • Providing details of case selection                                         |
| Dependability  | • Recording and transcribing the data                                        
|                | • Storing data in a collective database                                       
|                | • Detailed field notes                                                       
|                | • Detailed (written) descriptions of the research processes                  |
| Confirmability | • Multiple data sources                                                      
|                | • Systematic data gathering procedure and clear documentation                
|                | • Systematic data analysis, use of NVivo 10 software                         
|                | • Illustrations of coding (and thinking) paths                               
|                | • Illustrative data excerpts, e.g., original quotes                           |

Research credibility means consideration of the credibility and believability of the research results from the research participants’ (informants) perspective. This means consideration of how well the interpretations of the data (observations and conclusions) are in line with the informants’ views. To address research credibility, multiple actions were executed. Firstly, the research was conducted in close interaction with representatives of the case companies. The data was gathered within two large, individual research projects and one university-level course. The researcher was involved in all these projects together with multiple representatives from the industry and the academia. The projects involved high levels of interaction with all participants, including continuous presentations and discussions of the interpretations of the researchers with the representatives of the case firms (i.e., member checking). For example, the findings were presented in firm-specific workshops and steering group workshops of the research projects. These actions helped to ensure that the interviewees’ opinions on the issues were understood correctly, and they could confirm the credibility of the information. This helped also to confirm that the results of the case-study reflected the reality as far as possible (Creswell and Miller, 2000). Secondly, data triangulation was used to ensure a deep and complete view of the issue (Patton, 1990; Yin, 2009; Baxter and Jack, 2008). Multiple types of data were utilized, including data, e.g., from interviews, surveys, focus groups, and literature. Thirdly, within each individual publication, the data was collected from multiple sources, and the data was also checked by multiple researchers. According to Creswell and Miller (2000), multiple data sources help to increase the validity by achieving convergence among the different categories and themes of the phenomena under study. Finally, the credibility of the results was enhanced by presenting the research results in multiple academic conferences. In addition, the individual publications went
through a peer review process for the full paper. This was the case for all the other publications except for publication VI, which went through a peer-review process for a 1500 word outline, summarizing all the core items of the study.

**Transferability** refers to the transformation or generalizability of the findings from the research sample into other contexts or settings. The transferability of the results was enhanced by the following actions. First, the selection of the cases (industries, companies and informants) was based on theoretical sampling. Basing the case selection on theoretical reasons is acknowledged to be important especially in case studies, as the aim of the qualitative findings is often to extend theories or fill theoretical categories (Eisenhardt, 1989; Glaser and Strauss, 1967). Thus, the careful theoretical sampling used in most of the individual studies of this thesis, increased the transferability and trustworthiness of the research. Secondly, the case companies represented many different industries and types of organization, which increased the transferability of the results. Also the informants were selected due to the relevancy of their expertise and work position in the research topic. The details of the cases and their selection are given in each individual publication. This allows the readers to analyze the fit of the findings to their own, specific premises.

**Dependability** refers to quality control of the study, meaning the researcher’s responsibility to offer information about the research process. This is done to ensure the replicability of the research and to show that the process has been logical, well documented and traceable (Eriksson and Kovalainen, 2008). To increase the dependability, all the interview data for each individual publication was recorded, transcribed and stored carefully. Furthermore, detailed notes were made during the meetings of the focus groups and interviews. Also the data from the surveys and learning diaries were carefully stored. Detailed descriptions of the research process (e.g., according to the interview themes) within each individual study are provided in the publications.

**Confirmability** means in general that the results should be based on gathered data, and the links between the findings and conclusions are understandable to others. The empirical data was gathered in a systematic manner from several sources. In all data collection and analysis phases, clear documentation (i.e., the audit trail) was done, including details of research decisions and activities. The analysis was conducted systematically with the help of the Nvivo 10 program, designed for qualitative data analysis purposes. The findings were reported in a way that the reader can easily follow the logic of the interpretations made. This included for example providing illustrative examples of the coding paths. The data was coded by using the similar coding path for all the data of a particular individual study. The coding path used in content analysis was also discussed with co-researchers. In addition, extracts of the data were provided, including quotes from the interviews. These original and detailed examples of the data were used to provide proof of the findings.
4 Summary of the publications and results

This section introduces the primary findings of the thesis by summarizing the key results and contribution of each individual publication. Table 9 summarizes the research gaps and research topics addressed in individual publications. The last subsection presents a summary of the findings and discusses their relationship with the theoretical background of the thesis.

Table 9. Research gaps and topics addressed in individual publications

<table>
<thead>
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<th>Publication</th>
<th>Addressed gaps and research topics</th>
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| Publication I | • Identified challenges caused by structural impediments, uncertainty avoidance and conflicting aims within and between firms that hold back the creation of SOI with system-level impacts.  
• Identified the firms’ need to acquire capabilities in open innovation, evaluating and seizing radical opportunities, and reconfiguring the organization for systemic innovations for sustainability. |
| Publication II | • Identified economic, structural, psychological and behavioral tensions that appear related to implementing sustainable business practices in networks.  
• Explored the side-effects and negative value creation for SOI. |
| Publication III | • Identified the challenges of sustainable knowledge utilization related to different knowledge utilization process phases.  
• Analyzed the impact of digital solutions to address the identified challenges  
• Highlights the need for the development of organizational sustainability competences and capabilities, and education of decision-makers. |
| Publication IV | • Described sustainable value creation potential of sharing business model.  
• Identified the drivers and barriers for value creation for SOI and innovation management requirements in sharing economy context. |
| Publication V | • Identified the requirements for collective value creation for SOI through platform design.  
• Identified innovation management requirements for SOI in a platform-based business. |
| Publication VI | • Identified a set of underdeveloped competences presenting a target for the development of SOI education.  
• Highlights the need for the development of special skills and capabilities for SOI through continuing education. |
4.1 Publication I: Exploring the pitfalls of systemic innovations for sustainability

4.1.1 Background and objectives

There exists a strong call for sustainability-oriented innovations which shift firms’ focus from linear business operations increasingly to improving entire social systems (e.g., Adams et al., 2016; Iñigo and Albareda, 2016). This means a need for increased engagement with various external stakeholders and aims at achieving radical changes collaboratively. From the business perspective, considering wide system-level sustainability, the challenges are also seen to provide strategic advantages and create new market opportunities. In regard to this, previous studies have shown that the ambition to move beyond incremental changes exists, but firms fail largely in executing such innovations (e.g., Xavier et al., 2017). The first publication addresses the reasons behind this particular issue. The objective of the first publication was to explore the challenges of deriving systemic innovations for sustainability, i.e., seeking SOI with system-level impacts.

4.1.2 Main findings

The findings of the study were based on the empirical perceptions of 27 business experts from a multi-industry sample of globally operating Finnish companies. The firms, regardless of industry, were found to face three categories of inter-connected challenges in executing systemic innovations for sustainability. These challenges were related to 1) structural impediments, 2) uncertainty avoidance, and 3) conflicting aims within and between firms. Each of these categories were found to be connected to lacking capabilities in open innovation, evaluating and seizing radical opportunities, and reconfiguring the organization for systemic innovations for sustainability. More specifically, the common challenges were identified to be linked to the lacking ability of the current dynamic capabilities to address the idiosyncratic demands of shifting to a systems view in innovation for sustainability.

4.1.3 Main contributions

The study contributes to the discussion of SOI by paying attention to the need to develop specific dynamic capabilities to address sustainability-related challenges and develop more radical innovations and SOI with system-level impacts. The findings provide empirical verification of the current understanding about the challenges of systemic innovations for sustainability and links them to cumulative problems along innovation processes. The results highlight the need for innovation tools that address the nonlinear and dynamic issues involved in sustainability. This requires understanding the possible negative impacts of implementing SOI. The findings of the study contribute to the literature also by highlighting the links between undeveloped capabilities and decision-making problems. The undeveloped capabilities manifest as decision-making problems
in evaluating innovation outcomes and alternatives through the innovation process and communicating them to capture the intended value. From the managerial perspective, to acquire appropriate capabilities, firms should focus on building adaptive learning capacities and redesign processes to accommodate extensive uncertainty and collaboration. The development of capabilities for open and radical innovation could begin by addressing the challenges.

4.2 **Publication II: The darker side of sustainability: Tensions from sustainable business practices in business networks**

4.2.1 **Background and objectives**

Sustainability is considered as a key strategic direction for firms, nations and the society (Finke et al., 2016), and companies are increasingly implementing different types of sustainable business practices with the aim to create sustainable value (Johnsen et al., 2017). The mainstream of the literature concerning sustainable development assumes that implementing such practices will lead to win-win situations. Sustainable business development is driven by the need to commercialize solutions with positive environmental, economic and social impacts, i.e., finding sustainability-oriented innovations. Due to high the interest in convincing business managers to execute SOI, much of the literature has focused on examining the potential business benefits of different sustainability initiatives (Sharma et al., 2010; Fearne et al., 2012; Doganova and Karnøe, 2015; Patala et al., 2016). However, implementing sustainable business practices has a potential and high probability to involve also trade-offs and unexpected and detrimental consequences creating tensions between the network actors (Hahn et al. 2010; Öberg et al. 2012), presenting significant challenges for SOI. Previous research has addressed tensions from the perspectives of economic and social goals (e.g., Tóth et al., 2018; Chou and Zolkiewski, 2018) but research paying attention to environmental goals is limited. Combining these three perspectives is in the heart of SOI, due to which the second publication sought to create more understanding of the possible tensions of implementing sustainable business practices and how these tensions are experienced by different network actors.

4.2.2 **Main findings**

The findings were based on a case study in 17 firms that were developing new sustainable business practices. The data was collected by interviewing 43 business managers. The findings revealed 16 different tensions in business networks that may result in implementing sustainable business practices. These were identified to be manifested in the four categories of economic, structural, psychological, and behavioural tensions. In addition, based on the analysis, tensions were identified to occur between multiple actors (external tensions) as well as within certain actors (internal tensions). Tensions were also seen to occur within individuals, groups and organizations. The findings of the study
Illustrated the tensions from the positions of the implementer, supplier, customer, and network partner.

Frequently appearing economic tensions refer to conflicts between cost allocations. These include for example higher investments, operating and opportunity costs (implementer), need to accommodate increased compliance requirements (supplier), and higher prices (customer). Structural tensions refer to the need for and balance of coordination and governance of relationships with stakeholders. These include for example increased monitoring and controlling requirements (implementer) and increased network complexity (network partner). Psychological tensions refer to changes in emotions, attitudes, motives and feelings, caused primarily by the added uncertainty associated with sustainable business practices. These include tensions like increased financial, technological and political risks (implementer) and reduced motivation to adhere to the implementer’s codes of conduct (supplier). Finally, behavioral tensions refer to changes in operational or communicative behaviors within a business network. These tensions have been identified to include for example increased disclosure requirements and internal resistance (implementer), and an increased need to collect and share sustainability-related data and information (supplier).

4.2.3 Main contributions

The findings of the publication revealed three primary contributions, first, the findings concerned especially the call to explore the negative effects of sustainability, i.e., the “darker side of sustainability” (Öberg et al., 2012; Johnsen and Lacoste, 2016). Previous literature has focused much on the benefits and/or positive consequences that result from implementing sustainable business practices, but has paid limited attention to the potential costs and negative consequences. By illustrating how different sustainability initiatives can lead to a perceived strain and conflicts between the actors (tensions), the publication responds to recent calls that advocate tensions as a suitable lens to analyze the consequences of sustainable business practices at multiple levels. Second, the findings contribute to the previous industrial marketing literature, which has focused on examining how negative value perceptions emerge from interaction and collaboration. The research responses to the call to explore negative value perceptions in multi-actor contexts (Prior and Marcos-Cuevas 2016; Tóth et al., 2018) by embedding a multiple case-study design. The study illustrates how intra- and/or inter-firm misalignments related to environmental goals may lead to tensions and negative value perceptions, while previous studies have considered misalignment in economic or social goals as the main source of tensions and conflicts (Corsaro 2015; Prior and Marcos-Cuevas 2016). Thirdly, the study contributes to the literature on sustainability networks (e.g., Johnsen et al. 2017; Meqdadi et al. 2017) by highlighting networks as a potential source of inertia. The findings highlighted the need for firms to consider the network constraints when planning and implementing new sustainable business practices. The study helps managers to understand better why, despite good intentions and collective goals, sustainability investments may become costly, face social resistance, or even fail due to insufficient stakeholder support.
4.3 Publication III – Innovations for sustainability: Challenges of utilising sustainability-related knowledge

4.3.1 Background and objectives

The development of SOI is linked strongly to the success of combining economic, social and environmental information together in a way that creates market value (Nidumolu et al., 2009; Varadarajan, 2017). As recently highlighted, e.g., by Lopes et al. (2017), sustainability knowledge and skills are tools for engaging people, organizations and the society in sustainable development and delivering SOI. However, although much sustainability-related data and knowledge exist in firms’ available internal information and knowledge bases, the processes for the utilization of the data are inefficient (ibid). The management of innovation processes for SOI requires identification of relevant sustainability-related knowledge (e.g., Miller et al., 2011; Leon, 2013) and actions of integrating, transferring and utilizing this knowledge in value creation (Buys et al., 2014). Furthermore, the development of SOI requires the utilization of knowledge from external sources, as they often extend over wide networks of actors (Hansen et al., 2009; Lackmann et al. 2012) and involve coproduction of knowledge (Kaiser et al., 2016). Identifying and evaluating the relationships between sustainability-related problems, causes, impacts, solutions, and their interactions is a challenging task (Miller et al., 2011; Kumazawa et al., 2009), which is why companies seem to face challenges in transferring this data and information to utilizable knowledge. The objective of the third publication was to explore the reasons for the inadequate utilization of sustainability knowledge in executing SOI. Furthermore, in the analysis part, the focus was on the potential of digital technologies as a tool to lower the identified challenges and to help in finding SOI.

4.3.2 Main findings

The findings of the study revealed multiple challenges in the utilization of sustainability knowledge, which were analyzed further by linking them into the stages of the knowledge utilization process. The findings were based on semi-structural interviews with 27 informants from four case companies and an interdisciplinary expert workshop for multiple business experts. One of the main challenges of sustainability knowledge utilization was found to be difficulties in the identification of sustainability knowledge, which results in unrecognized opportunities for SOI. Many of the existing tools, measures and information are quantitative by nature, but sustainability knowledge also exists in qualitative means. Other issues creating managerial challenges were identified to include especially a non-supportive organizational culture and inconsistent employee motivation, as well as excessive relying on internal resources.

Furthermore, the challenges were found to be influenced by the emerging digital technologies and practices, as much of the data is stored and gathered in the digital form. In addition, the development of digital systems and tools was identified to increase the possibilities to utilize the stocks of information and reveal opportunities for SOI. For
example, digital platforms were identified to enable combining information from different systems to create knowledge, increase data quality and availability, and unify communication and documentation practices in different systems. Also improved refinement and analytics tools were found to solve some of the challenges in the measurement of sustainability knowledge. Game-like elements and virtualization in training and work were identified to have potential to increase the motivation of the employees and to find answers to the challenges related to cultural differences. Also improved advanced analytics solutions (big data, AI, etc.) were identified to provide help in analyzing data and identifying possibilities for SOI.

4.3.3 Main contributions

The study has three major contributions. First, the findings increase the understanding of challenges and noticeable factors related to the less-researched area of sustainability knowledge utilization. The identified challenges were especially related to four root sources of challenges: 1) organizational (internal factors), 2) management of knowledge, 3) measurement challenges, and 4) practices in monitoring the business environment and stakeholders, and the management of change. The development of SOI depends much on the utilization of the firm’s internal knowledge, but also taking advantage of the available external knowledge and collaboration. This calls for the development of open innovation practices, interaction with stakeholders, and establishing and strengthening the links between innovation and knowledge management processes. Thus, overcoming the challenges in sustainability knowledge utilization calls for the development of (innovation) capabilities to combine knowledge and skills and innovation actions. Second, the study paid attention to the role of digital assets and technologies for solving these challenges. The findings were especially analyzed from the innovation development point of view. The findings raised important questions about the role of digital technologies in allowing change in firms’ business models to find SOI. Thus, the study opened the discussion of the potential of digitalization in lowering the challenges in the utilization of sustainability knowledge. Finally, managing the utilization of sustainability knowledge was identified to be linked to the development of organizational sustainability competences and sustainability-related education. The study highlighted the need for SOI–related capability building and education for sustainable development to manage the identified challenges by facilitating the creation of relevant knowledge, attitudes and values, changing the mind-sets and building managerial competencies, routines and processes. These together make the creation of the capacity for SOI possible.

4.4 Publication IV - Increased value through sharing in multi-sided markets: Sustainability with ridesharing

4.4.1 Background and objectives

The increased interest in SOI has driven companies to look for opportunities beyond their traditional business models. This, together with changing customer behaviour, global
demand for sustainability and rapid development of information technologies has resulted in the birth of business models relying on collaborative consumption and sharing of resources (Belk, 2014; Botsman and Rogers, 2010). There exists a wide range of sharing business models, including for example the sharing of goods, accommodation, services, and transportation (Cohen and Kietzmann, 2014). Furthermore, increased urbanization has raised multiple challenges (e.g., increased environmental emissions and non-satisfactory public transportation), due to which people have started to look for sharing options. Especially ridesharing has grown in popularity (Kriston et al., 2010), one application of which is the sharing of taxis. Taxi ridesharing is an example of business in a multi-sided market, where value creation depends on the interaction of two market sides (Adner and Kapoor, 2010), taxi drivers and passengers. For successful implementation of such a business model, both sides need to have a sufficient number of entities, which depends on the perceived value for each side. Although the academic literature acknowledges the significant potential of taxi ridesharing for sustainable value creation (Santi et al. 2014; d’Orey et al., 2012; Shmueli et al., 2015), so far not many commercially viable services exist. The challenge is to understand how this type of a system should be built and to identify the value for the user. The focus of the study was on understanding the potential for wide market acceptance of taxi ridesharing and to find out how to create a sustainable business model for such a solution. The problem was analyzed from two perspectives, multi-sided markets and value creation for both sides and between the markets.

### 4.4.2 Main findings

First, the study introduced a conceptual framework for the value impacts of taxi ridesharing, combined by a mathematical model describing value creation in taxi sharing. Together, these increased the understanding on the acceptance conditions for taxi pairing service, by combining the perceived value from the perspectives of the taxi driver and the passenger. The model helps to see the actual business benefits of combining rides, which in terms of the supplier include the value created directly from an increased revenue potential and a more efficient use of resources. In addition, the model helps in understanding the value creation possibilities beyond monetary gains. From the customer perspective, the value from sharing is a combination of monetary and social value. From the passenger perspective, the model highlights the economic benefits (such as money and time savings), but also considers the soft value elements (such as enjoyment of the activity, enhancing sustainability) having an effect on the passenger’s behavioral intentions to share rides without higher (monetary) benefits. The study presented a detailed description of how value can be determined in a multi-sided market. Attention was paid to both market value (monetary) and intangible value elements, such as customer satisfaction and societal value. The model showed that pairing taxi riders will lead to both benefits and perceived losses for both parties, the division of which is a matter of negotiation. In best cases the division of benefits is a zero-sum game between the driver and the passenger.
4.4.3 Main contributions

The study contributes to the discussion of SOI in the context of value creation by sharing business models in multi-sided markets. This was done by introducing an analytical framework for understanding the limits for value creation when implementing sharing into an existing taxi company business model. In addition, the introduced mathematical framework proposed boundary conditions for building the system and creating a sustainable business model for taxi ridesharing. Understanding the market is critical for successful implementation of a new service. In the context of multi-sided markets, all sides need to accept the new model. Furthermore, to create a sustainable business model for sharing taxi rides requires the creation of a platform and management practices. As the mathematical model showed, the pricing questions are irrelevant at the system level, but contributes to the value allocation between individual agents having an impact on the acceptance of sharing. This highlights the importance of considering sustainable value creation from the perspectives of the system as well as an individual decision-maker. This opens an avenue for research on the management challenges in understanding the effect of the individual agents’ behavior on system-level sustainable value creation. Furthermore, the study highlighted the importance of societal support in giving birth to new sustainable business models, such as taxi ridesharing. This includes reducing conflicts between the public and private sector and incentives (i.e., taxation and regulations) to reinforce the birth of sharing models that make sense from the economic, social and environmental perspectives.

4.5 Publication V - Platform design framework: Conceptualisation and application

4.5.1 Background and objectives

Technological platforms provide new possibilities for value creation in interaction between different actors. These platforms work as a hub for value exchange (Eloranta and Turunen, 2016), enabling the connection of resources across markets, and value creation through complementarities and network effects (McIntyre and Srinivasan, 2017). Platforms are seen to provide multiple possibilities to enhance the development of SOI. For example, they enable information exchange and value allocation between the different actors required for circular economy-related solutions, or business based on sharing resources (e.g. Bocken et al., 2017). However, the creation of platform-based business is not easy. In platform ecosystems, value creation is affected by multiple choices related to platform governance (Tiwana et al., 2010; Gawer, 2014), competition (Rochet and Tirole, 2003; Van Alstyne et al., 2016), openness (Parker and Van Alstyne, 2008; Eisenmann et al., 2009), and the quality of the management of consumer expectations (Zhu and Iansiti, 2012). Furthermore, the value needs to be balanced between the different actors involved (Van Alstyne et al., 2016). In addition to the examination of these choices, they need to be taken into account in building a new platform, i.e., forming the platform design. Although the existing literature provides
examples of platform-based business models (e.g., Zhu and Iansiti, 2012; Bonchek and Choudary, 2013) and platform launch strategies (Parker et al., 2016), the literature lacks perspectives on the practical execution process preceding the platform launch. Furthermore, there is a need to understand how platforms and the related value creation are designed. This includes design challenges, processes and outcomes. The study addressed these research gaps by providing a literature-based framework for platform design. The objective of the fifth publication was to provide a practical tool for managers working or planning to work in platform-based business, helping in designing business models that target at sustainable value creation and SOI with a higher system-level impact.

4.5.2 Main findings

The study introduced a platform design framework which involves four different elements: 1) platform architecture, 2) value creation logic, 3) governance, and 4) platform competition. The framework responds to the intercorrelated problems related to the regulation and facilitation of value creation and capture, as well as coordination of the value components. This will help in the realization of platform value and ecosystem goals. The overarching framework for platform design was based on existing literature and was further illustrated empirically in the context of the Mobility-as-a-Service (MaaS) platform DORA. The framework presents problem focus areas and related core design problems. The empirical illustration includes examples of the core design choices related to the presented problems.

The first category of platform architecture describes the structure of the actors, market and fundamental setup of the platform. It includes paying attention to the core interaction and main purpose of the platform, the markets involved in the platform, the key actors presenting different market structures, and strategic choices for platform openness. The second category is the value creation logic, which concentrates on design problems related to the different roles of actors and who benefits from the platform, different value propositions, network effects, and a revenue model. This category defines the benefits of the platform and how each user contributes to value creation. The third category focuses on platform governance describing the common rules, laws and managerial level of the platform. This means consideration of platform leadership, ownership and specific platform rules for each actor. The final category is platform competition, which describes the setup for launching the platform, as well as competitive selections. Platform launch means thinking of how to ensure the access to the platform and how to attract users. Furthermore, platform competitiveness means paying attention to the unique competitive advantage of the platform. The last category involves also aspects of innovation and learning related to platform development and considering the questions related to platform growth.
4.5.3 Main contributions

The study contributes to the ongoing discussion on the development of platform ecosystems and how this model of business shapes future markets and changes the models of value creation. From the perspective of the thesis, this is crucial, as platforms are seen to provide multiple opportunities to facilitate value creation for SOI especially allowing the creation of new types of sustainable business models. However, value creation in this type of business requires understanding of the characteristics of multi-sided markets and network effects, as well as the role of different actors in value creation. The study provides systematic understanding of the platform design process, paying attention to crucial design problems and choices to be made before platform launch. The study also highlights the need to redesign the overall business models and ecosystems when aiming at platform-based business. In addition to theoretical contributions, the simplified platform design framework provides a tool for managers to apply in the design of platform-based business. The developed tool helps in linking the various stakeholder perspectives, finding common understanding on value creation, and accounting for platform-specific issues in business modelling. Applying the framework in the empirical context of DORA offered more practical examples of how to use the framework in business development. The aim of DORA is to create system-level sustainability benefits (e.g., to increase the efficiency of public transport and decrease the environmental emissions of logistics). Thus, the study contributes to the discussion of SOI focusing on platform-based business as a tool to enhance collaboration and shared value creation, crucial for the development of SOI with system-level impacts.

4.6 Publication VI: Continuing education requirements for supporting sustainability-oriented innovations

4.6.1 Background and objectives

The objective of the sixth publication was to examine the educational needs of current innovation managers in the context of SOI. Sustainability has achieved a major role in corporate strategizing and innovation actions. These innovations, aiming at enhancing sustainability and answering global sustainability challenges, require collaborative actions with various stakeholders, and are associated with radical, systemic, open, and disruptive innovation characteristics (Szekely and Strebel, 2013). From the firm and decision-maker perspectives, managing these innovations does not only require aligning with changing customer behaviors and regulation environment, but also acquiring new skills, capabilities and knowledge (e.g., Holm et al., 2016). These include creating deep understanding of the impacts of the system-level business model in relation to, e.g., product-service offerings, value chains and ecosystem compositions. In addition, the management of SOI requires special “soft” competences, such as systemic, anticipatory, critical, and creative thinking. Despite their importance, these issues have been lacking in the innovation management education of current decision-makers in organizations.
Lacking skills, capabilities and knowledge are one of the key bottlenecks in implementing sustainability strategies and SOI, and reaching a high sustainability level.

To acquire the knowledge, skills, attitudes, and values necessary to shape sustainable future, there is a strong call for sustainability education (e.g., Figueiro and Raufflet, 2015; Holm et al., 2015; 2016; Kearings and Springett, 2003; Lozano, 2016). There exists a growing body of literature concerning sustainability in higher education², emphasizing the importance of including this specific topic into innovation education. Although the importance of adult education in creating an equitable and sustainable world has been already identified (Griswold, 2017; Wehrmeyer and Chenoweth, 2006), the literature on education for sustainable development (ESD) largely neglects the critical importance of continuing education to complement the knowledge of current decision-makers and thus achieve near-term sustainability targets. The focus of the study was on continuing education (as a form of adult education and training) as a tool to address the competence gap of current innovation managers and responding to the immediate need for sustainability-related decision-making capabilities in organizations.

4.6.2 Main findings

The findings of the study of 17 decision-makers dealing with SOI decisions revealed three key messages. First, although many companies see sustainability as a source for value creation and business development, the current decision-makers’ understanding of sustainability and especially on SOI remains incomplete. Because of this lacking understanding of the relationship between innovation management and sustainability, deep changes in companies’ business models are still rare. The creation of SOI competences was identified to be too complex to undertake by self-learning, which led to the second key finding: the need for formal education concerning SOI. Especially underdeveloped or outdated competences at the managerial level were identified as a slowing factor in building the company’s capability to make effective SOI decisions. Based on the analysis of the empirical insights of current managers, and ESD and innovation management literature, the study summarized these competences into a set of sustainability decision-making and SOI–related competences. As an essential result, the study highlighted the need for building knowledge and skills on both domains in parallel and combining these two perspectives to allow the creation of SOI. Finally, the main findings included a call for wide-scale training and lifelong learning. Advancements in SOI-related business will increase also education and learning requirements, collaboration and combining competencies, and resources of multiple actors. Companies need to build specific capabilities for SOI, which requires focused SOI skill and

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² Higher education, also known as post-secondary education or third-level education, occurs after secondary education and presents an optional final stage of formal learning. This education is often provided by universities, universities of applied sciences, academies and colleges.
knowledge development of the key personnel, supporting the call for multidisciplinary continuing education.

4.6.3 Main contributions
The study provides a snapshot of SOI competences and identifies specific underdeveloped decision-making skills concerning sustainability. Development of the level of skills and know-how of current decision-makers related to sustainability and innovation allow companies to build special innovation capabilities for SOI. This is the starting point for the development of a firm’s dynamic capabilities to address sustainability challenges and find sources to create unique value. The findings of the study emphasized the role of adult education and training, especially continuing education, in enhancing global sustainable development and creation of SOI. The study combined the insights of academic literature on SOI with the literature of education for sustainable development (ESD) and sustainability in higher education. The study demonstrated challenges associated with the value creation for SOI and highlighted the importance of the research on designing the curricula and methods of continuing education programs to support the development of SOI. In addition, the results were also seen to be partly transferrable to entrepreneurship education.
5 Conclusions

5.1 Summary of the findings

In this thesis the focus was on challenges and supporting methods of value creation for sustainability-oriented innovations. The creation of such innovations is seen especially important in order to address worldwide sustainability challenges, to create environmental and social well-being, and also renew business and create economic value. SOIs have increased the interest of individual consumers, authorities, industries, and entire societies. Although also the managerial interest towards SOI is increasing, these innovations are not easy to find, and their development faces multiple challenges. Value creation for SOI requires consideration of special SOI characteristics, such as multi-dimensionality, involvement of multiple stakeholders, and balancing economic, environmental and social value creation across wide networks of actors. Based on these, the purpose of this thesis was to explore the challenges in value creation for sustainability-oriented innovations and to introduce supporting methods to manage these challenges.

The thesis addressed the main research question of how to cope with the challenges in value creation for sustainability-oriented innovations? The main research question was divided into two sub-areas: the first one concerning the challenges in value creation for SOI, and the second one moving the focus on supporting methods. Several sub-research questions were addressed in terms of these two themes through the findings of the individual publications.

Challenges in value creation for SOI

1) What are the main challenges in delivering systemic innovations for sustainability? (Publication I)
2) What kind of tensions may emerge when implementing sustainable business practices in business networks, and how are they experienced by different stakeholders? (Publication II)
3) What are the reasons for inadequate utilization of sustainability knowledge in management? (Publication III)
4) Which educational needs are faced by current innovation managers in dealing with innovations for sustainability? (Publication VI)

Supporting methods

5) How to enhance innovations for sustainability by utilizing digital assets? (Publication III)
6) How to create a sustainable business model for a taxi sharing service? (Publication IV)
7) How is platform value designed, and what are the key design challenges, processes and outcomes? (Publication V)
All the individual publications of the thesis had an important role in forming the overall contribution of the thesis. Table 10 contains a summary of the findings, contributions of each specific publication to the overall purpose of the thesis, and how the findings refine theoretical understanding of the subject (marked in italics).

Table 10. Key findings and contributions of the individual publications

<table>
<thead>
<tr>
<th>Research question</th>
<th>Main findings</th>
<th>Contribution to value creation for SOI</th>
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<tbody>
<tr>
<td><strong>Publication I: Exploring the pitfalls of systemic innovations for sustainability</strong> Palgrave Macmillan book of Innovation for Sustainability – Business transformations towards a better world, forthcoming.</td>
<td>Identifies interconnected challenges of executing SOI with system-level impacts. Recognizes the role of lacking capabilities in open innovation, evaluating and seizing radical opportunities and reconfiguring the organization for SOI. Recognizes the decision-makers’ lack of understanding of the complexity involved in SOI.</td>
<td>Highlights the need to create specific dynamic capabilities for SOI. Provides an empirical verification of the challenges of SOI with system-level impacts and links them to the innovation process. Organizes commonly met challenges in SOI and connects them to capability and innovation process viewpoints.</td>
</tr>
<tr>
<td><strong>Publication II: The darker side of sustainability: Tensions from sustainable business practices in business networks</strong> In a process for an academic journal.</td>
<td>Identifies tensions that may emerge when firms decide to implement sustainable business practices in business networks. Categorizes the tensions into four groups of economic, structural, psychological, and behavioural tensions. Analyzes the identified tensions from the perspectives of different network actors.</td>
<td>Illustrates how implementing SOI may lead to tensions that hamper value creation for SOI. Illustrates how different business network actors (implementer, supplier, customer and other network partners) experience these tensions. Identifies and organizes tensions resulting from sustainable business practice implementation; explicates the potential negative outcomes.</td>
</tr>
<tr>
<td><strong>Publication III: Innovations for sustainability: Challenges of utilising sustainability-related knowledge</strong> International Journal of Innovation and Sustainable Development, in press.</td>
<td>Identifies sustainability knowledge-related challenges and links them to the phases of the knowledge utilization process. Recognizes the role of digital technologies, the development of organizational sustainability competencies, and sustainability-related education as tools to lower the identified challenges and reveal the possibilities for SOI.</td>
<td>Highlights the main challenges related to the utilization of sustainability-related knowledge in development of SOI. Discusses the possibilities of digital technologies as a tool to overcome these challenges, to facilitate knowledge management processes, and to enhance the development of SOI. Connects SOI management challenges to knowledge utilization process.</td>
</tr>
<tr>
<td>Research question</td>
<td>Main findings</td>
<td>Contribution to value creation for SOI</td>
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<td>Publication IV: Increased value through sharing in multi-sided markets: Sustainability with ridesharing</td>
<td>A conceptual framework of value impacts and an analytical framework for understanding the limits for value creation when implementing sharing into an existing taxi company business model. A detailed description of how value can be determined in a multi-sided market.</td>
<td>Promotes the importance of seeing both the system- and individual decision-maker-level impacts on value creation in new types of sustainability-related business models. Increases the understanding of the requirements in executing SOI in multi-sided markets. <em>Exemplifies the application of research-based supporting method to resolve challenges in value creation for SOI.</em></td>
</tr>
<tr>
<td>How to create a sustainable business model for a taxi sharing service?</td>
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<td></td>
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<tr>
<td>Publication V: Platform value design: Conceptualisation and application</td>
<td>A conceptual framework of platform design. A detailed description of platform design problems, including aspects of platform architecture, value creation logic, governance, and competition. Empirical illustration of the design choices in the Mobility-as-a-service (MaaS) platform context, aiming at contributing to sustainability positively.</td>
<td>Provides a tool for value-based platform design, highlighting the core problems to be considered. Promotes the establishment of platform-based business models, working as a method for sustainable value creation and SOI in multi-sided markets involving a variety of actors. <em>Exemplifies the application of research-based supporting method to resolve challenges in value creation for SOI.</em></td>
</tr>
<tr>
<td>How is platform value designed, and what are the key design challenges, processes and outcomes?</td>
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<tr>
<td>Publication VI: Continuing education requirements for supporting sustainability-oriented innovations</td>
<td>Identifies the lack in the SOI – education of current decision-makers and the need for SOI-related continuing education to build the required competencies to execute SOI. Recognizes the need for multi-disciplinary, wide-scale training and life-long learning of managers dealing with sustainability-related decisions.</td>
<td>Identifies the challenges of current managers in making decisions related to SOI and the creation of sustainable value. Emphasizes the importance of continuous education and SOI-related skill and competency development. <em>Connects human resource management, skill development and dynamic capability viewpoints to managing SOI challenges.</em></td>
</tr>
<tr>
<td>Which educational needs are faced by current innovation managers in dealing with innovations for sustainability?</td>
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The overall findings of the thesis are illustrated in Figure 10. The thesis considers the main research question by identifying the challenges of value creation for SOI and introducing managerial support methods to comply with the identified challenges. The key findings are discussed briefly in the following two sub-sections and in more detail in
the individual publications where also more detailed answers to the sub-questions are discussed.

![Diagram showing challenges and supporting methods in value creation for SOI]

**Figure 10.** The findings of the thesis – challenges and supporting methods in value creation for SOI

### 5.1.1 Challenges in value creation for SOI

On the basis of the findings of the individual publications, several challenges in value creation for SOI were identified. At the top of Figure 10, these are summarized in the grey boxes. The challenges were identified to be connected to the increased complexity and changes in the external business environment (left), but also internal renewal of the firm (right). In addition, some challenges were found to be related to the interaction between these two fields.

Although many of the studied firms were identified to have a strong sustainability identity, the sustainability outlook, i.e., how to cope with increased future uncertainty and complexity related to sustainability, was not considered much. The thesis highlights the challenges that increased complexity related to sustainability has on value creation in the long run. Challenges related to the external business environment were identified to be caused by difficulties in facilitating and managing value creation in novel market settings. These markets, including, e.g., sharing economy and platform economy have been identified to provide multiple opportunities for sustainability-related value creation and innovation. However, the value creation in these markets is not without challenges. The
creation of SOI in these markets requires paying attention to value creation from the perspectives of an increased number of actors. For instance, value creation in the sharing economy and platform-based business is based strongly on facilitating the network effects on multi-sided markets, and balancing the perceived benefits and sacrifices between two or multiple actors. The challenges of value creation in these types of business were especially concerned in publications IV and V.

In general, there are special challenges in achieving SOI that aim at moving beyond incremental product and process development towards achieving system-level impacts. These were especially concerned in publication I. Furthermore, implementing sustainable business practices or SOI were identified to cause possible negative consequences that manifested as tensions across the business network (publication II). Publication II focused especially on these issues through the four categories of economic, structural, psychological, and behavioral tensions. The findings of publications I and II highlighted especially the increased complexity of networks, the fast-changing business environments, and high uncertainty and risks as main issues creating challenges for value creation for SOI. These were identified to be closely linked to the missing capabilities of decision-makers to cope with the multi-dimensionality of sustainability and to create business value beyond responding to the basic requirements and regulations of sustainability. These reflect also firms’ possibilities to build specific dynamic capabilities for SOI.

Challenges related to the internal renewal of a firm were especially concerned from the perspectives of sustainability knowledge utilization and skill and capability development. As the findings of publication VI highlighted, there is a need to create and develop special skills for SOI among current decision-makers. In this study, the special focus was on examining the current stage of decision-makers’ capabilities and skills for SOI, which were identified to be largely inadequate. In addition, also challenges in sustainability knowledge utilization were identified to play a major role in hindering value creation for SOI (Publication III).

5.1.2 Supporting value creation for SOI

To help in coping with the challenges of value creation for SOI, the individual publications introduced supporting methods targeted especially for managerial purposes. At the bottom of Figure 10, the introduced supporting methods and intermediate tools are listed in the blue boxes. Each of the methods has a special focus area related to the identified challenges. Publications IV and V introduced models that support sustainability value creation in sharing economy and platform economy contexts. Publication IV introduced a conceptual model for value creation through the sharing business model, which was further combined to the mathematical model to illustrate value creation in the multi-sided market of taxi ridesharing. By paying attention to value creation from the perspectives of multiple company stakeholders, this model helps in illustrating the different types of value creation elements that need to be taken into account in order to create sustainable value and successful SOI. Also publication V introduced a special
framework to facilitate value creation for SOI. The platform design framework was especially targeted at the purpose of establishing platform-based business, where different network actors’ perceptions and expectations on value creation need to be considered equally. This framework was designed to help in this process by identifying the core design problems and choices. The use of the framework was illustrated through a case of the platform-based information system DORA, developed to optimize travelling experiences. This case is a good example of a jointly developed platform-based business, where the basic motivation is in creating value from the environmental (by minimizing negative environmental effects of logistics), economic (creating business and increasing operational efficiency) and social perspectives (increasing the efficiency of public transportation).

To address the challenges related to tensions in business networks, publication II introduced a framework of the possible tensions in implementing sustainable business practices and how they are perceived by different network actors. This type of an intermediate tool helps in directing the managers’ attention to the possible challenges that may hamper sustainable value creation. To address the challenges related to the internal renewal of a firm, publication III analyzed the possibilities of digital technologies and solutions to help in the sustainability knowledge utilization process. For instance, the development of digital platforms was identified to have potential for unifying communication and documentation practices, as well as combining information from different systems to create knowledge. In addition, increasing digitalization was seen to provide multiple opportunities for value creation for SOI. For example, digital solutions for analytics (e.g., analysis of big data, machine fleet -level solutions, and Artificial Intelligence) can help in the analysis of a firm’s environmental measurement data, of its possibilities and relevance, and how to use it in innovation actions. Furthermore, emerging platforms and online technologies help in sharing data and information inside the firm, as well as between the firm and its customers and suppliers, and the authorities.

In general, all the identified challenges were somehow related to the lacking skills and capabilities for developing and managing SOI. The findings of publication VI paid attention to this particular issue by identifying the special skills that are required especially for the management of SOI. This listing was targeted at managers to advance their understanding of the requirements to develop the skills of the key decision-makers dealing with SOI. The target was to educate adults who already hold decision-making positions. Continuing education (additional and voluntary education provided beyond higher education) was highlighted as a tool to address the lacking skills, increase knowledge about sustainability, and help in linking sustainability with innovation management. The findings revealed that continuing education can increase multi-disciplinarity and collaboration across companies from various industries, as well as between actors from the academia, business and governmental organizations. The need for this type of education concerns not only business leaders but also for example governmental actors, who play a crucial role in shaping the future by making important political decisions (e.g., taxation and subsidies for certain raw materials).
Behind all the issues mentioned above, there is a need to build special capabilities to promote SOI with system-level impacts. A good starting point is paying attention to building skills and competencies to support open and more radical innovations. Figure 11 illustrates the relationship between building dynamic capabilities and value creation for SOI. As the figure illustrates, the main goal of SOI is to capture environmental, economic and social value. From business managers, this requires paying attention to the possible negative outcomes and tradeoffs of sustainable business practices and SOI in particular. The development of SOI involves multiple challenges related especially to the early phases of the innovation management process, including challenges in the recognition of opportunities for SOI, as well as complying with changing internal requirements (the firm’s goals, beliefs and values, and finding the fit between SOI and other business actions) and external requirements (a combination of demands set for example by customers, suppliers, shareholders and regulatory authorities). Firms need to comply with environmental regulations (such as emission limits), but also react to customers’ changing demands and create economic value for their shareholders.

**Building sensing capabilities for SOI for:**
- Recognition of opportunities and threats
- Recognition of constantly changing requirements for sustainability
  - External requirements, beliefs and values (e.g. regulations, market sustainability awareness)
  - Internal requirements, beliefs and values

**Building seizing capabilities for SOI for:**
- Selecting SOI goals
- Building business models and value propositions for SOI
- Building decision-making protocols to support SOI
- Building loyalty and commitment
- Managing complements, controlling platforms and ecosystems of actors

Building adaptive flexibility: adaptive learning, change, improvement and development

Complying and managing tradeoffs and negative value elements of sustainability

Capturing environmental, economic and social value

**Figure 11.** Creating value for SOI by building dynamic capabilities
In this process, the sensing capabilities play a crucial role. They do not only allow the recognition of opportunities and threats for SOI, but also help in paying attention to constantly the changing requirements to operate in dynamic business environments. For example, new, emerging technologies (such as technologies to sort waste) may advance SOI by creating new business opportunities, but also allow incremental improvements in existing business. They can provide significant help also in managing the SOI-related challenges, such as recognition of relevant knowledge and data which may be facilitated by digital solutions. Sensing the technological changes also help in preparing in advance for possible changes in the regulatory environment, as for example the technologies to reduce emission levels are developing constantly. On the other hand, the development of technologies may also be a threat to the firm’s existing operations, if the firm’s competitor manages to take advantage of the technology by creating a competing solution with better overall value for the customer. In addition, sensing the market and society –level changes is required to take advantage on SOI. Traditionally, sensing capabilities are utilized to recognize opportunities from the internal company perspective. However, as SOIs target increasingly at system-level changes, extending sensing capabilities to recognize possible changes also from the perspectives of company network partners would reveal opportunities for SOI. Thus, extended sensing capabilities refer to capabilities that companies utilize in identifying opportunities for their stakeholders to improve environmental, social and economic sensing actions. Systemic change is facilitated by the sensing of the stakeholders’ opportunities. This opens an interesting avenue for future research.

In addition to sensing capabilities, the development of SOI requires also the building of seizing capabilities. These types of dynamic capabilities allow moving from recognition of opportunities to concrete actions. Seizing capabilities help in the selection of SOI-related goals, creation of value propositions to support these innovations, and the design of business models around these propositions. Furthermore, seizing capabilities are connected to building decision-making protocols that support SOI, e.g., strengthening the link between innovation management and overall strategic decision-making within the firm. Importantly, they also facilitate the building of loyalty and commitment inside the organization and the among the firm’s stakeholders. Finally, they also help in managing the increased number of stakeholders and complexity of networks by for example facilitating the management of complements, balancing the value creation among the network actors, and controlling platforms and ecosystems. Building the sensing and seizing capabilities for SOI are the first steps in building of firm-level adaptive flexibility. For firms, the building of adaptive flexibility, including adaptive learning, change, improvement and development, is a key when aiming at taking advantage of value creation for SOI.

5.2 Contribution

This section discusses the theoretical and managerial implications of the thesis. As the main theoretical background for the thesis is in the research streams of sustainability-
oriented innovation and innovation management, the main implications are in these fields.

Most importantly, the thesis presents steps of the process to help future researchers in designing supporting tools and thus facilitate value creation for SOI. In addition, the thesis highlights the need for the development of SOI with system-level impacts and addresses the challenges in value creation for SOI in the context of novel market settings based on sharing resources, collaboration and utilization of digital opportunities. Furthermore, it also introduces supporting methods and intermediate tools that can be developed further into actual supporting methods to help in the challenging value creation process. In addition to the contributions to the SOI literature, the thesis contributes to the strategic innovation management literature addressing especially the relationship between the building of different types of dynamic capabilities and different-level SOIs. The thesis highlights the importance of developing specific SOI-related skills and knowledge of current decision-makers as a source for creating organization-level dynamic capabilities. Thus, the thesis answers the call by Adams et al. (2016) for research to seek the specific knowledge, competences and capabilities that help firms to move towards SOI with increased system-level impacts. In addition, as the results of this thesis also address the importance of sustainability education as a source for skill and capability development, it has some implications to the research on this field. The theoretical and managerial implications are discussed in detail in the following sub-sections.

5.2.1 Theoretical implications

To start with, the terminology used in the prior literature regarding innovations aiming at creating sustainable value (i.e., simultaneous economic, social and environmental value creation) has been multiform. This has hampered the creation of common understanding of SOI between academics, but also the implementation of SOI in practice, as the understanding of SOI among managers and governmental actors varies. The findings presented in this thesis support the definition of SOI by Adams et al. (2016) by highlighting the need to implement the ideology of sustainable value creation over the entire organization, ranging from organizational processes and practices to the skills and values of individual decision-makers. This means intentional efforts to achieve system-level sustainability benefits by seeking more open, radical and systemic innovations that will create economic, environmental and social value.

As the literature of SOI is new and evolving, naturally also the theoretical understanding of the supporting methods for value creation for SOI is limited. The findings of this thesis demonstrate that systematic value creation for SOI can and should be facilitated. This is the first main theoretical contribution. Furthermore, to help in the process of sustainable value design, supporting methods such as the platform design framework introduced in publication V can be created. This process, from the identification of challenges to the creation of supporting methods is summarized in Figure 12. The thesis contributes to existing literature by providing a schema that can be used to solve future SOI-related
questions. As the thesis shows, looking at the overall process, future research can generate targeted tools and methods for SOI management purposes.

**Figure 12. Process to create supporting methods for managing SOI challenges**

As the findings of the thesis illustrate, value creation for SOI involves multiple challenges, such as possible tensions between the network actors (publication II), identification of relevant knowledge (publication III), value-reducing elements (publication IV) lacking skills and knowledge of decision-makers (publication VI), and increased complexity (publication I). Deepening understanding of these challenges works as a basis for managers to build understanding of the requirements and changes that value creation for SOI have on their organization and operations. In other words, the challenge-based research provides a starting point for looking at the managerial implications that combining sustainability with innovation management has. Identifying these creates a basis for the development of intermediate tools, i.e., listings, process models and guidelines to recognize the key issues that need to be considered when aiming at creating value for SOI. These intermediate tools can be then developed further towards targeted and purposeful tools and supporting methods for coping with the challenges involved in value creation for SOI.

The second contribution of this thesis is paying attention to the challenges in value creation for SOI, by compiling the literature of this particular issue and expanding the understanding by the findings of empirical research. The literature of SOI has focused mainly on examining the positive effects of SOI and the opportunities in creating sustainable business value. The possible positive outcomes have been addressed, e.g., in terms of image benefits and the attractiveness of the firm (Branco and Rodrigues, 2005), economic outcomes and business opportunities (Ambec and Lanoie, 2008; Ameer and Othman, 2012), and overall increased competitiveness (e.g., Carillo-Hermosilla et al., 2010; Nidumolu et al., 2009). Some research has addressed also the possible challenges in sustainable value creation, e.g., in terms of negative economic impacts, such as high costs (Konar and Cohen, 2001), trade-offs (Hahn et al., 2010), rebound effect (i.e., increased consumption of resources due to improved production efficiency) (Alcott, 2005), and increased uncertainty (Hall and Wagner, 2012; Dangelico and Pujari, 2010). Many of the individual publications of this thesis provide detailed descriptions of the different types of challenges. The thesis contributes to existing literature by not only recognizing the possible challenges, but also considering them as manageable entities.
Thirdly, this thesis contributes to the emerging literature stream of SOI which highlights the need for system-level value creation. The SOI literature has recently focused on convincing the academics, managers and governmental actors of the need to move towards systems building. The prior literature of SOI has focused on examining companies’ efforts in executing especially micro-level SOI (i.e., in innovating green products and services or process enhancements) (Chen and Chang, 2013; Dangelico et al., 2017), or meso-level innovations (focusing on, e.g., improving supply chain sustainability) (e.g., Dooley, 2017). However, the researchers have highlighted the need to move from incremental improvements towards more radical solutions and changes in business models (Adams et al., 2016; Boons et al., 2013; Bocken et al., 2016; 2017; Geissdoerfer et al., 2017; Antikainen and Valkokari, 2016) and to find SOI with macro-level impacts. However, this research direction regarding SOI is still in its infancy. Especially publication I provides empirical verification of the challenges of SOI with system-level impacts, and links them to the innovation management process, thus contributing also to the innovation management literature. The thesis introduces several intermediate tools that address special challenges in value creation for SOI. These include a framework of possible tensions of implementing sustainable business practices (publication II), a framework of challenges in sustainability knowledge utilization (publication III) and listing of the specific skills required for SOI (publication VI).

The fourth contribution is linked to advancing the understanding of the specific challenges in value creation for SOI in relation to novel market settings, increasingly based on collaboration, sharing of resources and utilization of digital solutions, such as online platforms. Traditionally, as also noticed by Adams et al. (2016) in their systematic review of SOI, the research regarding SOI has focused much on the incremental, technically-focused and product-oriented view of innovation (e.g., Chen and Chang, 2013; Dangelico and Pujari, 2010; Dangelico et al., 2017). Lately, the interest has moved increasingly towards the development of sustainability-oriented business models (e.g., Rohrbeck et al., 2013; Booms and Leudeke-Freund, 2013) and circular business (Bocken et al., 2016; 2017; Geissdoerfer et al., 2017) that are based on collaboration and sharing of resources among wide networks of actors. These models provide multiple new opportunities for SOI. As addressed in this thesis, the development of these types of business are enhanced by the development of digital solutions, including, e.g., online applications that lower the barrier of internal and external knowledge and resource sharing (e.g., publications III, IV and V). This thesis contributes to the SOI literature especially by introducing methods to support forming value propositions for sharing business models (publication IV) and value-based platform design (publication V) thus expanding the understanding of possible business models for SOI (e.g. Bocken et al., 2014). Value creation based on sharing or combining resources of multiple actors through digital platforms requires paying attention to the characteristics of multi-sided markets and balancing value creation between various network actors. These types of businesses bring along new types of challenges, which are discussed in detail in publications IV and V.
The main implications of the thesis include also contributions to the innovation management literature. The fifth theoretical contribution addresses the prior literature of innovation capabilities by highlighting the need for companies to understand the relationship between sustainability-related knowledge and skills and a firm's innovation routines and processes. As previous research of innovation capabilities highlights (e.g., Ngo and O'Cass, 2013), these capabilities are a source for company-wide potential to generate new and unique value. In addition to research on innovation capabilities, the thesis contributes to the SOI and innovation management research fields especially by deepening the understanding of the link between the building of dynamic capabilities and value creation for SOI. The prior literature has especially concerned the need of building dynamic capabilities in order to improve the firm’s adaptability to deal with increased complexity and the changing, unpredictable sustainability environment (e.g., Amui et al., 2017; Iñigo et al., 2017). These capabilities are seen especially important in making it possible for firms to balance their business objectives between economic, environmental and social issues (e.g., Dangelico et al, 2017; Strauss et al., 2017) and to form sustainability strategies (Hart and Dowell, 2012; Wu et al., 2012). Similarly to sustainable development, also the development of SOI relies on balancing the economic, social and environmental business objectives, as well as complying with the requirements of external and internal stakeholders. However, in the context of SOI, the importance of sensing and seizing opportunities and threats is emphasized. This highlights the importance of connecting the prior understanding of dynamic capabilities more closely to the research and understanding of SOI, which is especially stressed in this thesis. Thus, the thesis contributes to the emerging literature on building dynamic capabilities for SOI by specifying the relationship between different types of dynamic capabilities and different-level SOIs.

This relationship is illustrated in Figure 13, which shows the links between two figures presented in the theoretical part of this thesis. Previously, e.g., Seebode et al. (2012) have highlighted the development of dynamic capabilities as a tool to build competencies and knowledge for SOI and move towards system-level perspectives. Building and adopting different-level dynamic capabilities (incremental, renewing and regenerative) allow companies to adapt their business to respond to the shift from incremental business development towards systems building, and to find links between the firm’s sustainability-oriented strategy, resources and competences. On the other hand, the different levels of incremental, renewing and regenerative dynamic capabilities, direct companies to pursue different types of innovations. As highlighted by Castiaux (2012), achieving the level of regenerative dynamic capabilities means the creation of sensing, seizing and transforming dynamic capabilities. Building more regenerative dynamic capabilities exploiting also competences, capabilities, knowledge, and resources from the external environment, is also a key for companies to move towards more impactful SOI. Furthermore, building extended sensing capabilities would allow firms to identify opportunities for their stakeholders to improve environmental, social and economic sensing actions and thus reveal opportunities for SOI.
By including the sustainability perspective into innovation has been acknowledged to increase innovation complexity due to the presence of new types of challenges and the number of involved actors (e.g., Zollo et al., 2013; Iñigo et al., 2017). As depicted in Figure 13, sustainability and the development of SOI involve the need to cope with the constantly changing requirements for sustainability. These include the external requirements, beliefs and values of various stakeholders, e.g., in terms of regulations, but also companies’ internal requirements, such as economic targets, company culture, and the beliefs and values of individual employees. SOI calls especially the reconfiguration of resources and capabilities to be aligned with sustainable business opportunities e.g. in the forms of collective decision-making and governance, creation of disruptive SOI-teams and distribution of knowledge management and sustainable business thinking (Iñigo et al., 2017). The development of dynamic capabilities has been previously seen much as an intra-organizational issue (e.g., Teece et al., 1997; Eisenhardt and Martin, 2000). However, including sustainability as part of innovation and development actions changes this (e.g., Castiaux, 2012; Ambrosini and Bowman, 2009). SOI actions no longer consider only the organization and its most close suppliers, but collaboration is required with legal
authorities, the overall government, other network partners (such as providers of supporting services), customers, and the community. Already many companies’ incremental improvement actions, e.g., related to increasing operational efficiency in terms of energy efficiency or reducing end-of-pipe pollution are driven forward by external regulations. The need to cope and collaborate with external parties is even increased when aiming at moving towards more impactful SOI. Although the motivation for organizational transformation may rise from internal urge to catch new market opportunities, the SOI targets include also the idea of shared value creation (introduced by Porter and Kramer, 2011). Thus, in terms of SOI, organizational boundaries are fading.

Although the importance of building dynamic capabilities for sustainability has been addressed in prior literature, there are no clear guidelines of what this actually means. The thesis contributes to this specific issue by highlighting the need for targeted SOI-related education to address the lacking skills of current decision-makers. As previous literature of dynamic capabilities has highlighted, (e.g., Eisenhardt and Martin, 2000; Helfat et al, 2007; Ambrosini and Bowman, 2009), management plays a crucial role in a firm’s ability to create value in a changing environment. In terms of SOI, the change process is enabled by managerial capabilities, such as skills, strategic leadership, beliefs, and intentions that combine the innovation and sustainability perspectives. The previous literature on dynamic capabilities has acknowledged also the importance of learning capabilities (meaning the acquirement, interpretation, understanding, integration, and sharing of knowledge) enabling the creation of dynamic capabilities (Zollo and Winter, 2002; Easterby-Smith and Priento, 2008).

The thesis highlights the need for the education of current decision-makers and improving their sustainability- and innovation-related skills and competences. These skills (e.g., systemic thinking and handling of complexity, creative and connective problem solving, the ability to learn and let go of old practices, and understanding the business benefits for SOI, see publication VI) are connected to the ability to recognize and cope with SOI-related challenges. Furthermore, there is a need for building skills to combine knowledge management and SOI actions (publication III), and creating skills for open, radical and system innovations (publication I). Combined with other assets, such as digital tools and platforms, these skills create basis for the development of firm-specific dynamic capabilities for SOI.

The findings support the call by Lopes et al. (2017) to combine sustainability, open innovation and knowledge management actions. Supporting the findings by Seebode et al. (2012) and Inigo et al. (2017), the findings of this thesis highlight the fact that although the re-framing business activities (i.e., incremental innovations) are important in terms of adopting sustainability in business practices, finding more radical SOI means co-evolving actions in a complex environment. In this process, the building of dynamic capabilities allows firms to adopt the required knowledge and move beyond their traditional innovation actions. The thesis highlights especially the role of the search and selection phases of innovation management processes, as within these phases there are multiple challenges that prevent companies from finding motivation to execute SOI.
Due to the reasons listed above, the thesis has also some theoretical implications on the literature of sustainability education. Sustainability education is acknowledged to play a crucial role in allowing sustainable development by helping people to acquire new knowledge, skills, values, and attitudes (e.g., Holm et al., 2015; 2016) and building new capabilities to meet sustainability challenges (Figueiro and Raufflet, 2015). Furthermore, knowledge collaboration and learning are seen as important tools to overcome the sustainability-related challenges (Lozano et al., 2013). The important role of adult education in creating an equitable and sustainable world has been acknowledged just recently (e.g., Griswold, 2017). This thesis contributes to this literature stream by highlighting the importance of sustainable continuing (or further) education, targeted especially at developing the skills of current decision-makers (especially concerned in publications I and VI). Thus, the findings respond to the call for research to support integrating sustainability into the whole educational system (e.g., Holm et al., 2016). This is particularly important, as continuing education is seen to enhance the collaboration between science and practice (Hardin et al., 2016) and thus help in the creation of SOI.

5.2.2 Managerial implications

This thesis contains also implications for practice. The main implications are targeted especially at business managers who cope with the planning, designing and developing of SOI. In addition to the business organization perspective, the findings of the thesis provide guidelines for the public sector and policy-makers.

The first message for the managerial audience is the need to understand the increasing call for SOI with system-level impacts and how it changes value creation. Thus:

- **Innovative value creation for SOI with system level impacts requires acquiring capabilities in open innovation, evaluating and seizing radical opportunities, and reconfiguring the organization.**

Answering global sustainability challenges requires SOI targeting particularly at system and society level changes. These types of SOIs are complex processes involving challenges related to structural impediments, uncertainty avoidance and conflicting aims within and between firms, which may also have cumulative problems along the innovation processes, affecting also value creation. Organizations can cope with these by acquiring appropriate capabilities especially in terms of building adaptive learning capacities and redesign processes to accommodate extensive uncertainty and collaboration. This also builds organizational resilience and helps in adaptation to changes in the business environment (Iñigo and Albareda, 2016). This can help a firm to increase their confidence to act in uncertainty and focus on the unexpected and thus find potential for radical and business model innovations. Aiming at achieve macro-level SOI means the acceptance of risks and uncertainty. The practical advice for the managerial audience is to increase collaboration with academic and society-level actors. Participation to multidisciplinary and collaborative research projects does not only help organizations
to develop SOI or find targeted solutions to their problems, but also increases knowledge exchange between companies, managers and academics. Also participation in different seminars and platforms, organized and facilitated by e.g. universities and NGOs, provides fruitful opportunities to develop knowledge and understanding of global sustainability needs.

SOIs that target at system level impacts require increased collaboration actions. This presents the second key message for business managers as well as public-sector and policy makers:

- *SOI with system-level impacts cannot be created on an island. Managers need to build and adapt tools (such as digital platforms) to facilitate the sharing of knowledge and resources with customers, suppliers, governmental decision-makers and other network partners.*

SOI calls for multi-disciplinary collaboration that crosses boundaries between industries, companies, public and private actors, as well as the academy, business, and society (Goodman et al., 2017). The need for collaboration is highlighted in all individual publications. Similar recommendations have been raised in previous management literature, e.g. in relation to open innovation (Chesbrough, 2017), and recently also in relation to SOI especially in the context of CE. Aiming beyond incremental improvements towards SOI with more radical and system-level impacts is a difficult task without utilizing the resources and knowledge available in the external environment. In the SOI context, the recommendation to open up firm boundaries is especially crucial, as many of the emerging enablers for example for sustainable business model innovation are strongly linked to network and ecosystem development. This means that each network actor contributes to value creation by providing e.g. information, resources, products and/or services, allowing the creation of economic, environmental and social value that no single actor can create alone. In this process the adaptation of digital tools, such as platforms, may help in facilitating for example the sharing of information about usable by-products or waste material and production assets with little use.

SOI does not only involve organizational change in terms of adopting sustainability values (i.e., in addition to economic performance, paying attention to social and environmental impacts of business), but also changes in mindsets and the organizational culture. This means intended actions to enhance collaboration between the business units inside the organization, as well as with external parties, such as customers and other firms. For example, business models for circular economy can be based on the idea that someone’s waste can be a valuable resource for someone else (e.g. Bocken et al., 2017). It is important to look beyond organizational boundaries and see what the firm’s stakeholders and the surrounded network have to offer.

The findings of the thesis reveal multiple challenges in value creation for SOI, understanding of which is a starting point for reducing, removing and managing possible negative value elements. This is important especially from the managerial perspective.
In creating SOI, the challenges of value creation will revolve around knowledge utilization, high uncertainty, and the complex relationships and tensions between involved stakeholders. Managers should assess the implications of these perspectives in their business.

This thesis introduces multiple intermediate tools that help in recognizing specific SOI challenges and their impact on business. These include, e.g., a framework of sustainability knowledge utilization challenges (publication III) and a framework of potential tensions in business networks (publication II). Utilizing these intermediate tools, companies should consider how these issues appear in their business context. For instance, the findings of the thesis highlight the need to combine sustainability, knowledge management and innovation management activities (e.g., Lopes et al., 2017). As presented in publication III, the first point is to create deep understanding of sustainability-related knowledge and existing information. This means the creation of activities to gather data, recognize information from different sources, and understand the relationships and links between pieces of information. New digital tools and assets help in this process. In addition to the implementation of supporting tools, firms should put efforts on enhancing communication between different business units. This can be done, e.g., by sharing ideas, data and news through online platforms, but also for example by establishing collaborative workshops, seminars and special facilities to support free idea sharing and knowledge exchange.

Furthermore, the new forms of business that are based on the ideas of value sharing, resource circulation, and effective use of digital solutions and assets, are seen to provide multiple opportunities for SOI. To help managers to cope with the changing rules of value creation, the thesis introduces supporting methods. One of the key messages is:

- Managers should utilize the introduced supporting methods and intermediate tools to cope with specific SOI challenges. These should be improved and developed further by following the process of designing research-based supporting methods.

The methods and tools include especially the conceptual and mathematical model introduced in publication IV and the platform design framework of publication V. These models guide especially in drawing managers’ attention to the core problems and challenges in value creation for SOI in the contexts of sharing economy and platform-based business. Especially the platform design framework helps in facilitating the finding of common understanding of value creation by linking different stakeholder perspectives and designing sustainable business models. In addition, this thesis presents a process for improvement and creation of further supporting methods. By following new research advancements related to sustainability, e.g. by participating joint research programs and seminars organized by researchers or NGOs, and following academic articles, companies can anticipate changes in their business environments. They should also assess the...
implications of the research findings to their own business and thus update and develop the implemented tools and methods.

The novel market settings involved high uncertainty, as for example the regulations and market rules for sharing economy are still evolving. Thus, the importance of public sector support is high. For example, as presented in publication IV, the development of business models around taxi ridesharing depends on the taxation and regulations which encourage the use of the system. The results (and support methods) introduced in this thesis are meant not only for the use of business managers, but can be utilized by the public sector, policy-makers and other societal actors as well. For example, designing value-based platforms targeted at improving healthcare or transportation systems provide multiple opportunities for the public sector to execute SOI and create overall well-being.

One important message especially for the managerial audience is the need to invest in SOI–related education. This issue does not concern only business managers, but also the public sector and policy makers.

- Managers, public sector actors and policy makers should invest in continuous SOI education of their key decision-makers to develop skills for the intersection of innovation management and sustainability.

To achieve SOI with system-level impacts, it is important to pay attention to the level of individual decision-makers as well. In general, developing the level of skills and know-how of the current decision-makers helps in coping with the challenges of value creation for SOI. As introduced in publication VI, the development needs are particularly related to the development of systemic thinking and handling of complexity, anticipatory and critical thinking, an interdisciplinary and cooperative mind-set, communication skills, as well as creative and connective problem solving. Furthermore, SOI decision-making requires abilities to learn new practices and let go of old ones, courage to experiment and risk failure, skills to create innovative environments and atmosphere, and skills to catch opportunities. By cultivating such skills, organizations will end up in building stronger capabilities in sensing, seizing and catching sustainable business opportunities. Education that combines sustainability and innovation management topics helps decision-makers to make better quality decisions and facilitates complex innovation processes and knowledge management. This is also important for policy-makers and the public sector. The low competence level of professionals, especially in moderately developed regions with low local support, is seen to hamper the collaboration required for SOI (Cannavacciulo et al., 2015). Education is a powerful tool to facilitate the creation of the SOI-related knowledge, attitudes and values, changing mind-sets, as well as building managerial competencies, routines and processes, and thus create capacity for SOI (Ferigotti et al., 2016). The development of SOI-related skills and knowledge, combined with other assets, such as digital tools and platforms allows firms to build capabilities to work with dynamic sustainability environments.
Especially continuing education is a tool to build the dynamic capabilities required for SOI and bring together decision-makers with different backgrounds to share their ideas and experiences of the topic of interest. Despite its possibilities, continuing education focusing on this particular issue is limited. In close collaboration with business, academia should design more practical courses and seminars beyond higher education that address particularly the theme of SOI and related topics such as environmental regulations, circular economy business models and creation of sustainable business value. The courses should be designed so that they bring together managers from different industries and governmental level to work together. Also the team of educators should consist of experts with different backgrounds such as innovation management, knowledge management, marketing, environmental technology, and information technology.

One key message of this thesis for policy-makers and the public sector is to provide support (e.g., financial, regulatory and educational support) for businesses to seek SOI. As the findings of the thesis illustrate, there are multiple challenges connected to SOI. Some of these challenges, for example ones related to financial and regulatory uncertainty can be reduced with the help of governmental decisions. The key is in reducing political uncertainty by developing clear long-term strategies, including taxation policies and environmental regulations that will help companies in making positive investment decisions. As the value creation for SOI is a complex process and involves a lot of stakeholders, policy makers should rather work as supportive partners than ones with contradictory goals and rules. Policy makers should put their efforts on reducing the extra bureaucracy, which has been identified to tie firms’ resources from for example the research and development actions required for SOI. Policy makers should also work in collaboration with business and the academia to ensure that they have the most recent knowledge for example of the technological possibilities for SOI.

5.3 **Limitations**

There are limitations in the thesis that need to be discussed. First, the majority of the collected data was from Finnish markets. Most of the data was collected by conducting interviews with Finnish business managers. Only the empirical data for publication V was collected by utilizing the design science approach, including various international workshops. Limiting the sample mostly to the Finnish context presents a limitation, as the identified challenges may have different emphasis areas in contexts (or countries) with a lower level of sustainability development. However, there are several reasons why this specific context provides a fruitful environment to study the challenges related to value creation for SOI. Most importantly, Finland is known for its advanced sustainable development stage. For example, the Finnish forest industry is globally recognized for its sustainability leadership and longevity (e.g., Mäkelä, 2017; Koskela and Vehmas, 2012), and many companies and other organizations have been highly ranked in global sustainability rankings. For example, in January 2018 the Finnish Innovation Fund organization Sitra was awarded in the annual meeting of the World Economic Forum with the Circulars 2018 award for the public sector actor of playing a key role in accelerating
circular economy (The Circulars, 2018). In addition, Finland is also known for its honouring and respectful attitude towards regulations and governance system and the societal trust on companies’ transparent and responsible business practices is high. Also the Finnish government and different NGOs provide financial and other types of support for companies to develop business around sustainability. Although Finland has a relatively small population and a small number of companies, many Finnish companies operate in international markets, which is also the case with many of the studied companies. This together with the additional data from international sources extend the applicability of the results.

Second, the data collection was mainly based on organizations that had implemented different types of sustainable business practices and SOI, and thus the research was conducted from the supplier/implementer perspective. Some of the presented challenges concerned also other network actors beyond the implementer firm. It is possible that there are other types of challenges in executing SOI that are especially faced by customers, suppliers, societal representatives, policy-makers, or other network partners. The conclusions of this thesis may vary from a different actor perspective. Furthermore, many of the companies were rather big and there were only a few insights from small and micro-sized firms in the data. Widening the research to cover different types of actors, sizes of companies and different network perspectives present a clear area for future SOI researchers to consider.

Third, one of the important limitations of this study is related to the limited insight on value capture for SOI. The focus of this thesis was on value creation, and the study did not take a stand on the theoretical background of value capture. Indeed, value capture has an impact on the SOI development process as it considers the question of how to earn revenues. It has thus an impact on business modelling especially in terms of sharing the created value. The value capture for SOI involves also certain challenges that are related to, e.g., regulatory uncertainty (e.g., Peltola et al., 2016). This study did not address these challenges or how to cope with them, which would provide, however, an interesting avenue for future research especially in terms of ecosystem-level sustainable value capture. Furthermore, as the scope of the study was on examining especially the challenges of early innovation process phases, the study did not address the challenges that may appear in relation to value creation (and capture) for SOI in relation to later stages, such as launching innovations to the market, or innovation diffusion challenges.

Fourth, there are also limitations related to methodological choices. The thesis followed the qualitative research methodology and most of the research was based on case studies. The aim of this research was not in theory building, but rather in exploring empirically the relatively new research area of SOI and providing guidance for the development of testable hypotheses. Future research could utilize different research methodologies to test and validate the results beyond the study context. For example quantitative studies that are based on large sample sizes could be used to study the relationships between the different identified tensions in implementing SOI presented in publication II.
Fifth, the study did not consider the differences of the challenges in value creation for SOI in different industries. Although the data combined insights from various industries (such as forest, steel, waste management, and energy industry), the study did not compare the findings between industries. For example, the emphasis of the challenges in value creation for SOI in the steel industry may vary from the fashion industry. In addition, there are also some other contextual factors that were not considered. These include for example differences between the development of different types of SOI (product, service, process and business model innovation) and different regulation premises. These limitations provide interesting avenues for future research.

5.4 Suggestions for future research

This thesis focused on revealing challenges for value creation for SOI and identifying ways to cope with them. Around this specific topic, there is also room for both theoretical and empirical research. Table 10 summarizes the main advancements that this thesis has on theory development (more details are provided in individual publications), and each of these naturally provide avenues for future research and theory development.

One of the key topics of this thesis was the systemic perspective on SOI. In general, systemic innovations involve multiple actors and require collaboration across the academia, business and government. Thus, further research following the Triple Helix concept (Etzkowitz and Leydesdorff, 2000) could be useful in examining effective policy options to support value creation for SOI and explain the root causes for challenges regarding system-level reactions. Many of the identified challenges in value creation for SOI were somehow related to a firm’s needs to cope with the external demands set by public actors (such as government and non-governmental environmental organizations). Thus, future research could focus more on the management of public-private partnerships especially in terms of sustainability. This could help in coping with the challenges for SOI, for example in relation to business models based on sharing resources (e.g. Cohen and Kietzmann, 2014).

As new market types, business models and technologies are evolving, also new opportunities and challenges for SOI are emerging. Innovation management and sustainability scholars alike should also continue the research on the challenges for value creation for SOI. For example, researchers should continue to explore the emerging tensions in networks (Öberg et al., 2012; Doganova and Karnøe, 2016) and the possible trade-offs (Hahn et al., 2015) and unintended consequences (Mortimer, 2016) of the development and implementation of SOI. One interesting context for future research is also circular economy (CE), which offers great opportunities to build new types of collaborative business models and SOI (Geissdoerfer et al., 2017; Bocken et al., 2016). The aim of establishing business around CE is to create value by minimizing waste and the use of energy and natural resources (Geissdoerfer et al., 2017; Bocken et al., 2017), and by addressing resource scarcity, minimizing the environmental impacts and producing short- and long-term economic benefits (Loiseau et al., 2016). In order to
provide and develop managerial and theoretical guidelines for CE-based business, the special characteristics and challenges of executing CE business should be studied. For example, research on revealing the drivers and barriers for CE-based business is needed.

This thesis introduced supporting methods that are especially targeted at facilitating value creation for SOI in the contexts of sharing economy and platform-based business. The research shed also some light on the possibilities of digital solutions to address SOI-related challenges. However, as the empirical context in this study was limited, future research could study the applicability of these frameworks in other contexts. In addition, future research could gain value from widening the research scope to address the challenges of value capture for SOI.

As mentioned in the previous sub-section, the research presented in this thesis could be enhanced by future research based on different methodologies. For instance, quantitative or simulation studies could examine the relationships between different elements that have an impact on value creation for SOI, by digging deeper into how different negative value elements are faced by different network actors. Furthermore, as many SOI-related benefits are realized after long time-frames, it would be interesting to study the effects and life-cycles of different types of SOI by using longitudinal research approaches. The pragmatist approach, which emphasizes action and practice orientation, problem solving and information production, could be especially useful in future research, focusing on the development of additional supporting methods and measurement tools.

In this thesis, the methodological approach of design science research was used in publication V, focusing on platform design. This methodology was identified to be a valuable tool to address the challenges related to value creation for SOI, such as how to deal with multiple perspectives and design a business in collaboration with a wide network of actors. The use of this method in management and innovation studies has been relatively limited, although it is a valuable research method to create interesting insights for both managerial and academic audiences (Gregor and Hevner, 2013). Future research should thus also consider the utilization of the design science (van Aken and Romme, 2009) and action research methodologies (e.g. Sein et al. 2011) more broadly also in terms of innovation management research. As the aim in design science research is to create an artefact (in addition to theoretical knowledge), this method could be especially valuable in future studies seeking to create supporting managerial tools by using a similar process as presented here.

As the findings of the thesis highlight, there is a need to develop possibilities for continuous education related to SOI that is especially targeted at business managers. Although innovation management as well as the education field have recognized the importance of sustainability in future research (e.g., Seebode et al., 2012; Figueiro and Raufflet, 2015), more attention should be paid to combining these two. The recent research has connected these streams in terms of higher education (Holm et al., 2015; Hoolgaard et al., 2016), but more research is needed especially in the context of adult and continuing education (Griswold, 2017). Scholars from the innovation management,
sustainability and education fields should strengthen their collaboration and focus on future requirements for SOI-related education. For example, researchers could explore more deeply the special skills required for SOI and thus deepen the understanding of the findings presented in publication VI. This could be combined with studies of adult education scholars on the possibilities, methods and tools to enhance business managers’ SOI-related skills and knowledge.
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PART II: PUBLICATIONS
Publication I

Tura, N., Mortimer, G., and Kutvonen, A.

Exploring the pitfalls of systemic innovations for sustainability

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Publication II

Tura, N., Keränen, J., and Patala S.
The darker side of sustainability: Tensions from sustainable business practices in business networks

The manuscript is currently under peer-review for an academic journal.
Publication III

Tura, N., Ojanen, V., and Hanski, J.
Innovations for sustainability: Challenges of utilising sustainability-related knowledge

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Publication IV

Tura, N., Kuitunen, A., Lättilä, L., and Kortelainen, S.
Increased value through sharing in multi-sided markets: Sustainability with ridesharing

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Publication V

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Platform Design Framework: Conceptualisation and Application

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Publication VI

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Continuing education requirements for supporting sustainability-oriented innovations

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