Tampere University

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Drivers and Limitations for Incorporating Environmental Considerations into Investment Decision-Making

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Anjalle, Eilalle ja Kaijalle,

sekä rakkaille Niklakselle ja Möttöselle

PREFACE

This dissertation project has taught me essential skills for becoming a researcher. I have learned to make sense of the world, describe my interpretations precisely, and explore the viewpoints of other describers. Such skills are also crucial for a mapmaker, which was my childhood career choice. Thus rather quietly and unexpectedly, this project also realized one of my childhood dreams. Besides serving professional goals, this project pushed me to grow personally. Starting the project required courage and curiosity while finalising it required endurance. As a whole the project was an inspiring, intense and character-building journey, and I was privileged to share it with many wise academics and practitioners. I am grateful for all these people for encouraging me to carry on my research and to seek further.

First and foremost, I want to thank my supervisors Teemu Laine and Petri Suomala for their support. I am sincerely grateful for Teemu for his guidance throughout this project and for always finding the time to help me with any questions I had in mind. I am also thankful for Petri for inspiring me to begin the doctoral journey in the first place and for giving insightful comments on my work. Besides my supervisors, I want to thank Miia Martinsuo for her constructive feedback during the final revisions of this dissertation, as well as Francesco Testa and Rafael Heinzelmann for their feedback during the pre-examination.

My amazing colleagues have been a pleasure to work with. I have enjoyed to be a member of Cost Management Center (CMC) research group, and therefore my special thanks go to my current and former CMC colleagues Anni, Jari, Jouni, Kati, Tuomas and Vesa. In addition to my research group, I want to thank my other dear colleagues at Tampere University. I wish to thank Eija, Jesse, Johanna, Lauri V., Matias, Milla, Rami and Toni for making me smile and for reminding me to keep calm and carry on with the project. Your empathy and peer support have been invaluable! I also want to thank Ari, Hannele, Jonna, Jukka, Maarit, Silja and Ulla for the great collaboration in sustainability-related teaching and research.

My other academic home has been the Nessling Nest office in Helsinki. Nessling foundation and its scholars in Nest have exposed me to a wide range of scientific fields. Simply put, I could not have wished for a better place to increase my understanding on environmental issues. It has been inspiring to work with highly

enthusiastic scholars from multiple disciplines, such as environmental politics, biology and organizational research. I wish to especially thank Minttu Jaakkola for putting her heart into creating such a great workplace. I also want to thank the whole Nest community for all the analytic and thought-provoking discussions during the past four years in Nest. My special thanks go to Eki, Galina, Heidi, Johanna, Katri, Kirsi-Marja, Kukka, Marjo, Outi, Riikka, Salla, Sanna, Sanna-Liisa, Sonja and Vilppu; you truly have broadened my perspective on meaningful research and life!

This research would not have been possible without financial support. I appreciate the TUT's doctoral school for the grant they provided, as well as the Finnish Technology and Innovation Agency (Tekes), Tampere University of Technology (TUT) and all the companies who funded the MASI research project. I also highly appreciate the time that the people behind MASI put in our joint research effort. I am especially thankful to Iina-Lydia, Johanna, Mari, Nuppu, Roosa, Tapani, and Viljami for their insights and vision on the studied topics. Additionally, several foundations supported my research with summer school grants or encouragement grants. I wish to thank EIT RawMaterials, Finnish Foundation for Economic Education, the Gas Fund of Finnish Foundation for Technology Promotion, the Economic Education Foundation of Tampere, and Walter Ahlström Foundation for enabling and appreciating my research.

I am deeply grateful to be surrounded by warmhearted people also outside the academia. Thank you for my friends for keeping me in one piece during this project. I appreciate all the good laughs and deep conversations we have shared when hiking in forests, testing new board games, renovating, making ceramics, organizing yoga retreats or running on the football field. Moreover, I owe my warmest thanks to my family. My father Ari, mother Maarit and brother Samuel have been my role models for keeping an active and optimistic attitude for life.

Finally, I want to thank my dearest Niklas. Your loving, firm and caring presence has meant the world to me when finalizing this project. Above all, thank you for believing in me when I forgot to do so. I look forward to our next adventure, as we are soon becoming parents for Möttönen. Getting to know her will certainly be an educating and enlightening journey as well!

Helsinki, September 12th, 2019

Natalia Saukkonen

ABSTRACT

Society's transition towards environmental sustainability seems inevitable from the perspective of limited resources and ecological degradation. Sustainability transition literature has addressed this need at the system level, but it has provided limited knowledge on enhancing sustainability at the company level and within individual businesses. This is unfortunate, as the transition requires forerunner actions that different companies and individuals can drive in practice. The literature has not thoroughly investigated the decision-making practices of companies and the role of environmental considerations in those processes. Therefore, the sustainability transition scholars have called for introducing management studies into the discussion.

Acknowledging the need for more environmentally conscious business practices, management accounting literature has recently developed new investment assessment tools and reporting methods. They enable the consideration of both financial and environmental information in managerial decision-making. However, the availability of such methods does not imply that companies would incorporate environmental considerations into their decision-making processes in reality. Therefore, to enhance environmentally conscious decision-making practice, a more thorough understanding is needed about the actual decision-making processes in situations in which companies are investing into cleaner technologies.

To address these needs, this dissertation studies the incorporation of environmental considerations into investment decision-making processes. More precisely, this dissertation identifies and elaborates on the external pressures that drive companies to consider environmental aspects of their technology investments, on the triggers that initiate the investments in actual decision-making situations, and on the limitations that hinder the incorporation of environmental considerations into investment decision-making processes.

To meet its research objective, this dissertation combines different in-depth qualitative research approaches. It is built on a summary and five research articles (Articles I–V). The theoretical basis of the dissertation combines contingency- and actor-based approaches to decision-making, together with Switching Patch Analysis Technique as a critical incident technique for analysing decision-making processes.

The individual articles employ conceptual analyses and in-depth case studies with some interventionist features. The case studies were conducted in the Finnish gas sector, involving central stakeholders from the gas providers and utilizers and the local authorities that foster local investments in biogas production systems.

Overall, this dissertation uniquely combines analyses of the pressures for environmental sustainability at the system level and of the triggers and limitations in decision-making processes at the company level. It integrates and elaborates upon the current understanding of the decision-making practices of companies as presented in the literature on sustainability transitions, management accounting, and energy technology. The findings illustrate how cleaner technology investments of companies are the result of complex interactions between external situational pressures, influencers, internal process structures, and individual decision-makers. These investments can be *triggered externally* by situational changes in a business environment or by active influencers. In contrast, *internal triggers* for these investments involve motivated individuals who possess supporting roles and values for initiating the investment. However, whether *pressured* externally or valued internally, the incorporation of environmental considerations can face challenges in practice. It can be hindered by *limitations* stemming from the investment decision-making process structure and the decision-makers involved. Therefore, achieving cleaner technology investments in an organization requires supportive situational factors in the external business environment, motivated external and internal influencers that foster changes in practice, and internal decision-making structures and interactions that allow the incorporation to take place in the organization.

These findings are relevant for practitioners who wish to influence the decision-making processes of companies from the outside. Such practitioners include policy-makers, technology providers, and management that promote cleaner technology investments in companies. These practitioners can increase the impact of their work as influencers by identifying the triggers and practical limitations for incorporating environmental considerations into decision-making. In particular, the representatives selling cleaner technologies can understand better the decision-making processes of their existing and potential customer companies. Future studies are encouraged to investigate external pressures, triggers, and limitations in other investment contexts. Furthermore, these studies could also address the roles, intentions, and actions taken by key influencers when they promote the cleaner technologies in their organisations.

TIIVISTELMÄ

Tarve kestävälle yhteiskunnalliselle muutokselle vaikuttaa välttämättömältä, kun tarkastellaan rajallisia luonnonresursseja ja ympäristön huononevaa tilaa. Kestävyysmuutoksen kirjallisuus on käsitellyt tätä tarvetta systeemitasolla, mutta sillä rajallinen ymmärrys ympäristökestävyyden edistämisestä yritystasolla ja edelleen yksittäisissä liiketoiminnoissa. Tämä on valitettavaa, sillä kestävyysmuutos tarvitsee toteutuakseen edelläkävijätoimintaa, joka käytännössä ilmenee organisaatio- ja yksilötasolla. Kirjallisuudessa ei ole syvällisesti käsitelty yritysten päätöksenteon käytänteitä ja ympäristönäkökulmien roolia päätöksentekoprosesseissa. Tämän vuoksi on toivottu, että johtamisen tutkimushaaroja tuotaisiin mukaan kestävyysmuutoksen keskusteluun.

Laskentatoimen kirjallisuus on hiljattain tunnistanut tarpeen ympäristötietoisemmalle liiketoiminnalle. Se on kehittänyt investointiarvioinnin ja raportoinnin työkaluja talous- että ympäristötiedon huomioimiseksi yritysten päätöksenteossa. Työkalujen saatavuus ei kuitenkaan vielä takaa, että yritykset todellisuudessa sisällyttäisivät ympäristönäkökulmia päätöksentekoprosesseihinsa. Ympäristötietoisemman päätöksenteon edistäminen tarvitsee perinpohjaista ymmärrystä todellisista tilanteista, joissa yritykset ovat investoineet puhtaampiin teknologioihin.

Vastatakseen näihin tutkimustiedon puutteisiin, tämä väitöskirja tutkii ympäristönäkökulmien sisällyttämistä investointipäätöksenteon prosesseihin. Väitöskirja tarkastelee ulkoisia muutospaineita, jotka ajavat yrityksiä huomioimaan ympäristönäkökulmia päätöksentekoprosesseissaan. Lisäksi se tarkastelee käynnistäviä tekijöitä, jotka aloittavat investoinnin todellisissa päätöksentekotilanteissa, sekä rajoitteita, jotka hankaloittavat ympäristönäkökulmien sisällyttämistä prosesseihin.

Väitöskirja rakentuu yhteenvedosta ja viidestä tutkimusartikkelista, jotka perustuvat laadullisiin tutkimusotteisiin. Tutkimuksen teoreettinen pohja yhdistää kontingentista ja pragmaattis-konstruktivistista lähestymistapaa päätöksentekoon sekä SPAT-vaihtopolkuanalyysimenetelmää yritysten päätösprosessien analysointiin. Yksittäiset artikkelit hyödyntävät kirjallisuuteen perustuvia käsiteanalyyseja sekä interventionistisia tapaustutkimuksia. Tapaustutkimukset tehtiin suomalaisella

kaasualalla. Ne käsittivät keskeisiä tahoja kaasun tuottajista ja käyttäjistä biokaasun tuotantojärjestelmiä paikallisesti edistäviin kuntatoimijoihin.

Tutkimuksessa tunnistetut ulkoiset muutospaineet, käynnistävät tekijät ja hankaloittavat rajoitteet tuottavat ymmärrystä yritysten investointipäätöksenteosta ja ympäristönäkökulmien sisällyttämisestä päätöksiin. Tulokset lisäävät ymmärrystä yritysten päätöksenteosta kestävyysmuutoksen, laskentatoimen ja energiatekniikan kirjallisuuteen. Ne myös havainnollistavat, kuinka yritykset investoivat puhtaampiin teknologioihin ulkoisten muutospaineiden, vaikuttajien, sisäisten päätösrakenteiden ja yksittäisten päätöksentekijöiden yhteisvaikutuksesta. Investoinnin voi käynnistää ulkoisesti liiketoimintaympäristössä muuttunut tilannetekijä tai aktiivinen vaikuttaja. Sisäisesti käynnistävät tekijät lähtevät motivoituneista yksilöistä, joiden roolit ja arvot tukevat investointia. Vaikka ulkoiset muutospaineet tai sisäiset arvot tukisivat ympäristönäkökulmien huomioimista, erilaiset rajoitteet voivat vaikeuttaa niiden sisällyttämistä päätöksentekoon. Rajoitteet voivat kummuta sekä päätösprosessien rakenteista että päätöksentekijöistä. Kokonaisuutena puhtaampien teknologioiden investoinnit vaativat käynnistäviä tilannetekijöitä liiketoimintaympäristössä, motivoituneita ulkoisia ja sisäisiä vaikuttajia sekä soveltuvaa organisaation päätöksenteon rakennetta ja vuorovaikutusta.

Tulokset ovat hyödyllisiä päättäjille ja teknologiatoimittajille, jotka haluavat edistää puhtaamman teknologian investointeja yrityksissä. Toimijat voivat lisätä työnsä vaikuttavuutta tunnistamalla käynnistäviä tekijöitä ja käytännön rajoitteita investointipäätöksenteossa. Etenkin puhtaampien teknologioiden myyjät voivat ymmärtää nykyisten ja potentiaalisten asiakasyrityksien päätöksentekoa paremmin tulosten avulla. Lisäksi tarvitaan jatkotutkimusta ulkoisista muutospaineista, käynnistävistä tekijöistä ja rajoitteista muissa investointikonteksteissa. Jatkotutkimus voi myös tarkastella keskeisten sisäisten vaikuttajien rooleja, arvoja ja keinoja edistää puhtaampien teknologioiden investointeja organisaatiossa.

CONTENTS

ORIGINAL PUBLICATIONS

Article I Saukkonen N., & Kirjavainen J. (2019). Business environment: Emerging external and internal pressures for sustainable production. In W. Leal, A. Azul, L. Brandli, P. Özuyar & T. Wall (Eds.). *Responsible consumption and production: Encyclopedia of the UN Sustainable Development Goals.* Cham, Switzerland: Springer.

Article II Kirjavainen J., & Saukkonen N. (2019). Sustainable competitiveness at the national, regional, and firm levels. In W. Leal, A. Azul, L. Brandli, P. Özuyar & T. Wall (Eds.). *Responsible consumption and production: Encyclopedia of the UN Sustainable Development Goals*. Cham, Switzerland: Springer.

Article III Saukkonen, N., Särkilahti, M., Saukoniemi, S., Jokinen, A., Rintala, J., & Laine, T. (in review) Municipalities applying circular economy principles: intentions and actions in establishing biogas production systems. Under review in *Energy Research & Social Science.*

Article IV Saukkonen, N., Laine, T. & Suomala, P. (2017). How do companies decide? Emotional triggers and drivers of investment in natural gas and biogas vehicles. *Energy Research & Social Science, 34*, 49-61.

Article V Saukkonen, N., Laine, T., & Suomala, P. (2018). Utilizing management accounting information for decision-making: Limitations stemming from the process structure and the actors involved. *Qualitative Research in Accounting & Management, 15(2)*, 181-205.

AUTHOR'S CONTRIBUTION TO THE PUBLICATIONS

The idea for the first article was developed together with the co-author. I worked together with the co-author to frame and position the paper. I carried out the literature search and review and wrote the majority of the article. I was also responsible for further developing the paper based on peer review comments. The co-author assisted me in finding the relevant literature for the paper. We worked together to revise the paper after receiving peer review comments.

The idea for the second article was developed together with the co-author. I worked together with the co-author to frame and position the paper. I took part in

finding the relevant literature and wrote minor parts of the article. I also worked together with the co-author to revise the paper after receiving peer review comments.

The idea for the third article was developed in collaboration with its second and third authors. I framed and positioned the paper together with the second author. The data were collected together with the second and third authors. I had the leading responsibility for the data analysis. I conducted and wrote the literature review together with the second author. We also wrote the full draft versions of the paper together. The paper was further developed in collaboration with the fourth, fifth, and sixth authors during the writing and revision process. I played a leading role in the submission process and in revising the paper after receiving peer review comments.

The idea for the fourth article was developed in collaboration with its co-authors. I was responsible for the interventionist work and data collection during the research process. I also analysed the research data and discussed the results of this analysis with the co-authors and case company representatives. I conducted and wrote the literature review and formulated the draft versions of the paper. The co-authors helped me to modify and develop the paper further. I had the primary responsibility for revising the paper and the revisions were jointly discussed with the co-authors.

The idea for the fifth article was developed in collaboration with its co-authors during an iterative research process. I was responsible for the interventionist work and data collection during the research process. I also analysed the research data and discussed the results of this analysis with the co-authors and case company representatives. I worked with the second co-author to frame and position the paper. I played a central role in writing the draft versions of the paper. During the review process, I had the primary responsibility for revising the paper. The co-authors provided comments and modifications to my revisions. The paper was included in a special journal issue in which one of the guest editors, Maria Major, and one of the journal's co-editors, Deryl Northcott, were entirely responsible for handling the paper in a double blind review process.

1 INTRODUCTION

1.1 Motivation and background

Society's transition towards environmental sustainability seems inevitable from the perspective of limited resources and ecological degradation (Rockström et al., 2009; Steffen et al., 2015). To address this need, sustainability transition (ST) literature has developed system level concepts for fostering environmental sustainability in the society. Operating at the societal level, ST literature has intended to inform policy-making to foster sustainability from a top-down perspective (Markard, et al. 2012). While the systemic view has been helpful in developing understanding of the bigger picture and the need for societal change towards sustainability, this focus might have come at the expense of more actor-oriented analysis. (Farla et al., 2012). Minor attention has been given to empirical studies with an organizational and individual actor focus. (Markard et al., 2012). So far, the literature has provided limited knowledge on enhancing sustainability at the company level and within individual businesses (Loorbach et al. 2013). This is unfortunate, as the transition requires forerunner actions that different companies and individuals can drive in practice (Koistinen 2019). Acknowledging this need, the scholars have called for introducing management studies into the ST discussion (Markard et al., 2012).

From company management perspective, the required transition affects the public expectations set for business. Companies can aim for more environmentally conscious business practices in order to meet these rising public expectations for sustainability. However, companies and their solutions cannot be sustainable on their own (Geels, 2010), as sustainability issues are too complex and interconnected to be addressed by individual organizations. Instead, companies can serve as elements of more sustainable systems, acting as strategic mediators between the macro-level systemic change and the micro-level activities in their organizations (Gaziulusoy & Brezet, 2015). These micro-level activities include environmentally driven changes in business practices, such as incorporating environmental considerations into technology investment decisions (Sannö et al., 2016).

Acknowledging the need for more sustainable decision-making, management accounting (MA) literature has developed approaches that enable the consideration of both financial and environmental information in organizational decision-making practices. Such approaches include, for example, investment assessment and reporting. In the investment assessment literature stream (Bebbington et al., 2007; Nijkamp et al., 2002), environmental issues are typically considered by modifying investment assessment techniques in the early stages of the decision-making process. Such alterations to assessment techniques can include estimating the long-term benefits of environmental actions or the potential risks of investments with serious environmental impacts (Bennett & James, 1998, p. 51). Different impact assessment techniques include, for example, multi-criteria analysis (MCA), environmental impact assessment (EIA), or cost-benefit analysis (CBA) (Räikkönen et al., 2016). In general, they provide a set of quantitative methods for analysing decisions with uncertainty and/or multiple conflicting objectives (Keeney & Raiffa, 1993; Corner & Kirkwood, 1991). Environmental consequences could be one of the multiple objectives for the decision outcome.

The technical work of designing appropriate investment assessment techniques and tools does not yet imply that environmental considerations and measures would be used in supporting actual decision-making processes (Järvenpää & Länsiluoto, 2016). To have impact, the tools and techniques need to fit actual decision-making contexts and practices. However, the investment assessment literature aims at providing systematic and consistent quantitative approaches to making decisions rather than at examining how the decisions are made in practice (Corner & Kirkwood, 1991; Bebbington et al., 2007). Therefore, the understanding gained about assessment techniques needs to be supplemented with the understanding of the actual decision-making processes.

In the reporting stream, MA literature emphasizes the importance of external environmental disclosures in achieving internal organizational change and awareness (Laine et al., 2017). However, prior work has also identified a gap between organizational practices related to environmental issues and their representations in environmental disclosures (Laine et al., 2017; Testa et al. 2018; Onkila and Siltaoja 2017). This loose coupling between external reporting and internal decision-making practices also calls for turning the focus towards actual decision-making processes in organizations (Zollo et al., 2013; Arroyo, 2012; Adams & Larrinaga-Gonzales, 2007).

Altogether, enhancing environmental sustainability at system level requires forerunner actions that companies as collective entities and as groups of distinct

individuals can drive (Koistinen 2019). Despite the important role of companies in fostering environmental sustainability, the ST literature has not thoroughly investigated the investment decision-making practices in companies. Introducing management studies into the ST discussion can answer this need. In particular, Management accounting (MA) literature represents a relevant literature stream for such focus because it largely concentrates on supporting decision-making with relevant information (Hall, 2010; Wouters & Verdaansdonk, 2002) and has shown its ability to study and enhance investment decision-making in organizations (Kaplan, 1984). In this vein, improving environmental performance in company operations requires changes in actual decision-making practices not only in assessment techniques or in reporting. Therefore, within the MA literature, the knowledge about investment assessment methods and environmental disclosures needs to be supplemented with the knowledge about actual decision-making processes. To gain this understanding, scholars call for closer engagement with practice (Järvenpää & Länsiluoto, 2016; Adams & Larrinaga-Gonzales, 2007; Ahrens & Chapman, 2006; Van de Ven & Johnson, 2006).

1.2 Research objectives and research questions

In order to address the research needs discussed above, this dissertation aims at identifying and elaborating on the drivers of and limitations to the incorporation of environmental considerations into the investment decision-making processes of companies. More precisely, the research objective is to identify and elaborate on the external pressures that drive companies to consider environmental aspects of their technology investments, on the triggers that initiate the investments in actual decision-making situations, and on the limitations that hinder the incorporation of environmental considerations into investment decision-making processes.

The focus of this study is in technology investment decisions, which refer to the organizational choice to use money to acquire equipment. The equipment is an asset that contributes to the production capacity of a company (Horngren et al. 2009, p.481), and its use significantly influences both the financial and the environmental consequences of the company's operations over the equipment lifespan (Kärri, 2007; Testa et al., 2011). In a broader context, such technology investment decisions can be also classified as strategic decisions (Carr et al., 2010), but strategic decision-making in a broad sense is not under examination in this dissertation. The studied technology investment decisions took place in the Finnish gas sector and covered

investments in gas technologies, i.e., in biogas production systems and gas vehicles. Environmental consequences is a commonly discussed topic in this context, because the gas technologies are linked to energy production and use. Moreover, when discussing environmental considerations in technology investments, this study acknowledges that different technologies hold different environmental considerations in their use contexts. For example, biogas production systems enable nutrient recycling in waste treatment while gas vehicles enable carbon dioxide and particulate matter emission mitigation in transportation. These different environmental impacts may be obvious for fuel suppliers and technology providers operating in energy sector. However, most of the gas technology users operate primarily outside the energy sector where such environmental considerations may not be self-evident. Therefore, it is potentially valuable to study the investment decision-making mechanisms in those companies.

To achieve its objective, this study approaches the decision-making processes of companies with the following assumptions. First, this study acknowledges that the decision-making processes are influenced by external pressures and the companies' responses to them. The pressures can result from both the situational changes in business environment (Duncan, 1972) and the external influencers that actively want to influence the decision-making processes (Roos, 1999; Roos & Gustafsson, 2011; Freeman, 1984).

Second, this study interprets organizational decision-making as a process that involves both structural and actor-based features (Nielsen et al., 2015). This means that both the internal decision-making process structures and the individual participants have an impact on the decision outcome. For more thoroughly understanding the structural and actor-based features of the process, this study primarily leans on concepts taken from the contingency theory (Fredrickson, 1986; Donaldson, 2001) and the pragmatic constructivism theory (Nørreklit, H., Nørreklit, L., & Mitchell, 2010).

Third, this study analyses the external pressures and the companies' reactions to them as situational, influential, and reactional triggers. The triggers are analytical devices that are part of the Switching Path Analysis Technique (SPAT), a method for analysing actual decision-making behaviour (Roos, 1999; Roos & Gustafsson, 2011). The underlying assumptions behind SPAT are in line with the processual, structural, and actor-based views on decision-making that are applied in this study. Consequently, this dissertation uses SPAT as a tool to combine different perspectives that affect decision-making practices and to uncover the dynamism present in actual organizational decision-making processes.

These theoretical approaches to decision-making allow forming a holistic view of the companies' investment decisions in the research setting. To unveil the drivers of and limitations to the incorporation of environmental considerations into the investment decision-making of companies, this study answers the following research questions (RQs):

RQ1: What kinds of external pressures motivate companies to consider environmental aspects in their investment decisions?

RQ2: What kinds of triggers can initiate environmentally conscious investments in actual decision-making situations?

RQ3: What kinds of limitations can hinder the incorporation of environmental considerations into investment decision-making processes?

Essentially, this dissertation presents a novel approach, combining the analyses of the pressures for environmental sustainability at the system level with the analyses of the decision-making processes and practices of companies from multiple perspectives (triggers, limitations). Answering RQ1 on external pressures provides a contextual basis and motivation for delving deeper into the actual decision-making mechanisms studied in RQ2 and RQ3. The situational, influential, processual, structural, and actor-based features of decision-making are emphasized differently in each research question. The external pressures examined for the RQ1 are viewed as external contingencies or situational factors that motivate companies to alter their practices (Fredrickson, 1986; Donaldson, 2001). The triggers examined for RQ2 recognise not only the situational factors but also the roles played by the external and internal influencers as well as the companies' reactions to them (Roos, 1999; Roos & Gustafsson, 2011). The limitations examined for RQ3 recognise the influence of process structures and decision participants in the decision-making processes (Nielsen et al., 2015; Ahrens & Chapman, 2006; Chapman, 1997). Together, the identified external pressures, triggers, and limitations provide understanding about how environmental considerations become incorporated into decision-making processes in companies (Table 1). This understanding is relevant for those policy-makers and technology providers who want to advance cleaner technology adoption in companies. Table 1 summarizes the research design of the dissertation by connecting the analytical focuses and original research articles to each of the research questions.

Table 1. Research design of the dissertation

Research question	RQ1 External drivers for the incorporation	RQ2 Triggers influencing the decision-making process	RQ3 Limitations for the incorporation in practice
Analytical focus	Macro level pressures →	Situational changes	
	Micro level pressures →	External influencers	Limited power
	Internal pressures →	Internal influencers and internal reactions to critical incidents	Actors and process structure
Article contribution	Articles I and II	Articles III and IV	Articles III and V

This dissertation aggregates the findings for all research questions from the original research articles I–V. More precisely, the questions and the articles are related to each other in the following manner. Articles I and II answer RQ1 by reviewing the existing literature on sustaining a competitive advantage in a business environment that increasingly requires environmental sustainability. Articles III–V explore decision-making mechanisms in inter- and intra-organizational settings. Articles III and IV answer RQ2 by providing understanding of the external influencers and other triggers present in investment decision-making situations that involve environmental considerations. Articles III and V answer RQ3, which focuses on the limitations for incorporating environmental considerations into investment decision-making. More precisely, Article III answers RQ3 using an inter-organizational context. It focuses on external influencers and on their actions, when they intend to influence companies in the inter-organizational network. Finally, Article V answers RQ3 using an intra-organizational decision-making context. It focuses on the limitations stemming from the actors and decision-making structures involved in the investment decision-making process.

1.3 Research process

The research process underlying this dissertation took place during the 2015–2019 period. The dissertation and its original research articles are based on two different research collaborations, featuring engaged research (Van de Ven & Johnson, 2006;

Lyly-Yrjänäinen et al., 2017) and versatile research cooperation. The first research collaboration was initiated by the Managing Service Impact (MASI) project (Engaging facts and feelings, 2015–2017). The project relied on the interventionist work of researchers (Suomala, et al., 2014), meaning that researchers built close collaborations with participating companies through real life development projects. The results from the MASI collaboration were reported in three research articles that are titled Articles III, IV, and V in this dissertation. The second research collaboration occurred as part of an international research effort called the Encyclopedia of the UN Sustainable Development Goals project (2018–2019). Contributing to the Encyclopedia project resulted in two research articles, which are titled Articles I and II in this dissertation. The remainder of this section describes the researcher's participation in the MASI and Encyclopedia projects in more detail (Figure 1).

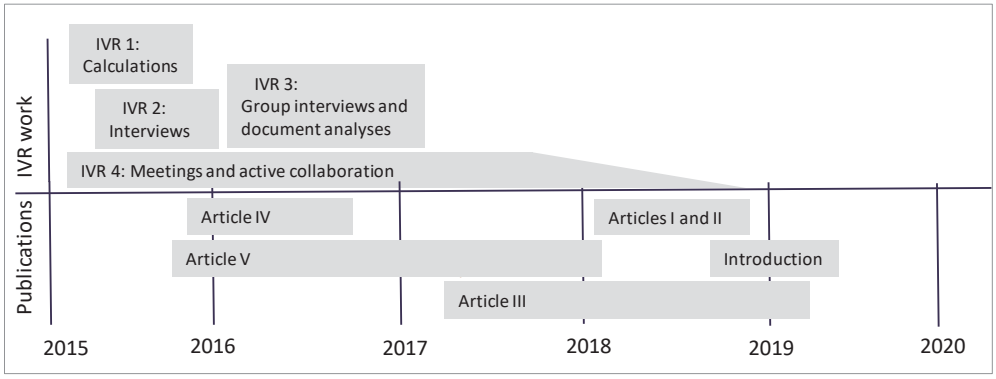

Figure 1. Research process timeline, interventionist work (IVR) and research articles

In the MASI research project, the researchers created a joint subproject with one of the participating companies—the Energy Company (hereafter, the fuel supplier). The project applied an interventionist approach in a case study setting, meaning that the empirical material was gathered through a close cooperation with the fuel supplier. The interventionist approach combined theoretical research interests with technological developments and societal challenges (see Lyly-Yrjänäinen et al., 2017, for the interplay between those perspectives). The fuel supplier was looking for support in ensuring the quality of their upcoming large refilling infrastructure investment decisions. For the fuel supplier, the profitability of the refilling infrastructure investment and the biogas production investment was highly dependent on fuel demand in the transportation sector. Therefore, they actively

enhanced the adoption of gas vehicles in their customer companies as part of their market creation work. By joining the MASI project, the supplier hoped to better understand the facts and feelings behind the decision-making of their customer companies. Recognizing the actor-based features of decision-making was new to the fuel supplier because it operated in a business context that bears a conventional engineering mind-set.

The interventionist work at the fuel supplier started by jointly outlining a practically and scientifically relevant research problem (Van de Ven & Johnson, 2006). After discussions with top management, the aim of the project was framed to create an understanding of the decision-making processes of the supplier's customer companies. The joint discussion about the research problem and identification of relevant key informants built trust between the researchers and the company representatives. This trust created research access to the organization (Ahrens & Dent, 1998) and enabled the researchers to join the company's development discussions almost as insiders. The intentionally participatory role (Suomala et al., 2014; Lyly-Yrjänäinen et al., 2017) was also created through steering group meetings, Research and Development (R&D) workshops, and informal meetings in which the researchers offered their research expertise for the fuel supplier's use. Through the interventionist work, the researchers had the possibility to engage in discussions with different company representatives, from top management to R&D, corporate social responsibility, business development, and sales positions. Later on, the research collaboration also had implications for university teaching, as company representatives were invited to give guest lectures and join a case competition organized for students.

The first phase of interventionist work included the creation of two investment calculation tools to be used with the fuel supplier's customers (IVR 1 in Figure 1). This development work enhanced discussion and the understanding of the factors that affect the profitability of a gas vehicle investment. The second phase included conducting interviews with customer companies and within the technology network to deepen the understanding of the different perspectives involved in investment decision-making (IVR 2). By interviewing the customer companies about their actual investment cases and related decision-making processes (SPAT), the researchers had the opportunity to discover the factors and triggers behind company decision-making and place them in a wider business context. Finally, the rich understanding gained was reported in Articles IV and V.

During the MASI project meetings, the fuel supplier representatives saw a link between the MASI project and their other research project. The supplier's

representatives also participated in a project that studied municipalities as key actors in establishing biogas production systems. Essentially, this project featured access to group interviews with the key stakeholders of biogas production systems (IVR 3). The project was initiated by the Chemistry and Bioengineering unit of Tampere University. This was the same university where the author of this dissertation also worked in. Sharing the interest in biogas production and utilization, the author also joined the data gathering and analysis work for that project. This research collaboration resulted in Article III.

The understanding acquired from these projects was relevant for answering the practical questions of the fuel supplier, as it was directly related to the fuel supplier's marketing strategy and infrastructure network planning. This was important because the projects aimed at yielding practically relevant yet scientifically novel understanding (Van de Ven & Johnson, 2006; Lyly-Yrjänäinen et al., 2017). Altogether, the collaboration with the fuel supplier's representatives resulted in rich data, including notes and documents from various sources. The data included material from the two investment calculation tools created, the two workshops organized, over twenty formal and informal meetings conducted, over 500 sent and received email correspondence with representatives, dozens of phone calls made, and interviews arranged with over 43 informants representing 22 organizations in the fuel network. All these interactions enabled in-depth empirical data collection and continuous learning throughout the research process (IVR 4 in Figure 1). In addition, the variety of information sources within the multi-stakeholder research process enabled data triangulation during the research process.

Finally, the Encyclopedia project was a multidisciplinary research effort to address the 17 sustainable development goals (SDGs) and their terminology in a comprehensive and integrated way. In the first phase of the project, an expert panel listed 100 terms associated with each SDG. In the second phase, suitably qualified authors from all continents and from a wide range of disciplines were invited to join the project. The author of this dissertation was one of the invitees due to her prior experience in studying investment decision cases in the context of biogas production and utilization and in investigating the role of investment decisions in enhancing sustainable development. Together with a colleague, two book chapters were written that contributed to SDG goal 12: "Ensure sustainable consumption and production patterns." These publications analysed two terms from the term list—the notions of competitiveness and business environment. Following a peer-review process, the articles were published together with other Encyclopedia project articles; they are included as Articles I and II in this dissertation.

1.4 Outline of the original articles and dissertation structure

This section provides an outline of the original research articles that resulted from the research process described above. Article I provides a broad overview on how requirements for improved environmental performance emerge and cut across the levels of today's business environment. The article first discusses macro-level pressures and moves on to micro-level influencers in the immediate operational environments of companies. Finally, the paper sheds light on internal influencers that can push companies to search for improved environmental performance. Discussing emerging sustainability-related changes in a business environment helps companies to understand the increasing physical and societal pressure to shift their strategies towards more sustainable resource use, leading to a more sustainable provision of products and services.

Article II provides a conceptual analysis of competitiveness and sustainable competitiveness at national, regional, and company levels. The article first describes competitiveness at the national, regional, and firm levels, and then moves on to address each from the perspective of competing sustainably. Finally, the article discusses the measurement of concepts and future directions for advancing sustainable competitiveness.

Article III explores the perspective of municipal actors during the establishment phase of biogas production systems. The study is based on three biogas system cases in which the municipal actors had taken an active role in fostering the systems and enhancing cross-sectoral collaboration for system establishment. The findings provide insight on how principles for sustainable development and circular economy are operationalized in practice through the development work of municipal system builders. In particular, the study provides understanding about the intentions of municipal actors and their actions during system establishment. Finally, the study reflects on municipal actors' chances to influence companies' investment decisions when the latter are invited to join the system. As system builders invite companies to join the system as financially self-sufficient entities, the companies can also make their technological choices independently. This means that control over technological choices is distributed among the companies that join the system.

Article IV explores the investment decision-making dynamics of companies concerning alternative fuel vehicles (AFVs). The article is based on an interventionist case study (i.e., engagement with the fuel supplier and the use of a customer interview strategy for unveiling the decision-making processes). Moreover, interventionist work included the creation of investment calculation tools for the fuel supplier' use.

The empirical data of the paper consist of in-depth analyses of seven investment cases, based on qualitative interviews with the decision-makers (customers). The interviews were supplemented with extensive analyses of the technology under examination, the fuel supplier (case company), and the Finnish use context. The findings unveil the decision-making triggers of companies, their investment criteria, and the use of information sources in AFV investment decision-making processes. In particular, the findings show that AFV investment is a complex decision-making process in companies, guided not only by the number of filling stations, maintenance infrastructure, and residual value of the vehicle but also by subjective, non-rational elements, such as personal interest in the technology or value for domestic fuel origin, piloting, and the environment.

Article V investigates the limitations for management accounting (MA) information utilization in a real-life investment decision-making context. In particular, the study explores limitations stemming from the decision-making process structure and the involvement of several managerial actors. The study is based on an exploratory case of a fuel supplier and its customer company, discussing the role and content of MA information in the customer's vehicle investment decision-making process in particular. The findings illustrate current challenges in providing and integrating MA information (e.g., financial figures demonstrating cost efficiency or CO_2 emission figures on environmental performance) into decision-making. Moreover, they also demonstrate how a seemingly analytical decision-making procedure may exclude certain viewpoints that are relevant from different managerial perspectives or strategically important for the organization.

In sum, the first two articles investigate the potential motivators for companies to incorporate environmental considerations into their business practices. The pressures for environmental considerations can stem from external and internal sources, as demonstrated by the literature searches conducted for Articles I and II. Organizations that recognize the emerging environmental, regulative, normative, and competitive pressures for environmental sustainability can develop their practices by incorporating environmental aspects into their investment decision-making. The multiple facets of investment decision-making are further explored through empirical analyses presented in Articles III–V. The studies take place in gas utilization and production contexts, where either local authorities or suppliers are trying to enhance the investments of companies into cleaner technologies. Altogether, the empirical analyses on investment decision-making practices explore the intentions and actions of external influencers (Article III, IV, and V), the triggers and drivers present in decision-making (Article IV), and the limitations for

incorporating environmental considerations into investment decision-making processes (Articles III and V).

In its entirety, this dissertation is built on a summary and five research articles (Articles I–V). The remainder of its summary portion is structured as follows. The second chapter provides an overview of different literature streams that discuss the interplay of environmental and economic considerations in decision-making at different levels. With respect to those literature streams, this dissertation primarily focuses on organizational-level decision-making. Furthermore, the second chapter also discusses organizational decision-making from the viewpoints of process structure, actors, and decision-making triggers. The third chapter introduces the research approach and context as well as the data collection and analysis methods applied in each original article. The fourth chapter discusses the findings that answer research questions (RQs)1–3. The fifth chapter presents and discusses the theoretical and practical implications of the findings, provides an assessment of the research, and concludes with suggestions for future research.

2 THEORETICAL BACKGROUND

2.1 Key terms and concepts

Key concepts of this dissertation include investment decision, technology investment decision and environmental considerations. These concepts are here briefly examined prior to the broader literature analyses in this chapter.

In this dissertation, the concepts of investment decision and technology investment decision refer to the organizational choice to use money to obtain access to and ownership of equipment. The acquired equipment is supposed to affect operations in the long term, i.e., over multiple fiscal years (Horngren et al. 2009, p. 1043). In a business context, using equipment in operations is expected to generate future financial benefits. Thus, the equipment is an asset that contributes to the production capacity of an organization. (Horngren et al. 2009, p.481) The investment decision is called a replacement investment decision when the production capacity is renewed and a new equipment investment when the capacity is extended (Mauer & Ott, 1995).

In a broader context, technology investment decisions can be also classified as strategic decisions (Carr et al., 2010). Other strategic decision categories include new business investment decisions (e.g., mergers, acquisitions), investments in internal reorganization (e.g., internal reorganization or information systems), and investments in the marketing domain (e.g., marketing channels, new product introduction), (Papadakis et al., 1998). Strategic decisions are vital for companies' long-term success because they help companies define their future direction, achieve their long-term goals and sustain their operating performance. For these reasons, strategic decisions also are an important focus for management research, but strategic decision-making in a broad sense is not under examination in this dissertation.

This dissertation essentially acknowledges that the technology investment significantly influences both the financial and the environmental consequences of a company's operations. The consequences occur over the equipment lifecycle, which includes the adoption, use, and, ultimately, the abandonment of the equipment. In financial terms, the investment implicates capital expenditures and costs during the

equipment lifecycle (Kärri, 2007). In environmental terms, the investment implicates environmental impacts, such as greenhouse emissions, acidification, eutrophication, stratospheric ozone ducting, photochemical smog, and land use (Testa et al., 2011), during the equipment lifecycle.

In this dissertation, the incorporation of environmental considerations into investment decision-making refers to choosing investment into equipment while, at the same time, also considering environmental impacts in the decision-making process. In practice, such environmentally conscious investments can include defensive expenditures, such as expenditures on pollution control equipment, and proactive expenditures, such as expenditures to prevent pollution at source (Bennett & James, 1998, p. 55). Such investments, which hold environmental considerations as well, are also called environmental investments in the literature (Järvenpää & Länsiluoto, 2016; Testa et al., 2016). The literature uses also the term cleaner technology investment, which implies that the technology under investigation has superior environmental performance in relation to alternative technologies.

2.2 Research streams that combine environmental and economic considerations in decision-making

2.2.1 Societal, inter-organizational, organizational, and individual levels

Several different literature streams have recognized the need for environmental sustainability and hold implications for fostering it at societal, inter-organizational, organizational, and individual levels. Consequently, these literature streams also contribute to enhancing the sustainability transition in society. However, a major portion of the sustainability transition discussion operates only at the societal level and intends to inform policy-making from a top-down perspective (Markard et al., 2012). For this purpose, sustainability transition studies utilize literature streams that address environmental sustainability at both societal and system levels, such as ecological economics and socio-technical systems (Geels, 2010).

Lately, sustainability transition scholars have recognized the central role that companies play in fostering environmental sustainability in society (Markard et al., 2012; Farla et al., 2012). These scholars have called for introducing more organizational and individual actor-oriented studies to the discussion (Geels, 2010). In addition, system-level studies on sustainability transition have not extensively or

thoroughly addressed the investment decision-making practices of companies. Therefore, sustainability transition literature can benefit from literature streams with more organizational and individual actor-level focus. Such literature streams include studies on industrial ecosystems, environmental management and accounting, and environmental psychology. They address environmental considerations in decision-making at the inter-organizational, organizational, and individual levels.

To present existing understanding on the interplay of environmental and economic considerations in decision-making, this section summarizes the literature streams that discuss the topic at the societal, inter-organizational, organizational, or individual levels. For this purpose, the section introduces five relevant literature streams on environmental sustainability—ecological economics, socio-technical systems, industrial ecosystems, environmental accounting and management, and environmental psychology (Table 2). These streams show different perspectives on companies and their role in enhancing environmental and economic sustainability. Furthermore, depending on the level of analysis, these literature streams treat companies as solution providers in socio-technical systems (Farla et al., 2012), as members of inter-organizational networks (Jacobsen & Anderberg, 2005), as arenas for management practices (Gray et al., 1995), or as fields for individual behaviour (Kollmuss & Agyeman, 2002).

Table 2. Existing literature streams for understanding the interplay of economic and environmental considerations in decision-making

Literature stream	Analytical focus	Interplay of economic and environmental considerations	Example references from the literature
Ecological economics	Decoupling economic growth from its negative environmental consequences.	The relations between economic and ecological systems at the societal and regional levels.	Røpke, 2005; Spash, 1999; Korhonen, 2018.
Socio-technical systems	Changing socio-technical systems in society at multiple levels: niches, regimes, and landscape.	Lock-ins and path dependencies in changing energy, transportation, and food systems towards more sustainable pathways.	Geels, 2004, 2010; Farla et al., 2012; Loorbach & Wijsman, 2013; Markard et al., 2012.
Industrial ecosystems	Improving environmental performance in inter-organizational networks.	Technical and social coordination for more efficient use and processing of material, energy, and information flows in industrial networks.	Jacobsen & Anderberg, 2005; Korhonen, 2001; O'Rourke, Connelly, & Koshland, 1996; Howard-Grenville & Paquin, 2008.
Environmental accounting and management	Enhancing intra-organizational environmental management.	Trade-offs and win-win situations in enhancing financial and environmental performance in organizations.	Bennett & James, 1998; Gray et al., 1995; Parker, 2005.
Environmental psychology	Understanding the connections between pro-environmental attitudes and behaviours of an individual.	Costs, effort, and other barriers of changing behaviour in relation to pro-environmental intentions and values.	Kollmuss & Agyeman, 2002; Testa et al., 2016; Papagiannakis & Lioukas, 2012.

First, the ecological economics literature stream operates at the macroeconomic level and provides system-level understanding of economic development and its environmental consequences. Therefore, this stream provides a holistic view on the need for more environmentally sound development in society. It relies on logical positivist methodologies that build on mathematical models and technical competence (Spash, 1999). More particularly, it combines models of economic

markets and ecological production to provide an understanding of the relations between ecological and economic systems (e.g., Korhonen et al., 2018). This literature stream is concerned about the embeddedness of the economy in nature, natural capital, and ecosystem services, the resilience of critical ecosystems in nature, and the management of natural resources (e.g., Røpke, 2005; Spash, 1999). Moreover, it discusses the public good character of clean environment and the substitution between natural and man-made capital, reminding that environmental consequences are often treated as externalities in the economic discussions. What makes the ecological economic approach different from environmental economics is that it takes a more critical perspective on techno-optimism and economic growth (Røpke, 2005; Spash, 1999). The practical implications of both approaches are usually related to environmental politics rather than concentrating on individual organizations.

In economics, the key assumptions related to the decision-making of companies follow the rational choice view. Thus, companies can take a green technology leader role to differentiate themselves from competitors or to postpone the "green" investments because of uncertainties in future regulations, price fluctuations, and the willingness of customers to pay more for green products (Rugman & Verbeke, 1998). To influence this investment behaviour, neo-classical economists suggest changing the conditions under which the markets operate (Geels, 2010). When changing these conditions, governments can internalize the environmental costs to markets with policy instruments, such as environmental taxes, subsidies, and tradable permits, with carbon emission allowances being one example of such efforts (Cuckston, 2013; Bennett & James, 1998, p. 52). This internalization is seen to eventually lead to price changes that stimulate more sustainable R&D and capital investments (Geels, 2010). This logic holds the assumption that companies are rational entities that choose between alternatives from a given choice-set and have free access to information about the alternatives and their consequences. Under such decision conditions, the organizational decision-makers can make cost-benefit calculations to rationally determine the best alternative to adapt to the regulative measures (Geels, 2010).

Second, the socio-technical systems literature stream operates at the societal system level and provides understanding of the role companies play in socio-technical and systemic transitions. The socio-technical systems consist of networks of actors (individuals, companies, and other organizations) and institutions (societal and technical norms, regulations, standards of good practice), as well as material artefacts and knowledge (Markard et al., 2012; Geels, 2004; Markard et al., 2011).

The literature describes a set of processes that lead to a shift in the socio-technical systems and includes changes in the material, political, economic, socio-cultural, technological, and institutional dimensions of the systems (Markard et al., 2012; Koistinen, 2019). In practice, the key concerns of the socio-technical transition literature stream include changing the energy, transport, water, and food systems to more sustainable forms. In such changes, new products, services, business models, and organizations emerge and they partly complement and partly substitute the existing ones. For example, changing a transportation system that has vehicle technology at its core requires development of infrastructure, fuel supply systems, maintenance services, user practices, etc. (Markard et al., 2012).

Many of the socio-technical transition studies intend to inform policy-making and have, therefore, often focused on governance and on guiding the transition from a top-down perspective (Markard et al., 2012). However, a portion of the socio-technical system literature also acknowledges the role companies play in the transition. According to the systemic view, companies and their solutions cannot be sustainable on their own (Geels, 2010). This is because sustainability issues are too complex and interconnected to be addressed by individual organizations. However, they could serve as elements of more sustainable systems, acting as strategic mediators between the macro-level systemic change and the micro-level activities in their organizations (Gaziulusoy & Brezet, 2015). In practice, such micro-level activities in organizations mean environmentally driven changes in operations. These changes could include, for example, the incorporation of environmental considerations into technology investments (Sannö et al., 2016).

Third, the industrial ecosystem literature stream takes the discussion from the societal level to the inter-organizational level of analysis. This stream is concerned with enhancing environmental sustainability in industrial and collaborative settings. In particular, it emphasizes the circulation of energy and material flows in inter-organizational or symbiotic contexts. It provides understanding of the actual material and energy flows in production-consumption systems and of how the circulation of flows across organizations can foster environmental or material efficiency at the inter-organizational level. Ecosystem studies also provide understanding of the social aspects related to the system by, for example, focusing on the action-coordination side of inter-organizational industrial development (e.g., Jacobsen & Anderberg, 2005; Korhonen, 2002; O'Rourke et al., 1996). In this action-coordination side, the literature stream recognizes the roles of external influencers in fostering development. Such key actors have been referred to as leading advocates, champions (Hewes & Lyons, 2008), or influential actors (Korhonen, 2002) in the literature.

Fourth, moving to the intra-organizational level, the environmental management and accounting literature stream provides understanding of the interplay between the environmental and economic considerations within organizations. This stream includes studies on the relationship between organizational financial and environmental performance, as well as on investment assessments, information measurement, and information disclosure. According to management literature, financial rationales for environmental considerations can stem from risk mitigation, such as securing access to raw materials, locations, production capacity, or customers (Hart, 1995), reducing regulatory risks in emission taxes and environmental performance standards (Ambec et al., 2013), or reducing threat for substitution (Peattie & Charter, 2003, p. 732). In addition to risk reduction, the rationale for environmental considerations can stem from gaining a differentiation advantage and price premiums (Porter & Van der Linde, 1995) or achieving cost advantages through material and energy efficiency efforts (Hart & Ahuja, 1996).

Fifth, in addition to investigating the financial rationales for environmental considerations, the management literature also studies the impact of employee attitudes and values on organizational environment-related outcomes. (Papagiannakis & Lioukas, 2012; Testa et al., 2016). For such studies, management literature has taken insights from environmental psychology. The environmental psychology literature focuses on understanding environmental attitudes, perceptions, and values at the individual level. The key concerns of this literature stream focus on the reasons behind and barriers to the pro-environmental behaviour of individuals (Kollmuss & Agyeman, 2002; Gifford & Nilsson, 2014). According to environmental psychology literature, the interplay of financial and environmental considerations relates to understanding the factors that cause pro-environmental behaviour but also to understanding the social and cognitive barriers to changing behaviour according to pro-environmental intentions and values. Such understanding holds implications to understanding of decision behaviour and outcomes in a consumer context. Moreover, individual-level understanding is relevant for understanding employees and managers as individuals who influence organizations.

Despite the fact that all five literature streams address relevant topics related to enhancing environmental sustainability and the decision-making of companies, the actual decision-making practices of companies have not been sufficiently addressed. System level perspectives (streams on ecological economics and socio-technical systems) are required in order to understand the pressures that affect the companies' decisions. Analysing inter-organizational, organizational, and individual decision-

making practices (streams on industrial ecosystems, environmental management and accounting, and environmental psychology) provides insights into external and internal influencers and limiting factors of decision-making. Nevertheless, potential lies in combining these different analytical focuses and thus exploring the organizational decision-making practices that are influenced by the multiple perspectives addressed by these literature streams.

2.2.2 Management accounting perspective on the incorporation of environmental considerations into investment decisions

In order to understand and analyse the actual investment decision-making practices in companies, this dissertation operates primarily at the organizational level. The investment decisions have an effect on the financial and environmental outcomes at the organizational level. Management accounting (MA) literature represents a relevant literature stream for such focus because it largely concentrates on supporting decision-making with relevant information (Hall, 2010; Wouters & Verdaansdonk, 2002) and has shown its ability to study and enhance investment decision-making in organizations (Kaplan, 1984). Thus far, however, the streams of performance measurement, investment decision-making, and environmental reporting have not yielded a coherent, comprehensive understanding about combining financial and environmental aspects in the decision-making process.

In addition to its focus on financial outcomes, the MA literature has already been aware of different non-financial information and performance measures in assisting operational decision-making in companies for a long time (Kaplan & Norton, 1992; Nørreklit, 2000). Such non-financial measures are often related to operational efficiency and performance of organizational functions, such as productivity and cycle times in manufacturing or market share and customer satisfaction in marketing (Granlund & Lukka, 1998a).

Environmental information has been acknowledged as one of the relevant non-financial information sources for performance measurement (Testa et al., 2014; Laine et al., 2017; Passetti et al., 2014). However, traditionally, integrating environmental considerations into managerial goals and measures is not as straightforward as with the non-financial aspects that have a direct impact on the financial performance of companies. Justification for integrating information on customer satisfaction or quality and material or energy efficiency are closer to

financial performance indicators than emission information, which may not have direct financial implications for the company.

In case of environmental measures, the information may also be closely related to real operations of companies. These operations and processes utilize physical materials and energy flows as inputs and their conversion processes to outputs have an impact upon the natural environment (Bennett & James, 1998, p. 40). Environmental considerations include acknowledging the information about either the use of material and energy resources, the efficiency in processing them, or the environmental effects or outcomes of the processing (Bennett & James, 1998).

In practice, investments involving environmental considerations can be investments in operational efficiency, such as investments in material or energy efficiency. Such improvements have implications for company financials through reduced material and energy costs. Instead, the financial incentives for reducing the environmental impact of process outputs may not be as straightforward. Environmental protection efforts, such as investments in emission output control, may be treated as obligatory costs of staying in business and as an answer to normative and regulative environmental requirements (Laine et al., 2017). Similarly, if a company invests in technology that has superior environmental performance but does not provide any cost reduction in comparison to alternatives, then the gained improvement in environmental performance could be seen as an additional cost only (Bennett & James, 1998, p. 40). In practice, the boundaries between environmental and non-environmental activities and their caused expenditures may be rather blurred (Laine et al., 2017), as all company activities have an impact upon the environment to some extent.

Typically, the MA literature approaches the incorporation of environmental considerations into investment decision-making by modifying investment assessments in the early stages of the investment decision-making process. Such alterations to assessment techniques can take into account the long-tern benefits of environmental actions and the potential risks of investments with serious environmental impacts (Bennett & James, 1998, p. 51). In practice, such assessment methods include, for example, multi-criteria analysis (MCA), environmental impact assessment (EIA), or cost-benefit analysis (CBA) (Räikkönen et al., 2016). The decision analysis methods provide a set of quantitative methods for analysing decisions with uncertainty and/or multiple conflicting objectives (Keeney & Raiffa, 1993; Corner & Kirkwood, 1991). In these assessment methods, the implications to environmental performance can be one of the decision objectives. As Corner and Kirkwood (1991) remark, the decision analysis literature aims at providing systematic

and consistent quantitative approaches to making decisions rather than examining how the decisions are made in practice. The technical work related to assessment tools and methods does not yet imply that the environmental considerations and measures would be used in actual decision-making (Järvenpää & Länsiluoto, 2016).

The MA literature has also considered environmental aspects through studies on environmental reporting and disclosures. These studies emphasize the importance of external disclosures for achieving internal change and awareness about environmental issues (Laine et al., 2017). However, this argumentation has also been challenged by other scholars who have identified a gap between organizational practices and their representations in environmental disclosures (Onkila & Siltaoja, 2017). Laine et al. (2017) explain this gap between representation and action as loose coupling, where external reporting on environmental issues is decoupled from internal decision-making practices. If the company does not have any internal driver for considering environmental aspects, then the reported environmental disclosures and environmental management certifications (such as EMAS or ISO 14001) could remain only ceremonial activities in this organization, without any actual improvements in environmental performance (Testa et al., 2018; Onkila & Siltaoja, 2017). Acknowledging this challenge, various recent studies recommend turning the focus to actual decision-making processes (Zollo et al., 2013; Arroyo, 2012; Adams & Larrinaga-Gonzales, 2007). They call for investigating how environmental issues affect and become incorporated into actual decision-making situations.

To conclude, knowledge about performance measurement, investment assessment methods, and environmental disclosures needs to be supplemented with knowledge about actual decision-making processes. To gain this understanding, scholars call for closer engagement with practice (Järvenpää & Länsiluoto, 2016; Adams & Larrinaga-Gonzales, 2007; Ahrens & Chapman, 2006; Van de Ven & Johnson, 2006). To answer this call, this dissertation studies the actual decision-making processes of companies. Studying the latter provides understanding about how and why decision-makers incorporate environmental considerations into investment decisions and how these environmental considerations are intertwined with other considerations in the decision-making process.

2.3 Contingency- and actor-based approaches to organizational decision-making

Existing sustainability transition literature addresses environmental sustainability challenges at the system level, but also calls for introducing management studies into the discussion. Management accounting literature provides suitable approaches for such organizational focus, as it is deeply rooted in real-life decision-making contexts (Lyly-Yrjänäinen et al., 2017). Together the literature streams provide understanding on the system-level need for environmental sustainability and on organisational practices that combine economic and environmental considerations.

However, exploring investment decision-making as a process requires understanding the notion of decision-making more thoroughly. In general, research has approached the notion of decision-making through either analysing decision-making as an analytical structure or as an interaction among actors that operate within the structure (Nielsen et al., 2015). To understand both the structural and actor-based features of decision-making, this study primarily leans on concepts from two theoretical perspectives—structural contingency theory and pragmatic constructivist theory. As Ahrens and Chapman (2006) acknowledge, practice may best be understood and explained when referring to multiple theories. The field material is messier than the different separate theoretical perspectives would suggest (Ahrens & Chapman, 2006; Chapman, 1997) and, consequently, a combination of theoretical lenses can provide the researcher with a comprehensive view of the studied phenomenon. Subsequent sections, 2.3.1 and 2.3.2, discuss these two theoretical perspectives on organisational decision-making more thoroughly.

To unveil the dynamics present in actual decision-making situations, this study utilizes the Switching Path Analysis Technique (SPAT). The underlying assumptions behind SPAT are in line with the processual, structural, and actor-based views on decision-making. Therefore, this study uses SPAT as a tool with which to uncover the dynamism present in actual decision-making processes in organizations. More particularly, this study uses SPAT to trace the chain of events, triggers, and decision-making criteria that make the involved parties realize the cleaner technology investment. Section 2.3.3 discusses SPAT itself in more detail.

2.3.1 Contingency-based approach to the decision-making structure

The structural approach has its roots in the contingency theory, viewing organizational decision-making as a calculative, structured, and rational process. In the contingency theory, the optimal course of action is contingent, i.e., dependent upon, the internal and external situation of a company (Duncan, 1972). The approach pays attention to optimal decision-making structures to achieve a fit with the internal and external context of an organization. The desired contingency fit between the business context and the decision-making process then ensures the most effective practice (Chapman, 1997). In this view, the contingency theory is deterministic and positivist in nature—it holds that a fit between the contingency variables and the decision-making structure ensures operational effectiveness and, thus, optimal organizational performance (Donaldson, 2001, p. 2). Furthermore, changes in an organization's situation, i.e., contingencies, lead to changes in structure because of an organization's need to regain fit and performance (Donaldson, 2001). The decision-making process structure is defined objectively to fit the internal and external context of an organization.

The contingency approach offers conceptual devices for understanding the structures that build the boundaries and conditions under which the decision-makers operate and interact. To study the structures that enhance efficient practice, the contingency-based approach offers a variety of structural dimensions. Commonly, research refers to the dimensions of centralization, formalization, and complexity (Fredrickson, 1986). Centralization refers to the degree to which the right to make decisions and evaluate activities is concentrated. The degree of formalization specifies the extent to which an organization uses rules and procedures to prescribe behaviour. Last, complexity refers to horizontal and vertical differentiation and spatial dispersion, illustrating the degree to which an organization has numerous levels, broad spans of control, and multiple geographic locations (Fredrickson, 1986).

The contingent or context-dependent nature of decision-making also has implications for information utilization in decision-making (Chenhall, 2003; Gerdin, 2005). The contingency-based approach views decision-making as a process that follows analytical steps, from diagnosing the problem to generating alternatives, evaluating them, and finally making the decision (Fredrickson, 1984). The analytical steps assume that comprehensive information is available or can be made available for decision-making (Arbnor & Bjerke, 2008, p. 88; Nielsen et al., 2015). The role of information is to assist the decision-makers to analyse alternatives for a given

decision objectively (e.g., Thyssen et al., 2006). More specifically, the literature on decision-making stresses the importance of cost comparisons and their significance in the final choice (Nielsen et al., 2015).

In the contingency theory, the analysis is depersonalized and at the level of organization, as a collective entity pursuing its objectives. Consequently, the theory pays less attention to individual-level behaviour and action. It holds that change in contingency leads to change in organizational structure because of the need to regain fit and performance. The organization is seen as being forced to adjust its structure to material factors such as size and technology. Little attention is paid to the actors' choice or free will. The identified structures do not address questions about who makes the decisions exactly, what their motives are, and how the structures are implemented (Donaldson, 2001, p. 131). Such considerations are not the central focus of the contingency theory because the key phenomena, such as the optimal level of organizational decision-making structure to achieve performance, cannot be discussed unless a collective level of analysis is made (Donaldson, 2001). Despite its limited attention to actors, the contingency approach offers conceptual devices for understanding the structures that build the boundaries and conditions under which the actors operate and interact.

2.3.2 Pragmatic constructivist approach to the actors involved in decision-making

In addition to the decision-making structures, this study interprets organizational decision-making as action that is fostered and experienced by actors. In this actor-based approach, the study leans on the concepts from pragmatic constructivism. Pragmatic constructivism emphasizes the fact that the majority of decision-making processes involve multiple managers with different intentions (Trenca & Nørreklit, 2017) and different ways of reasoning. Each decision participant's action is driven by his or her own manner of perceiving the decision-making context (see *topos*, as discussed in Nørreklit et al., 2010) and the participants hold unique pieces of information designed to serve different purposes (Ang & Trotman, 2014).

The pragmatic constructivist approach focuses on the decision participants and their active involvement in developing decision alternatives. With respect to information use and incorporation of different managerial viewpoints, the approach emphasizes the interactions between the participants when reviewing, discussing, and appraising modifications to the information used in the decision-making process

(Nielsen et al., 2015; Arbnor & Bjerke, 2008, p. 152; Heinzelman, 2016). Even the analytical MA tools used for decision-making, feature value-based choices on what scope and content should be included in the tools. Thus, communication enables collaboration among participants with conflicting values, different preferences (March, 1962), and constrained information provision capabilities (Nielsen et al., 2015; Cohen et al., 1972). Like the analytical approach, the actor-based approach can also involve systematic methodological steps aimed at making the best possible choice and a functioning practice (Nielsen et al., 2015, p. 77). However, in the actor-based approach, these steps emphasize interactive and reflective techniques to utilize the MA information for decision-making.

The structural contingency and pragmatic constructivist theories supplement one another; they offer different orienting sets of explanatory concepts for understanding organizational decision-making. The contingency theory emphasizes the structural aspects of an organization, stating that the optimal course of action is contingent, i.e., dependent upon, the internal and external situation of the company (Donaldson, 2001). While focusing on the fit between the contingency variables and the decision-making structure, the theory neglects behavioural and socio-cultural aspects involved in decision-making. Conversely, the pragmatic constructivist theory focuses on decision-making actors and their underlying worldviews in enabling action in a social setting (Nørreklit et al., 2010) but pays less attention to supporting the rational processes with structures, analytical tools, and procedures.

To conclude, most organizational phenomena seem to be affected by both structural and actor-based behavioural features. Analytical features (e.g., decision-making procedures) and actor-based features (e.g., intentions) both deserve attention when discussing decision-making in actual investment contexts. The analytical approach suggests that incorporating new criteria and perspectives into investment decision-making requires technical work. Such technical work includes altering the calculations, multi-criteria models, and structured procedures that support the logical reasoning in rational decision-making process. In contrast, actor-based perspective emphasizes that incorporation requires changes in collective values and mutual interaction in organizations. By building on Nielsen et al. (2015), this study argues that the existing practice may contain features of both analytical and actor-based approaches.

2.3.3 Switching path analysis technique for analysing the triggers in decision-making processes

The Switching Path Analysis Technique (SPAT) enables the analysis of different stakeholders' actual behaviour in decision-making processes, as well as the identification of triggers and determinants of those processes (Roos, 1999; Roos & Gustafsson, 2011). Additionally, different SPAT trigger types include societal, organizational, and individual aspects as perceived by the key actors involved in the processes. Therefore, SPAT fits well into the research setting of this dissertation.

SPAT continues in the vein of critical incident research techniques (CITs). Originating from the work of Flanagan (1954), CITs offer methods for analysing incidents that have a special significance and effect on human behaviour. As analysis techniques, CITs offer procedures for gathering certain important requirements for a particular activity in defined situations (Flanagan, 1954). Marketing and service studies have developed CITs further to capture the reasons and requirements that initiate changes in customer behaviour (Edvardsson & Roos, 2001; Selos et al., 2013). Such behaviour can include a decision to end an existing supplier relationship and switch to another supplier or technology (Roos, 1999).

What makes SPAT different from the other CITs is its focus on actual behaviour. Instead of analysing hypothetical decision situations, intended behaviour, or opinions, as some of CITs do, SPAT analyses the actual reasons that lead to customers switching behaviour (Edvardsson & Roos, 2001). SPAT focuses on describing both negative and positive critical incidents in the decision-making process and unveiling their configuration. More specifically, the key idea is to recognize that the switching event is affected by the situational factors, the incidents that call for reaction, and the influence of the active and passive roles of both the supplier and customer (Roos, 1999; Roos & Gustafsson, 2011). These critical incidents are called triggers.

In SPAT, triggers represent the reasons why customers begin to consider switching at all. The reasons are divided into situational, reactional, and influential triggers. Situational triggers are defined as changes in customers' own situations and are not necessarily related to the supplier at all. Influential triggers are related to the competitive situation and include the supplier's and its competitors' efforts to change customer behaviour. Reactional triggers are immediate customer responses and they can result from dissatisfaction in customer relationship or the solution used (Roos et al., 2004).

The developers of SPAT call for empirical studies to deepen the understanding of the applicability of this technique in different research settings. Initially, SPAT was developed in a consumer–customer context. More particularly, it was first used in studying consumer behaviour in telecommunications, retail, retail banking, and insurance sectors (Roos, 1999; Roos et al., 2004). Later Selos et al. (2013) broadened the scope to business-to-business (B2B) contexts by applying SPAT to B2B supplier switching processes. It turned out that the B2B case narratives were relatively easily translated into the SPAT terminology, without a need for notable sacrifices in content. However, it was notable that, in B2B contexts, an assembly of triggers built up the sensitivity for the switch together, instead of one single trigger initiating the action (Selos et al., 2013).

Lastly, there are several methodological issues to consider when applying SPAT. It relies on key informant's memory during an interview process and when analysing and reporting historical events and their consequences. The identified triggers rely on the interviewees' perceptions of previous incidents that are stored in the interviewees' memories, judged by them to be critical, and then reported by them when asked for in the form of narratives (Edvardsson & Roos, 2001). Finding respondents who have recently made a switching decision may also be a limiting factor of SPAT-related research, while techniques that study intended behaviour are not restricted by this limitation (Edvardsson & Roos, 2001). For data analysis, the classification of critical incidents (i.e., triggers) is an inductive one and relatively subjective (Flanagan, 1954). Therefore, the incidents must be studied in the light of the research context, meaning that the researcher must be aware of the background factors and conditions operating in a specific decision situation (Flanagan, 1954).

The underlying assumptions behind SPAT are in line with the processual, structural, and actor-based views on decision-making. The technique recognizes the processual and structural nature of decision-making, as it views actual decision-making behaviour as a sequence of critical incidents (Selos et al., 2013). For the actor-based view, SPAT recognizes that the decision participants may have both positive and negative experiences related to the switching situation and could actively influence the decision outcome (Edvardsson & Roos, 2001). The technique also emphasizes interaction because the critical incidents or triggers cannot be understood unless they are put into the context of the customer's world (Edvardsson & Roos, 2001). By retrieving the judgement situations from the decision participant's memory and describing the decision-making dynamism, the SPAT may also be a suitable technique for predicting future decision-making behaviour.

To sum up, this study primarily leans on the concepts from both the contingency theory (Fredrickson, 1986; Donaldson, 2001) and the pragmatic constructivist theory (Nørreklit et al., 2010) for understanding, combining and elaborating upon the structural and actor-based features in organizational decision-making processes. Following the contingency-based approach, this study acknowledges that the decision-making processes of companies are influenced by external situational pressures and the companies' responses to them. Following the pragmatic constructivist approach, in turn, this study also acknowledges that individual decision participants have an impact on the organizational decision outcome. Lastly, this study uses the Switching Path Analysis Technique (SPAT) as a tool with which to combine the issues that affect decision-making at multiple levels. Using SPAT uncovers the dynamics present in actual decision-making processes in organizations, as perceived the key actors involved. Following SPAT, this study also acknowledges the role played by external influencers who actively want to influence the organizational decision-making processes (Roos, 1999; Roos & Gustafsson, 2011; Freeman, 1984). SPAT analyses the external situational and influencer pressures and the companies' reactions to them as situational, influential, and reactional triggers. These triggers are utilized as analytical devices in this study. Together, these theoretical approaches described above allow a comprehensive view to be gained about the companies' investment decisions, with a focus on the actual behaviour of the actors involved in decision-making processes. This understanding is used to unveil the drivers of and limitations to the incorporation of environmental considerations into the investment decision-making processes of companies.

3 METHODOLOGY

3.1 Research approach

In general, researchers approach their subject via assumptions about the nature of the world and the way in which it may be studied. First, the researcher holds ontological assumptions about whether the reality is of an objective nature and given out there to be observed, or of a subjective nature, being the product of individual cognition and one's mind (Burrell & Morgan, 1979, p. 1). The second set of assumptions follows this ontological question. Such epistemological assumptions are about how the researcher can understand the world and communicate this knowledge to others. The different ontologies and epistemologies imply that the researcher may treat the social world more objectively or subjectively. In the objective approach, social world is seen as being real and external to the individual. In objectivism, the research focuses on analyzing relationships and regularities between the various elements that comprise the objective reality. This approach aims at finding universal laws that explain the reality that is being observed. (Burrell & Morgan, 1979, p. 2) Subjectivism is an alternative approach to objectivism. It emphasizes subjective experiences of individuals and treats the reality as personal and unique to an individual. The approach emphasizes the relativist nature of the social world and is concerned on understanding how the individual interprets the world in which she finds herself. The objectivist approach is common in research streams that are based on natural sciences, such as energy research. In contrast, many social science-based research streams, such as management accounting research, have long research traditions in both of the approaches. This research follows the subjectivist approach, but recognizes the existence of more objective and measurable facts in reality, such as those related to the environmental impacts of different fuel types.

Overall, this research employed multiple qualitative research methods using an exploratory and interpretative approach (Lukka & Modell, 2010; Ahrens & Dent, 1998). The individual research articles relied on both conceptual analysis and development and on in-depth explorative case studies with interventionist features (Suomala et al., 2014; Lyly-Yrjänäinen et al., 2017). Conceptual development refers

to building understanding by structuring and synthesizing the existing literature. Such analysis provides clarification on recently discovered concepts in order to attain synthetized and comparable understanding that future research can build on. In contrast, the qualitative and explorative case study setting is suitable for research that aims at gaining a holistic understanding of a phenomenon in its real-life context (Eisenhardt & Graebner, 2007). In general, the purpose of qualitative case studies is not only to discover generalizable truths or objective predictions but to provide in-depth understanding (Yin, 2008). In this study, the research questions are formulated as "what kind of" questions, aiming to identify and reflect upon the studied phenomena in an exploratory manner.

When discussing the interventionist and explorative way of studying social reality, one must note the theory building potential of the approach. Interventionist research approach is not limited to only solving practical problems, even though interventionist work is often related to providing practitioners with analytic instruments and context-specific understanding in the field. (Lukka & Suomala, 2014; Lyly-Yrjänäinen et al., 2017, p.46). Interventionist researchers gather qualitative and in-depth understanding on theoretically interesting phenomena when they are exposed to them in real-life contexts. The gathered understanding and novel insights from the field can be used for testing, refining, extending and building theories. (Lyly-Yrjänäinen et al., 2017, p.38). At best, the research approach can result in both theoretically novel and practically relevant results. This can be achieved when the interventionist researchers and practitioners work together successfully to understand the phenomenon present in the field.

The empirical articles found in this dissertation employ rich case study data for exploring the studied phenomena and extending existing theories in this manner. In general, theory building from qualitative case studies can rely on different reasoning logics. Inductive reasoning relies on producing a new theory from data and deductive reasoning relies on testing a theory and using the data acquired to conduct the testing. (Eisenhardt & Graebner, 2007). Abductive reasoning utilizes both of these approaches iteratively, meaning that theoretical explanations are developed with the help of both empirical and theoretical knowledge about the issue being examined (Lukka & Modell, 2010). Such reasoning is well in line with the interventionist research approach that acknowledges the iterative formulation of research questions and the interplay between the theoretical and empirical domains (interplay between *etic* and *emic*, as discussed in Suomala & Lyly-Yrjänäinen, 2012; Lyly-Yrjänäinen et al., 2017, p. 22).

As reasoning logics can differ, so can the research questions adhering to the logics. The research questions can be more theory- or phenomenon-driven, meaning that the research frame can emphasize either the importance of the existing theory or of the phenomenon (Eisenhardt & Graebner, 2007). This dissertation primarily followed an iterative research process to formulate and answer the "what kind of" research questions. The iterative process featured several types of interactions, primarily using abductive reasoning (empirical Articles III–V). However, those parts that focused on conceptual analysis and development (Articles I–II) utilized deductive reasoning, even though these analyses were also informed by previous empirical work by the author. Table 3 summarizes the research approaches and techniques for data collection and analysis applied in each individual article. The methodological choices are discussed more thoroughly in the data collection and analysis section.

Table 3. Research approaches applied in the individual articles

Article	Research approach	Primary data collection	Data analysis	Empirical context
I	Explorative research design	Literature search	Deductive synthesis and conceptual analysis	No empirical part; overview of the topic according to established literature
II	Explorative research design	Literature search	Deductive synthesis and conceptual analysis	No empirical part; overview of the topic according to established literature
III	Qualitative case study design	Facilitated group interviews	Abductive content analysis	Biogas production system establishment
IV	Qualitative case study design with an interventionist approach	Interventions at the fuel provider (case Energy Company) and interviews at the technology adopters (customer companies)	Abductive study at the Energy company in combination with deductive content analysis; categorization according to the SPAT triggers	Decisions to invest in gas vehicles at selected companies
V	Qualitative case study design with an interventionist approach	Intervention at the technology adopter (case Delivery Company) and a facilitated group interview at the technology adopter	Abductive content analysis; the limitations were identified according to analytical and actor-based approaches	Decision-making process concerning vehicle fleet investments in a chosen case company

3.2 Research context

The case studies presented in this dissertation were conducted in the Finnish gas sector. They involved all central stakeholders, namely, the organisations that either produce biogas, utilize natural gas or biogas, or try to foster local investments in biogas production. In particular, the case studies involved gas suppliers, customer

companies utilizing gas for transportation, and municipal organizations that foster biogas production through regional development projects. The investment decision cases studied represented investments in capital equipment, such as investments in vehicles or biogas production. In environmental investment terms, these investments were examples of proactive expenditures (Bennett & James, 1998, p. 55). This means that during the decision-making process there was no regulative pressure for organisations to adopt certain gas technologies. The stakeholders involved in decision-making processes could make choices according to their own financial and environmental considerations. This was a fruitful starting point for exploring decision-making practices in a more thorough way. This section introduces the investment decision cases that were studied and their contexts.

Article III explored three system establishment cases within the contexts of three different biogas production systems. As illustrated in Figure 2, multiple organisations were involved in biogas production systems. Together, these organisations formed a socio-technical system that involved various activities and material flows. These featured cooperation among multiple private and public parties, with different roles, feedstocks, and business models in the system.

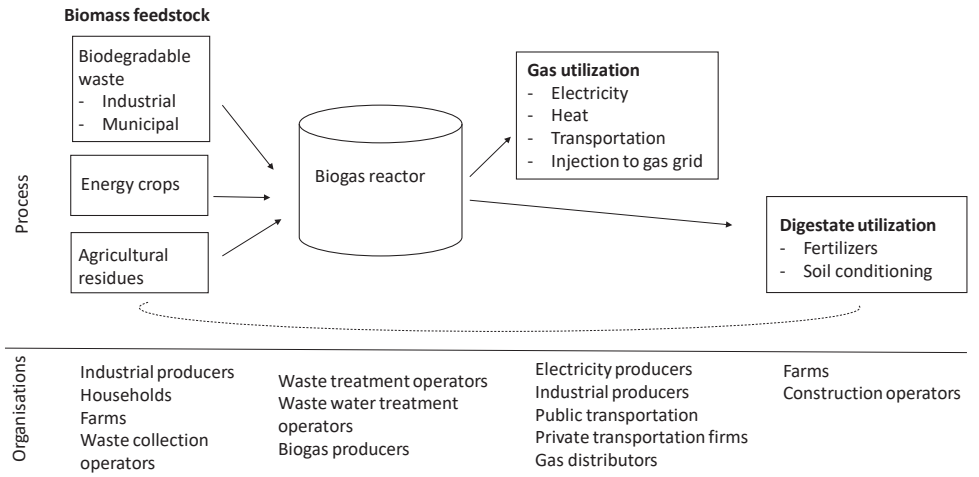

Figure 2. Central activities and organizations involved in biogas production and utilization in Finland (adapted from Article III)

In practice, developing a functioning system required motivated system builders to advance system establishment and encourage other parties to invest in it. In Finland, municipalities have taken an active role in this kind of action. The study analysed the

role played and actions taken by the municipal system builders in three specific biogas system contexts. The choice of the three biogas production systems to be studied followed the principles of diverse sampling (Eisenhardt, 1989), as all three systems featured either the municipalities' industrial, agricultural, or urban development objectives. In-depth access to these biogas production systems was granted because of the underlying research project with the Chemistry and Bioengineering unit (see Section 1.3 for more details). The three system cases and their representatives are presented in Table 4.

Table 4. The organizations and key informants involved in Article III

Organization	Interviewed actor	Main offering	Role in the gas sector
Municipality A	Manager of the development project	Public services and regional development	System builder for biogas production
Municipality B	Municipal manager; Chairman of the municipal executive board; Technical director	Public services and regional development	System builder
Municipal-owned platform company	Chief executive officer (CEO); Project manager	Regional development	System builder
Municipal-owned waste treatment utility	Development manager	Waste treatment	System builder
Municipal-owned intermediary organization	CEO	Regional development	System builder
Regional development organization	Planning director	Regional development	System builder support
University	Researcher	Knowledge production for regional research projects	Industry expert
Central Union of Agricultural Producers and Forest Owners	Executive director	Lobbying services for farmers and forest owners	Spokesperson for farmers
Centre for Economic Development, Transport and Environment	Senior officer	Supervision of regional development projects	Regulator

Articles IV–V utilized studies in the business context of an Energy Company that is a fuel supplier for both natural gas and biogas. The fuel supplier is a relatively large player in the Finnish energy industry, with a little over 300 employees and net sales of over €1 billion. This company offers biogas and natural gas for use as a transportation fuel, for electricity and district heat production, and for industrial processes and energy production. It offers liquefied natural gas (LNG) for use as a shipping fuel and LNG or liquefied biogas transported by truck to customers outside the natural gas pipeline network. During the studies, the company developed gas station infrastructure to foster market growth for gas vehicles. The profitability of the infrastructure investment was highly dependent on the future demand for gas vehicles that have not been widely adopted yet. For the company, the planned infrastructure investment was a so-called irreversible investment—it was very specific and had a long lifetime. If this kind of project failed, it would tie corporate resources down for a long period of time and would be difficult to get rid of at a moderate cost (Kärri, 2007). The fuel supplier looked for support to ensure the quality of its upcoming large infrastructure investments. This led the researchers to identify vehicle investment cases from the fuel supplier's customer companies. The customer cases and their representatives are presented in Table 5.

Table 5. The organizations and key informants involved in Articles IV and V

Organization	Interviewed actor	Main offering	Role in the gas sector
Energy Company	Sales manager; Network development manager; Business controller; Head of business support & strategy; Development manager; R&D manager; R&D engineer; Chief technology officer (CTO); Chief executive officer (CEO); Sustainability expert	Natural and biogas production and distribution	Gas supplier
Delivery Company A	Head of sustainability; Development manager; Senior asset manager; Heavy duty vehicle manager; Asset manager; Category manager	Post and package delivery service	Gas user
Delivery Company B	CEO	Fast delivery and food delivery service	Gas user
Delivery Company C	CEO	Post delivery service	Gas user
Waste Management Company	Head of fleet	Waste management, property maintenance, and cleaning services	Gas user
Church welfare foundation	Chief financial officer (CFO)	Home care services	Gas user
Driving school	Owner and CEO; Owner	Driving education and licenses	Gas user
Taxi A	Entrepreneur	Taxi services	Gas user
Taxi B	Entrepreneur	Taxi and product delivery services	Gas user
Taxi C	Entrepreneur	Taxi services	Gas user
Taxi agency	CEO	Call centre services	Gas user
Leasing company	International sales manager; Team sales manager	Vehicle leasing services	Technology provider
Vehicle retailer	B2B sales director; Product manager 1; Product manager 2	Vehicle retail	Technology provider

For Article IV, the gas vehicle investment cases were selected from the supplier's customer companies, representing different industries and different sizes. New companies were selected for the study until major results were saturated (Morse,

1995). The exploratory process benefited from the recommendations given by the fuel supplier, who was extensively aware of the business context. In their business, all customer companies that were studied provided some kind of service for their clients. Succeeding in service production required using vehicles for transporting waste, goods, clients, or employees. Therefore, vehicle investments were closely connected to the companies' strategies and operational success. More precisely, vehicles were linked to the competitive advantages of these companies by enabling cost competitiveness, reliable and flexible service provision, environmental friendliness, differentiation as a domestic operator using domestic fuels, and outstanding customer service in offering an effortless, clean, spacious, and safe way to travel. All in all, vehicle investments represented a meaningful decision for all customer companies studied.

In Article V, the research focused on studying one of the customer companies in more detail. The decision-making case of this particular customer company was chosen for three reasons. First, the company had a large vehicle fleet, consisting of more than 1,000 vehicles, and it had operated with the large fleet for many decades. This indicated that the company had established investment practices and a decision-making process structure. Second, the company had officially committed to considering environmental aspects in its procurement, subcontracting, and investment decisions. The company had also established an official sustainability agenda, aiming at reducing its CO_2 emissions by 30 % by 2020. The company was also voluntarily compensating for its carbon emissions and had recently announced a target of 40 % of its vehicle fleet to run on alternative fuels. This background indicated that the organization needed to integrate multiple considerations regarding environmental sustainability, operational efficiency, and profitability targets into their vehicle investment decisions.

3.3 Data collection and analysis

The research articles used somewhat different methodological choices for their respective data collection and analyses. The individual articles employ conceptual analyses (Articles I and II) and in-depth case studies with some interventionist features (Articles III–V). The processes of data collection and analysis are discussed below in a more detailed manner for each study.

3.3.1 Articles I and II

For the first and second studies (Articles I and II), the materials were gathered based on literature searches. The searches utilized keyword search and iterative snowball sampling to identify the relevant literature. Since the purpose of these articles was to work as synthetizing book chapters in the Encyclopedia project, the literature was chosen based on its relevancy and impact in the field. In identifying the relevant literature, citation counts acted as indicators for relevancy in the research field. The researchers identified frequently cited publications and tracked the "core" of the literature by observing the citations between the publications. By starting with the core articles, the iterative search helped the researchers obtain an overall picture of the concepts studied, namely business environment and competitiveness, and their relations to the existing literature related to sustainable development and environmental sustainability. This understanding was combined with the researchers' prior knowledge in the field. In the end, the researchers created summarizing frameworks for the two book chapters and discussed their understanding of the existing knowledge according to the frameworks. The frameworks also helped structure the discussion in the two book chapters.

3.3.2 Article III

The empirical studies (Articles III–V) followed an iterative process in data collection and analysis, which is typical for an interventionist research process. As presented by Lyly-Yrjänäinen et al. (2017, p. 14), such process includes i) gathering pre-understanding for starting the research collaboration, ii) outlining ideas for change in pre-intervention, iii) testing the ideas for change in intervention, iv) reflecting the effects of the ideas in post-intervention and finally v) reporting the lessons learned from the process. The processes of data collection and analysis are discussed below in a more detailed manner for each empirical study.

For the third study (Article III), the researchers conducted facilitated focus group interviews (Wilkinson, 2004 , p. 177) as a primary data collection method for three biogas production system cases. Prior to the group interviews, the key organizations and actors in each system were identified using the researchers' prior knowledge in the field, available online documentation about the system development plans, and email inquiries to actors working within the biogas production systems. One focus group interview setting was organized for each biogas system case and each setting gathered the key actors involved in that specific case. The participants represented

both public and private organizations that could potentially have an operational, supporting, or regulating role in the systems. The focus group interviews were semi-structured, enabling natural discussion to emerge and collective sense-making to take place. The interviews were recorded and transcribed to enable content analyses later on.

Several sources of secondary data were used to supplement the primary data from the group interviews. First, the second author of Article III supported the municipal actors in one of the studied case systems by organizing discussion forums and workshops to further develop their urban circular solutions. This work provided the researcher with access to in-depth discussions with the municipal actors; therefore, her field notes constituted an important portion of the secondary research data on development actions. Second, the researchers used publicly available, case-specific materials, such as municipal strategy, system development plans, environmental impact assessments, local media news, and organizational websites, in order to gain an extensive understanding of the three system cases. Third, the authors utilized their prior work experience from joint research projects with biogas producers and distributors. Fourth, the researchers also participated in external workshops and site visits related to industrial and urban biogas production systems to develop a more diverse understanding of the cases at hand.

The municipal system builder perspectives in the three cases were analysed with the help of primary data from group interviews, supplemented with other secondary data sources. The research data were coded according to the themes of the research questions (i.e., actors, intentions, uncertainties, possibilities, actions taken, and forms of governance) using the Atlas.ti analysis software. Two of the authors first analysed the data independently and then compared their interpretations to enhance the reliability of the results. The data analysis followed summative content analysis characteristics (Hsieh & Shannon, 2005), which means that the keywords (such as intentions and enhanced possibilities) were derived from the researchers' prior knowledge of the existing literature. Later on, the analysis abductively evolved by developing theoretically informed explanations for the emerging empirical observations. More precisely, the roles of the municipal actors were further analysed by applying the pragmatic constructivist (PC) approach (Nørreklit et al., 2010). In practice, this meant applying a reflective approach to understand the micro stories found in the interview data and to clarify the interpretations derived from secondary documentation, news, and notes from participatory observations. According to the PC approach, interviewees express their concerns and intentions for action through their choice of language in communication. The municipal actor perspective was be

studied by analysing how the interviewees made sense of the system establishment situation. The actors' micro stories about their experiences allowed the researchers to understand the actions, as well as the intentions and the factual bases behind those actions.

3.3.3 Articles IV and V

For data collection in the fourth and fifth studies (Articles IV and V), the research material came from an interventionist study setting. The interventionist approach allowed the researchers to build a joint research collaboration with an Energy Company (i.e., the fuel supplier) and to work as active and participating actors during the study. Throughout the study period, the interventions varied from weaker to stronger ones. In the fourth study, the joint development work and insights gained from customer interviews acted as a strong form of intervention for the fuel supplier's sales practices. According to the company representatives, the gathered knowledge strongly affected the company's strategic choices with respect to fuel sales selling. This differentiated the fourth study from the fifth, where a facilitated group interview with the fuel supplier's customer, i.e., a Delivery Company, worked as a weak intervention for the development of the Delivery Company's investment practices. The nature of the interventionist work was described in more detail in the overview of the research process in Section 1.3.

The primary data for the fourth and fifth studies were gathered by interviewing the fuel supplier's customer companies. This exploratory process benefited from recommendations provided by the fuel supplier, who was extensively aware of the key decision-makers in relation to gas vehicles in each customer company. The interviews focused on the switches to and from using gas vehicles and the role and content of management accounting (MA) information in making these switches. By interviewing the fuel supplier's customer companies about their actual investment cases using SPAT (e.g., Roos, 1999, 2007, 2002; Selos et al., 2013), the researchers had the opportunity to discover the factors and triggers behind their decision-making processes and to place them in a wider business context. As part of the interview round, the researchers also facilitated a focus group meeting at the fuel suppliers' customer company (i.e., the Delivery Company). The focus group meeting engaged the Delivery Company representatives into a discussion about the current limitations to MA information utilization in their organization's decision-making processes. Together, both individual and group interviews saturated to rich data (Morse, 1995)

from companies of different sizes and belonging to different industries—but all with investment experience in gas vehicles.

Altogether, the research material gathered from the joint research collaboration consisted of documented emails, phone conversations, and face-to-face discussions; customer surveys and marketing materials that were provided by the fuel supplier; the customer companies' Excel calculation tools; and interviews with both customers and technology providers. All documents received were stored into files, the meeting notes were prepared immediately following each visit, and the interviews were transcribed. Furthermore, the researchers also closely followed public discussion on the technologies related to the fuel supplier's business during the active collaboration period, from January 2015 to August 2017.

When engaging in discussions with the Energy Company representatives, its customer companies, and municipal actors, the researchers asked the following questions from the research material: Who are the key actors involved in the decision-making process? What role do different actors play in this process? What role do key actors' individual values and organizational responsibilities play in their reflections on the situation? What impact do situational factors have on the decision process? Who wanted to influence the decision outcome? Why would the external influencers want to influence the outcome? What type of analytical assessment was used for the investment decisions? How were the environmental considerations incorporated into the decision-making process and how did they interact with financial considerations? What role did cost information have in the decision outcomes? The understanding gained was iteratively reflected upon on the basis of prior literature and a variety of information sources enabled triangulation of the results during the analysis.

For data analysis in the fourth study (Article IV), an existing theoretical framework—(SPAT)—was utilized for analysing the interview data collected from customer companies. The customer companies' decision-making processes were approached as a sequence of influencing critical incidents, called triggers in SPAT (Roos, 1999). SPAT was used to trace the chain of events, triggers, and decision-making criteria that made the parties involved realize the investment . Therefore, the codes used in the data analysis were partly derived from SPAT (i.e., company, investment criteria, triggers, facts, and feelings). As an existing theoretical framework was used for naming the codes, the fourth study also applied directed content analysis (Hsieh & Shannon, 2005), following deductive reasoning.

For fifth study's data analysis (Article V), the focus was placed on providing a detailed description of the phenomenon (limitations in information utilization)

studied in the case. Then, the analysis built on the existing literature by describing the analytical- and actor-based features of decision-making (Nielsen et al., 2015). Interpreting the interviewees' collective sense-making in the focus group meeting, the study identified the limitations stemming from the decision-making process structure and the involvement of several managerial actors. The study first applied a conventional content analysis to the data (Hsieh & Shannon, 2005), meaning that codes were defined during the data analysis and were derived from the data (i.e., management accounting content, management accounting role, environmental factors, and financial factors). Later on, the study applied an exploratory approach to the case materials and followed abductive reasoning for the data analysis, meaning that theoretical explanations were developed using both empirical and theoretical knowledge about the examined issue (Lukka & Modell, 2010). The iterative process utilized the Atlas.ti software for the analysis of the transcribed group discussion material.

4 FINDINGS

This chapter presents the external pressures, triggers, and limitations that were identified for incorporating environmental considerations into investment decision-making processes in companies. The findings are gathered based on the main insights obtained from the literature reviews and case studies found in Articles I–V.

4.1 External pressures that motivate companies towards more environmentally conscious investment decisions

As discussed in Article I, the pressure for altering company business strategy and operations can originate from several sources. This section presents a framework for identifying these different sources and gives examples of their influence at different levels of the business environment. Utilizing the framework created, this section especially focuses on regulative aspects that create pressures at the macro level and on the customers, competitors, and suppliers as important micro level influencers. Furthermore, to draw more insights on the competitive pressures at the micro level, the section utilizes the findings presented in Article II. The framework and its dimensions are discussed more thoroughly in the original articles.

4.1.1 Macro-level pressures in the business environment

The first research question of this study is answered based on a framework presented in Figure 3. For its use purpose, the analytical framework developed in Figure 3 could assist companies in identifying the external pressures that motivate them to consider environmental aspects when making their investment decisions. The external pressures can originate from general trends in the macro environment of companies or result from a more direct stakeholder influence in the micro environment. According to the framework, the pressures can also emerge from internal sources. There is a dynamic interaction between the different levels and their dimensions. Neither the external nor the internal dimension is stable over time (Duncan, 1972)

and their dynamics vary in terms of predictability and turbulence (Dreyer & Grønhaug, 2004). Some of the key influences are precise, quantitative, and predictable (i.e., the demographics in a market area), while many other factors are imprecise, qualitative, and difficult to predict (i.e., the customers' attitudes and politics) (Amer et al., 2013). Considering this dynamic and the context-specific nature of business environments, the classification provided by this framework helps to identify the pressures and to analyse the interlinkages between them.

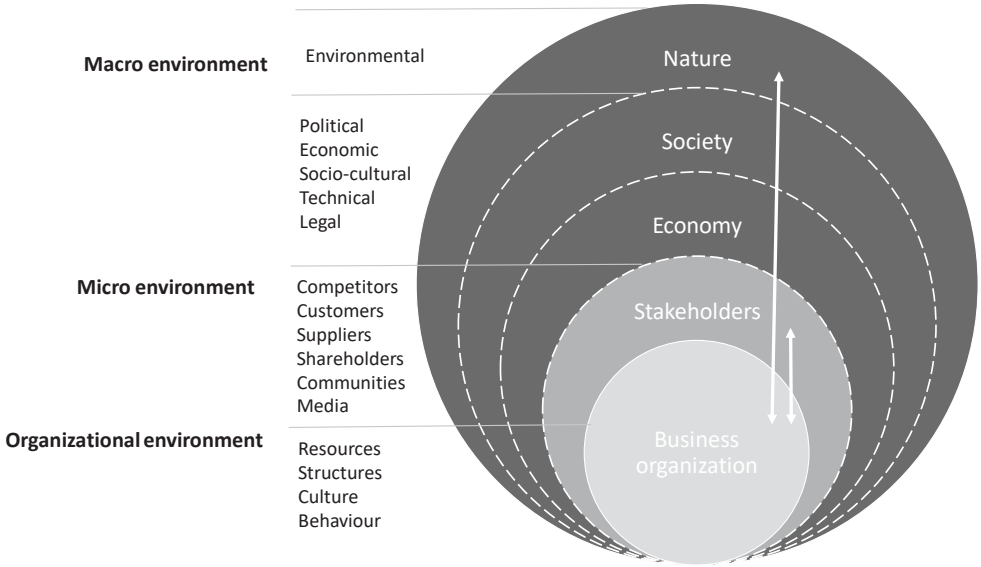

Figure 3. Business environment at the macro, micro, and organizational levels (adapted from Article I and developed on the works of Marcus et al. [2010], Freeman [1984], and Capon [2009]).

The framework interprets the macro environment elements through an embedded view (Marcus et al., 2010). In this view, the macro environment consists of nested systems in which the natural system, Earth, acts as a parenting system for all human-created systems, including society and economy. From this perspective, the pressure towards incorporating environmental considerations originates from the changes occurring in this parenting system and its processes. More precisely, the changes in the natural system processes include the depleting state of the Earth's biosphere integrity, biogeochemical flows (phosphorus and nitrogen cycles), land-system change, freshwater use, and atmospheric aerosol loading (Rockström et al., 2009; Steffen et al., 2015). Regional level changes of the states of these processes affect the

overall Earth system at the global level, with climate change and biosphere integrity being the core planetary boundaries through which the other critical processes operate (Steffen et al., 2015). To sum up these mechanism, human activity on Earth increasingly burdens the finite natural system and this tension holds implications for other dimensions in the macro environment of companies.

The remaining macro environment dimensions—political, economic, socio-cultural, technological, and legal—describe trends in society and economy. These dimensions are strongly interlinked and have causal relationships (Burt et al., 2006), as the elements of modern society are densely interconnected and interdependent. For example, rising public concern about climate change has affected the political environment and resulted in international and national climate change policies, such as the carbon trading system in EU. The system has sector specific implications because increased carbon control costs can affect the international competitiveness of carbon-intensive firms (Kuik & Hofkes, 2010). Through these kind of mechanisms, the changes in the macro level dimensions, such as the environmental and political ones, can eventually influence the competition between firms at the micro level. The next paragraph provides examples of regulative measures that can convey external political pressures onto companies, thus motivating them to alter their existing practices.

Practitioners and scholars recognize environmental regulation as one of the key measures for motivating companies towards improving their environmental performances. The incentive to remain compliant with the regulation is rather straightforward, assuming that companies want at sustain their right to operate in the region. The regulative measures for sustainable production include, for instance, the producers' responsibility requirements, subsidies for investments into cleaner production, regulation for waste management, and regulation for natural resource use. At the national level, public authorities can also allocate national innovation funds for the sustainability-driven R&D activities of companies or develop practices for environmental permitting of industrial plants. Moreover, national authorities can steer the market towards more environmentally sound consumption by introducing environmental criteria for public procurement or intervening in consumer behaviour with incentives and taxation (Edquist & Hommen, 2000). Besides national effort, there is also an increasing body of knowledge that discusses the roles municipalities play in incorporating environmental considerations into regional development efforts (Burström & Korhonen, 2001). Such active roles include influencing the access and business conducting possibilities of companies in the region through land use planning and infrastructure investment decisions.

4.1.2 Stakeholder pressures in the business environment

Stepping from the macro to the micro level, the motivation to consider environmental aspects can also stem from the influencers in the companies' immediate business environments. The framework in Figure 3 categorizes such micro-level influencers though a stakeholder view (Freeman, 1984; Palmar et al., 2010). This view identifies the institutions, individuals, or groups that "affect, or are affected by, the achievement of an organization's mission" (Freeman, 1984, p. 52). Such stakeholders include competitors, suppliers, customers, shareholders, media, local communities, and nongovernmental organizations (NGOs). Each group can have different expectations about the environmental performance of companies and their motives for pressuring companies can vary (Aguilera et al., 2007).

The framework identifies customers as one of the key stakeholders. As buyers, they have power to require better environmental performance from products and services they purchase. Customers can be public or industrial organizations or consumers. The public sector is responsible for a substantial level of consumption. Public organizations' rising interest in green public procurement (Ambec & Lanoie, 2008) indicates that an increasing amount of tendering processes will include environmental criteria in the future. Such requirements can shape the market conditions, giving potential competitive advantage to greener products and services in the market. Together with green consumers (Peattie & Charter, 2003), these customer groups can form more environmentally aware income flows, giving companies a chance for differentiation and premium pricing.

Competitors are another key influencer group in the micro environment as discussed in Article II. The rationales for environmental considerations from the competitor perspective result from debating whether "it pays to be green" in business rivalry for markets (Walley & Whitehead, 1994; Porter & Van der Linde, 1995). Following Porter (1990), many researchers agree that the companies' ability to compete against their competitors results from productivity (Bhawsar & Chattopadhyay, 2015; Doyle & Perez-Alaniz, 2017). Following this view on productivity growth, the motivation for environmental consideration can result from the companies' aim to achieve lower costs or to differentiate its products (Porter, 1990). Improving operational efficiency via material and energy efficiency is one way for a company to lower costs in comparison with its competitors. However, the potential competitive advantage in operational efficiency also depends on the right timing and scale—the company is more likely to achieve competitive advantage from cost reductions when making an early or a large-scale move towards resource

efficiency (Hart, 1995; Hart & Ahuja, 1996). In terms of product performance, better environmental performance may reduce the threat for substitution (Peattie & Charter, 2003, p. 732) and result in superior customer value (Porter & Van der Linde, 1995). The ability of greener products to compete against traditional products with respect to their technical performance has however been questioned (Wong et al. 1996; Walley & Whitehead 1994). The debate has progressed towards analysing circumstances under which companies are able to offset the costs of environmental investments (Reinhardt, 1998).

Suppliers can act as active influencers and incorporate environmental considerations into operations and offerings of their customers. The environmental considerations can result from both downstream and upstream collaboration (Vachon & Klassen, 2008). However, the pressure to improve environmental performance in supply chains is often discussed from a top-down perspective, as a wish of the customer company to "green" its supply chain. With this approach, suppliers develop more environmentally friendly technologies as a reaction to their customer's needs. Suppliers can initiate the greening of the supply chain by offering greener solutions to companies that are followers in considering environmental issues. Such active supplier influence is found in the empirical investigations of Articles IV and V, which are discussed further in the subsequent sections. The delivery companies and renewable fuel suppliers studied in these papers illustrated situations in which the initiative for greener operations can also emerge from the bottom-up.

In addition to the external sources discussed above, the motivation for incorporating environmental considerations can also emerge from internal sources. Employees within the company are a critical organizational resource that makes a difference in identifying, interpreting, and responding to external pressures. Internal factors, such as organizational culture and identity, shape both the interpretations of the external pressures and the organizational responses to them (Howard-Grenville & Paquin, 2008). Therefore, the values of a company's employees and management members can create internal pressure to change current business practices.

As outlined in the above framework, the motivation for incorporating environmental considerations into investment decision-making can originate from several sources in the business environment. These influences can occur externally at either the macro or micro level or internally within an organization. The empirical findings presented in the following sections provide additional insights into the external regulative pressures, suppliers and local authorities as external influencers, and managers as internal influencers on investment decision-making.

4.2 Triggers that initiate environmentally conscious investments in actual decision-making situations

In response to the second research question of the dissertation, this section focuses on the triggers that initiate environmentally conscious investments in actual decision-making situations. The findings are aggregated based on Article IV, which utilized SPAT to study the triggers present in actual vehicle investment decisions. This understanding is complemented by the findings obtained in Article III, exploring the role of municipal actors as external influencers who foster investments of companies in biogas production systems. The findings from Articles III and IV together provide understanding of the external influencers, situational factors, and internal drivers that stimulate environmentally conscious investments in actual decision-making situations. The findings are discussed more thoroughly in the original articles.

When interpreting the findings, one should be aware that the meaning of the term environmentally conscious investment is context specific. This is because different technologies hold different environmental considerations in their use contexts. In the gas vehicle context of Article IV, environmental considerations were related to mitigating carbon dioxide and particulate matter emissions in delivery operations. In the biogas production context of Article III, instead, the environmental considerations were primarily related to improving nutrient recycling in waste treatment and to circulating material flows between organizations.

4.2.1 The role of external influencers in initiating investments

As demonstrated by Articles III and IV, external influencers may play a role in initiating or influencing the investment decisions of companies. In both studies, external influencers were involved and actively worked to influence the decision outcomes in companies. This meant that there was active fuel supplier involvement in the gas vehicle context and active municipal actor involvement in the biogas production context. This section briefly describes the roles taken by these external influencers—i.e., the fuel supplier and the municipal actors. The motives and actions of the external influencers have been discussed in more detail in the original versions of Articles III and IV.

In Article III, the municipal actors took an active role in initiating regional investment action and inviting companies to join a regional development project.

Based on interviews, incorporating environmental considerations into regional development work was in line with the municipal actors' agenda. As public actors, they perceived that they had a broader regional responsibility to think through the regional material utilization chains. However, it appeared that the economic dimension of sustainable development was a relatively clear motive for initiating the biogas production systems in all studied cases. The economic aspects included building an appealing brand for the city and the region, increasing self-sufficiency in energy and nutrients, taking full advantage of the local biomass resources, and increasing regional export capabilities. Environmental considerations were of secondary importance.

In Article IV, the fuel supplier took an active role in enhancing gas vehicle investments among its customer companies. For the fuel supplier, the profitability of its refilling infrastructure investment was highly dependent on the gas demand in transportation sector. Therefore, the supplier actively worked on enhancing the adoption of gas vehicles in their customer companies. This sales work included collaboration with several service providers, offering vehicle leasing and importing in a new vehicle market, as well as vehicle retail, conversion, repair, and maintenance in the aftermarket. The fuel supplier joined in the investment decision-making study as part of its market creation work. The following sections discuss the situational factors and the internal drivers for investment that were present in actual vehicle investment decisions.

4.2.2 The options available to decision-makers are limited by the purpose and symbolic meaning of the investment object

Before looking at the triggers that initiate investment action and their dynamics in a more detailed manner, one must understand the starting points for decision-making narratives. As shown in Article IV, the use purposes and symbolic meanings of the investment object can vary between organizations. The different practical and symbolic limitations restrict the decision-makers' available options in the investment decision-making situations.

The investment object needs to support operational effectiveness in companies, which sets practical limitations on the decision-makers' available options. In the gas vehicle context, the companies' delivery operations set specific requirements for the vehicle model and features. For the majority of the interviewed decision-makers, the use purpose the investment object was the starting point for decision-making. For

example, automatic gears were fundamental to saving taxi drivers from back pain, a post delivery driver needed a right-hand drive and front windows installed at an ergonomically low height, and food delivery operations set requirements for the shape of the boot space and attached equipment. Finding a suitable vehicle model with the appropriate brand, features, and purchase price can be a challenging task even without considering the environmental impacts or costs of different fuel types. The decision-makers need to attach many practical requirements to the technology before the environmental or financial information can be considered.

In addition to different use purposes, vehicle as an investment object also had differing symbolic meanings for decision-makers, depending on their role in relation to the investment object and on the overall nature of the company's business (Table 6). Different symbolic meanings implied different decision-making criteria and therefore affected what the decision-makers perceived as relevant information for making an investment decision. For example, taxi entrepreneurs emphasized that the vehicle represented an investment into customer premises, entrepreneurial status, and working conditions. The vehicle was a place for serving customers, which set special requirements for functionality and model features—the back seat of the vehicle should feel luxurious, spacious, and comfortable. Furthermore, the taxi entrepreneurs described how certain vehicle brands and models represented status symbols in the taxi sector. The interviewed entrepreneurs were demanding, especially in terms of the driving experience, and expressed driving experiences attached to different car models and brands during the interviews. Taxi entrepreneur A described the decision in the following way: "*If you spend all your working time in that driver's seat, the car should definitely be to your liking!*"

Hence, personal preferences and symbolic meanings attached to the investment object, such as brands from German automobile manufacturers, limited the decision-maker's options.

Table 6. Vehicle as an object for investment has different symbolic meanings in different companies, (adapted from Article IV)

Company	Fuel used in gas vehicles	Vehicle as an object for investment
Waste management	Natural gas	Machine, focus is on maximizing utilization rate and minimizing capital cost.
State-owned delivery	Biogas	Part of a large flexible fleet, focus is on technical performance and ergonomics requirements.
Private delivery	Biogas	Environmental choice, focus is on the differentiation means it provides.
Driving school	Natural gas	Teaching tool, focus is on the first contact for a youngster to learn safe driving and experience natural gas vehicles.
Church welfare foundation	Biogas	Enabler for operations, focus is on mitigating safety risks for users, ease of use, and effortlessness.
Taxi A	Biogas	Working space and customer premises.
Taxi B	Natural gas	Working tool.

4.2.3 The role of internal influencers in initiating investment decisions

When describing the switching situation, namely investing in gas vehicles, the decision-makers cited various reasons for taking action. These triggers explain why a customer company decided to invest into a technology that has environmental benefits.

The investment action resulted from a complex interaction between the external and internal influencers, the situational changes in regulation and available technologies, and the decision-makers' reactive responses to these external influencers and situational changes. Table 7 summarizes the relevant influencers, information inputs, and situational factors that triggered companies into investment action to switch to gas vehicles. The SPAT interviews unveiled also switching cases where companies had switched from gas vehicles back to using conventional technologies. These triggers were related to limitations in maintenance network and available vehicle models (situational triggers), technical problems (reactional trigger), and urgency in making the decision before changes in taxation (reactional trigger).

Table 7. SPAT analysis: Triggers for the switch to gas vehicles (adapted from Article IV)

Company	Identified triggers
Waste management	**Influential:** The company expected lower life-cycle costs with good technical performance and had a general interest in piloting different technologies.
State-owned delivery	**Influential:** Employees had interest in environmentally friendly pilot projects. **Situational:** Governmental initiatives for pilot projects and time pressure from regulation (last chance to try gas in a Euro 5 type vehicles) set situational triggers for the switch.
Private delivery	**Influential:** The company had interest in using gas vehicles for differentiation. Moreover, the chief executive officer (CEO) of the company was personally active in initiating the investments as he valued biogas for its domestic and environmentally friendly origin. **Situational:** Infrastructure and technology were available.
Driving school	**Influential:** Because of environmental and cost savings, the decision was made to keep one gas vehicle in the vehicle fleet. Close training collaboration with the fuel supplier strengthened the investment decision.
Church welfare foundation	**Influential:** The retirement of a personal contact from the former vehicle retailer enabled an open-minded consideration of different options. The chief financial officer (CFO) of the company searched actively for cost and CO_2 savings. **Situational:** Availability of locally produced biogas; availability of required models and infrastructure.
Taxi A	**Influential:** Based on own active information search, the entrepreneur expected lower fuel costs and lower taxation for gas vehicles. The entrepreneur had active interest in piloting and this, combined with availability of a suitable model, triggered the investment action.
Taxi B	**Influential:** The entrepreneur expected fuel cost savings based on her own active search and promises from the technology provider.

Based on the gathered narratives, all investment decisions were driven by motivated organization members who promoted new vehicle alternatives to decision-makers.

The motivated individuals, such as the asset manager, CEO, CFO, or quality manager, collected and interpreted information concerning the business context, technology alternatives, and related cost and environmental aspects.

The motivation to promote cleaner technology investments seemed to result both from personal values and the decision-makers' organizational responsibilities. Pioneering spirit and environmental values seemed to be the key values related to gas vehicle investment decisions. Ranging from a large state-owned delivery company to a taxi entrepreneur, the decision-makers' interest in trying new technologies and piloting alternative fuels furthered the gas vehicle choice. Moreover, regardless of company size, the decision-makers' expressed their interest in pioneer projects.

Additionally, the decision-makers' environmental values were present in the switching narratives regardless of company size and decision-maker role—small companies, with their founders as their CEOs (Private delivery, Driving school), as well as a large company with environmental managers (State-owned delivery) and a non-profit organization (Church welfare foundation)—all emphasized environmental values. The informants justified the incorporation of environmental considerations into investment decision-making by referring to the entrepreneurs' personal choices in small companies and to official environmental goals and strategies in large companies. For example, the founder of Driving school saw gas vehicle investments as one to decrease fine particle and CO_2 emissions produced by the organization:

"*I don't think it is advisable to drive with diesel vehicles in the city centre area because of the fine particle emissions. You can't influence much on what is happening in the world – you are a tiny ant, but you can do your small bit for this environmental cause.*"

Even though valued as important, environmental considerations seemed to have an impact on decision-making only when functionality was not compromised. This links to the previously discussed practical limitations that restrict decision-makers' available options in investment decision-making situations. Functionality aspects, such as model features, technical performance, usability, or technical performance, were valued over environmental aspects in all companies, except for one that based its differentiation on gas vehicles. In this exception, the founder of the company saw environmental values and domestic fuel origin as such meaningful attributes that the whole business strategy was built on using biogas in gas vehicles and wind power in electric vehicles. Therefore, the cost information related to different fuel technologies did not affect the decision for this company to same extent as environmental facts:

"I don't want to think about it too much [laughter], but I pay 10,000 euros extra yearly for that choice. There, now I said it. And this year the amount will be even more. We would be a different company if we talked only about fossil fuels. I can tell you that the customer can't understand the difference between the fuels. I would probably get as many customers with the fossil fuel. If I had a similar concept, it would be enough."

4.2.4 Decision-making structures that influence the incorporation of environmental considerations into decision-making

To reflect further on the findings presented in Article V, the decision-making structures in the interviewed organizations differed from one another. In line with the typology of Nesbitt and Sperling (2001), the number of decision participants and the level of formalization in decision-making procedures varied among companies, as the companies differed in terms of organization size, vehicle fleet size (Table 8), and ownership structures. Therefore, the environmental considerations became incorporated into decision-making through different levels of formal procedures.

Table 8. Vehicle fleet sizes in the companies studied

Company	Size of vehicle fleet
C1 Waste management C2 State-owned delivery	> 1,000 vehicles
C3 Private delivery C4 Driving school	10–30 vehicles
C5 Church welfare foundation C6 Taxi A C7 Taxi B	1–10 vehicles

The structures differed in terms of the level of formalization and the number of decision-makers involved in the decision-making process, as illustrated in Figure 4. These different decision-making structures in organizations may also have an impact on the decision outcome. Furthermore, the formality of the procedure can have an effect on the integration of individual actors' values into the process. Entrepreneurs, as founders of their businesses, could rather effortlessly incorporate their personal values and preferences into an informal decision-making process, as demonstrated by narratives from the Private delivery, Driving school, Taxi A, and Taxi B. In contrast, the informants from larger operators, such as the Waste management and

State-owned delivery companies, emphasized the official organizational goals, asset management aspects, and decision-making procedures during their interviews.

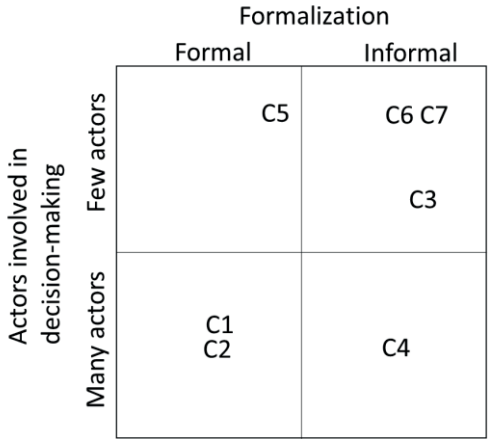

Figure 4. Investment decision-making structures in the companies studied (further reflection on the findings in Article IV, inspired by Nesbit and Sperling [2001] and Fredrickson [1986]).

In summary, although emphasized in gas vehicle adoption discussions, rational evaluations and reasoning about the supporting infrastructures (e.g., number of filling stations, maintenance infrastructure) or financials (e.g., residual value of the vehicle) did not on their own determine the decision outcomes in the studied companies. Quantitative information, such as life cycle costs or emission information, strongly interacted with other more subjective inputs in the process. The decision outcome was determined by the purpose of use and the symbolic meaning of the investment object, as well as by the decision-makers' personal values for domestic fuel origin, piloting, and environment, an interest in alternative technologies, and contacts with technology providers and fuel suppliers. These subjective elements determined the use and role of quantitative inputs and the kind of information that the decision-makers considered relevant in the process.

The findings emphasize the impact of motivated and active internal influencers who fostered technology investment decisions in the organizations studied. The internal actors were especially able to foster investments into gas vehicles even though the decision-making procedures did not suggest this decision alternative. The findings propose that in these types of decision-making setting the outcome of the

decision—cleaner technology adoption—can be difficult to anticipate from the outside if the impact of the pioneering and environmental values is not recognized.

4.3 Limitations for incorporating environmental considerations into investment decision-making processes

Even though the decision-makers could possess the supporting values or organizational roles for considering environmental aspects, they may face challenges when trying to integrate environmental considerations into their decision-making. This section discusses the possible limitations for incorporating environmental considerations into investment decision-making processes. The empirical investigations in Articles III and V answer the third research question of this dissertation by exploring the limitations that hinder the incorporation of environmental considerations into decision-making. Article III explores the limitations in an inter-organizational context and focuses specifically on municipal system builders as external influencers when they intend to influence companies in the inter-organizational network. Article V explores the limitations in an intra-organizational context and focuses on the limitations stemming from a bureaucratic decision-making process structure and on decision-makers involved in the process. The findings are discussed more thoroughly in the original articles.

4.3.1 Limitations in the inter-organizational development context

In the inter-organizational context, environmental benefits can be achieved through improving the material and energy circulation between organizations. In Article III, the municipal system builders aimed for improving environmental performance at inter-organizational level instead of promoting technology adoption in a single organization. Establishing systems that improve material circulation requires motivated key actors that drive the development work. Such key actors (i.e., the system builders) have a vision of the intended outcomes and aim at steering the development process accordingly. However, the system builders can face limitations that hinder them from reaching their intended outcomes. The limitations in inter-organizational context are discussed in line with the findings presented in Article III.

Article III reminds that companies do not accomplish or improve the environmental sustainability of their operations in isolation. Also investments made by other organizations have an effect on the overall environmental performance of

companies' operations at the inter-organizational and system level. Understanding this requires looking at the investment decision-making made in the company's operational environment. For example, a local biogas plant investment can enable farms and the food industry companies to circulate their biodegradable waste flows within the same geographic region. In this kind of setting, environmental performance can be improved at the system level through enhancing renewable energy production and secondary raw material utilization.

Article III explored the system builder role of municipal actors and analysed their intentions and actions in establishing biogas production systems. In the regional development cases studied, the municipal system builders had limited power to influence the overall sustainability of the system due to the overlapping intentions of the actors involved, uncertainty on the causal chains between actions and sustainability outcomes, and distribution of control due to a lack of technical knowledge. Moreover, the system builders invited private companies to join the system as financially self-sufficient entities, meaning that the companies could also make their technological choices independently. Thus, the power of making choices related to, for example, energy and material efficiency of the processes or fuels used in transportation, were out of the system builder's—and thus the municipalities'—control. Instead, control over the technical choices was distributed among the companies that joined the system.

A crucial question in municipality-driven inter-organizational settings is whether the system builders can simultaneously enhance multiple voice co-creation among companies and not lose their power to steer the regional development project towards intended outcomes. In other words, how do municipal system builders ensure that the more technically knowledgeable actors from companies are not the only actors defining the development and how do they protect their own power along with preserving the co-creation process? The findings propose two limitations for incorporating environmental considerations into decision-making processes in inter-organizational settings. The key actors who drive the inter-organizational development can have limited 1) power and 2) technical knowledge to influence the overall outcome of the developing system. The social aims for open governance and co-creation can cause challenges for ensuring the environmental protection aims of the system are met. These challenges emerge when the decision-making about technologies and operation models is distributed among the more technically advanced actors in the system.

4.3.2 Limitations in the intra-organizational decision-making context

As discussed in Section 4.2, both the decision-making process structure and the decision-makers involved can have an influence on the investment decision outcome. In terms of structure, higher levels of formalization can affect possible alternative scopes that decision-makers consider in the process. Moreover, decision-makers' personal values and organizational responsibilities can have impact on what information content is considered relevant in the investment process. This section summarizes the findings drawn from analysing a decision-making process in a chosen case company. The decision-making process was approached by focusing on the decision-making structure and the actors involved in the process (Figure 5). In this process, the actors use information to understand the decision-making situation and to support logical thinking. The limitations that hinder information utilization and the incorporation of environmental considerations can stem from the structural and actor-based features of the process. A more detailed description on the limitations and this decision-making process in the case of a Delivery Company and its supplying Energy Company is presented in Article V.

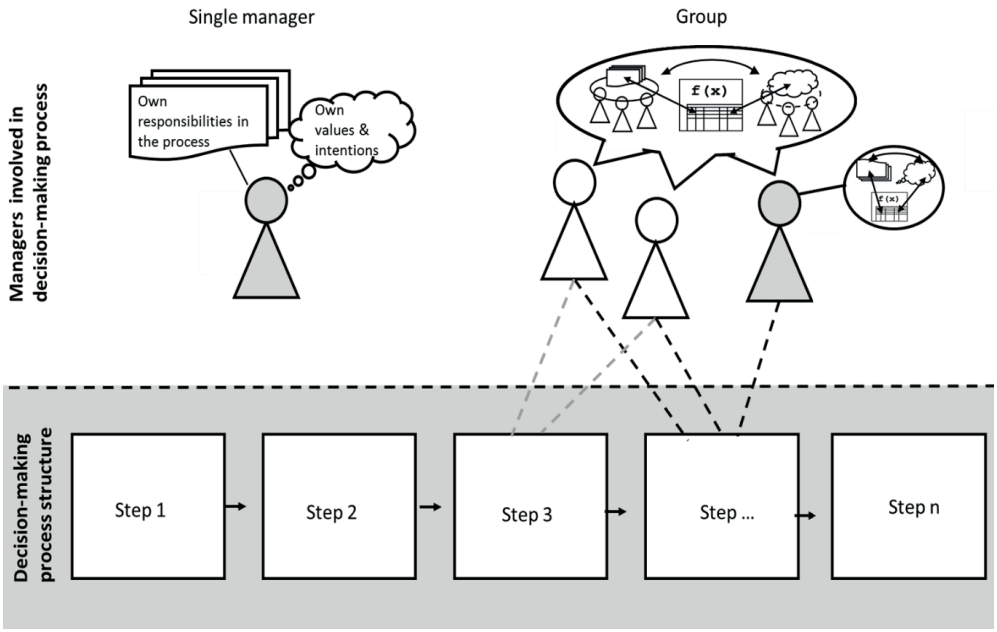

Figure 5. The decision-making process structure and the actors involved. (adapted from Article V)

First, the decision-making structure may ignore motivated actors and their environmental viewpoints. In large organizations, especially, formal decision-making procedures can bring clarity to a complex internal operational environment. The procedures hold potential for bringing efficiency, traceability, and predictability to the decision-making processes. However, the structured procedure may exclude certain actors and their viewpoints. This was demonstrated in the Delivery Company case, where investment alternatives were compared, evaluated, and finally accepted without considering CO_2 emissions and fuel cost, even though they were regarded as strategically relevant information and linked to organizational goals. If the decision procedures are mainly defined according to a prior understanding of operational efficiency, the procedures may not allow alternative technologies to enter the investment discussions. This can lead managers to utilize separate decision-making tracks when adopting disruptive technologies outside the routine options.

Second, managers can hold differing expectations for a desired outcome—managers see the desired decision outcome differently, depending on their organizational roles, as illustrated in the case of the Delivery Company. The interviewed managers had different organizational responsibilities and intentions related to environmental sustainability and operational efficiency of their vehicle fleet. Managers, such as the Head of sustainability or the Quality manager, can be responsible for sustainability-related development work, whereas asset management can be more concerned with improving operational efficiency and flexibility of the fleet. Such different expectations for the investment outcome imply different criteria used for a desired decision outcome, thus resulting in different information requirements.

Third, managers hold different expectations for the means of achieving the desired outcome. For example, environmental aspects can be considered either in the decision-making process as decision criteria or afterward by improving energy efficiency in operations. Altogether, these different ways of reasoning can result in different managerial needs in terms of the scope, content, and timing of economic and environmental information.

Fourth, managers can hold constrained information provision and integration capabilities—they may have limited expertise in analysis tools, which limit the possibility of integrating the desired viewpoints. For example, managers might lack technical expertise to incorporate the carbon emission targets and carbon emission compensation costs into analysis templates during the decision-making procedure. Even though management would consider environmental information as strategically relevant, lacking information integration capabilities can hinder the

integration. Finding correct figures and converting them to financial terms can be considered as too time consuming or complicated.

Fifth, external incentives can be insufficient for motivating the integration: In addition to the listed actor-based limitations, external incentives can be insufficient to motivate the organizational actors for the integration. For example, managers can consider CO_2 allowance costs to be too small to have an impact on vehicle fleet decisions. Therefore, regulative incentives can be too small to motivate the managers towards information integration.

Altogether, the findings propose that decision-making practices can be limited by both structural and actor-based aspects, which suggests that those perspectives can also be combined in research, as was done in this dissertation. In particular, in response to the third research question of this dissertation, the incorporation of environmental information into intra-organizational decision-making can be limited by 1) a decision-making structure that ignores certain managerial viewpoints and decision alternatives; 2) different managerial expectations for the decision outcome and the means for achieving that outcome, which results in different appreciations of the information scope, content, and timing; 3) managers' constrained information integration capabilities and limited expertise in using analytical tools; and 4) insufficient external pressures from market or regulation.

5 DISCUSSION AND CONCLUSIONS

5.1 Synthesis of findings

The objective of this dissertation was to examine the drivers of and limitations to the incorporation of environmental considerations into the investment decision-making processes within companies. To support this examination, the dissertation formulated answers to its research questions by identifying and elaborating on i) the external pressures that motivate companies to consider environmental aspects in their technology investment decisions, ii) the triggers that can initiate environmentally conscious investments in actual decision-making situations, and iii) the limitations that can hinder the incorporation of environmental considerations into investment decision-making processes. This section answers the three research questions based on the research findings.

Overall, this dissertation extends the understanding of the mechanisms through which environmental considerations become incorporated into decision-making practices of companies. These mechanisms essentially involve external situational and stakeholder pressures for environmental considerations, triggers that initiate action in actual decision-making situations, and limitations that restrict or hinder the ideal manner of conducting incorporation actions. The mechanisms examined are shown in Figure 6. This figure is an illustrative one, as it provides examples of the pressures, triggers, and limitations observed in the literature searches and case studies. The figure uniquely shows the external pressures, triggers, and limitations that were studied in this thesis in the same image. Thus far, these perspectives have been studied from different isolated perspectives in other environmental sustainability studies—namely ecological economics, socio-technical systems, industrial ecosystems, environmental accounting and management, and environmental psychology (see Section 2.2). Together, these illustrated mechanisms contribute to the discussion about incorporating environmental considerations into business decision-making practices. The actual dynamics of the pressures, triggers, and limitations may be different in different contexts and evolve over time. Therefore, future studies should test the transferability of these mechanisms to other contexts.

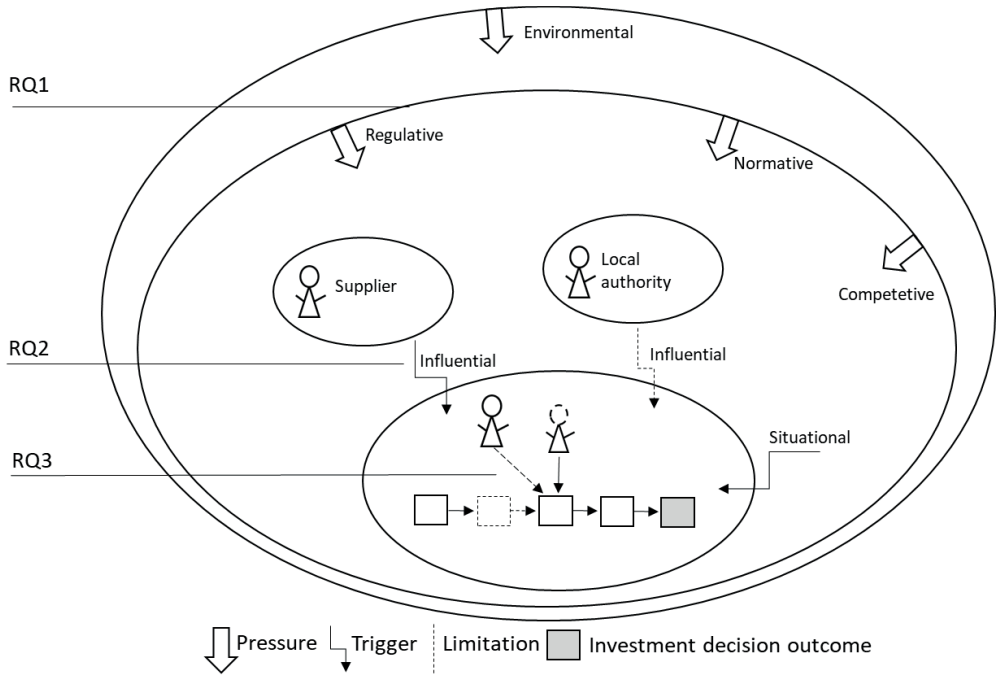

Figure 6. Synthesis of the pressures, triggers, and limitations for incorporating environmental considerations into investment decision-making practices.

In addition to the overall mechanisms presented in Figure 6, this dissertation yielded answers to its specific research questions. These are subsequently answered one by one and connected to the existing literature.

RQ1: *What kinds of external pressures motivate companies to consider environmental aspects in their investment decisions*?

Importantly, this dissertation created a framework for identifying the different pressures emerging in business environment from a company perspective. The framework integrated existing management literature by first dividing the pressures into external and internal pressures (Duncan, 1972) and then the external pressures into macro and micro level pressures (Marcus et al. 2010; Freeman. 1984). The framework contributes to the sustainability transition literature by offering a company view on business context, because the literature has usually looked at companies from a top-down perspective (Markard et al., 2012). The framework also

illustrates and positions the role of regulation amongst other pressures in business environment.

According to the created framework, external pressures can originate from general trends in the macro environments of companies as well as from more direct stakeholder influence. At the macro level, human activity on Earth increasingly burdens the finite natural environment and this tension creates environmental pressures for change. Consequently, this tension holds implications for other dimensions in the companies' macro environment, such as the political and legal dimensions. In these dimensions, environmental regulation is an example of a carrier that conveys external political and legal pressures to companies and motivates them to alter their existing practices. At the micro level, external motivation to consider environmental aspects stems from stakeholder pressures. The influencers in the immediate business environment of companies have different expectations regarding their environmental performance and thus the motives for pressuring companies can vary (Aguilera et al., 2007; Freeman, 1984). The following findings of this dissertation build on this observation and provide more detailed understanding of such influencers.

RQ2: *What kinds of triggers can initiate environmentally conscious investments in actual decision-making situations?*

This dissertation used SPAT to uncover the dynamism present in actual organizational decision-making processes (Roos, 1999; Roos & Gustafsson, 2011), thus providing knowledge on enhancing sustainability at the company level and within individual businesses (Loorbach et al. 2013; Koistinen 2019). The findings illustrate how external influencers, such as fuel suppliers and local authorities, can take an active role in promoting environmentally conscious investments in companies. Additionally, the investments can also be driven by internal influencers who collect and interpret information concerning the business context, technology alternatives and related cost, and environmental aspects. In these cases, the decision participants may justify the incorporation of environmental considerations into investment decision-making by referring to personal choices and values or to official environmental goals and strategies. However, even though valued as important, environmental considerations seem to have an impact on decision-making only when functionality is not compromised. The investment object needs to support the effectiveness of companies' operations, which sets practical limitations to the decision-makers' available options (see Sovacool & Hirsh (2009) as a rare example

of such observation in the energy context). Moreover, the investment object has different symbolic meanings for different decision-makers instead of being an objective outcome from a rational cost-benefit comparison, like easily assumed in the policy-making and economics literature (Geels, 2010). The symbolic meanings seem to be different depending on the role of the decision-maker in relation to the investment object and on the nature of their company's business. These different symbolic meanings imply different decision-making criteria and therefore affect what the decision-makers perceive to be relevant information in making the investment decision. Through these mechanisms, the purpose of use and the symbolic meaning of the investment object limit the decision-makers' available options.

RQ3*: What kinds of limitations can hinder the incorporation of environmental considerations into investment decision-making processes?*

To achieve a comprehensive view of the limitations studied, this dissertation uniquely combined lenses from two theoretical perspectives—structural contingency theory (Fredrickson, 1986; Donaldson, 2001) and pragmatic constructivist theory (Nørreklit et al., 2010). The dissertation provided understanding on organizational decision-making as a process that involves both structural and actor-based features (Nielsen et al., 2015). This means that both the internal decision-making process structures (Fredrickson, 1986; Donaldson, 2001) and the individual participants (Nørreklit et al., 2010) have an impact on information utilization and the decision outcome. Therefore, also the limitations stem from both the process structures and the participants in the decision-making processes. The identified limitations clarify the requirements set for information utilization in practice (Ahrens & Chapman, 2007) and assist in designing more useful information for managerial decision-making (Hall, 2010; Miller, 2001; Wouters & Verdaansdonk, 2002).

In addition to the intra-organizational context discussed above, the findings also unveiled limitations in an inter-organizational context. In this context, external influencers may have wishes and intentions regarding the investment decision outcome of another organization (Aguilera et al., 2007; Freeman, 1984), but no power or technical capability to influence it. As illustrated by the findings, external influencers may face practical limitations when trying to exert influence on and provide information for the organizational decision-making processes.

5.2 Theoretical contributions and practical relevance

5.2.1 Theoretical contributions

Altogether, this dissertation shows how companies' cleaner technology investments result from a complex interaction of external situational pressures, external influencers, internal process structures, and individual decision-makers. The dissertation represents a novel approach in the sustainability field by enriching analyses of the system level pressures for environmental sustainability (Rockström et al., 2009; Korhonen et al., 2018; Markard et al., 2012; Koistinen, 2019) with the analyses of the triggers and limitations present in the decision-making processes at the company level (Roos et al., 2004; Nielsen et al., 2015; Nørreklit et al., 2010; Hall, 2010; Wouters & Verdaansdonk, 2002). The investments can be triggered externally by active influencers or by situational changes in business environments. In contrast, the internal triggers for cleaner technology investments involve motivated individuals who are in supporting roles and possess values for initiating such investment. However, even if pressured externally or valued as important internally, the incorporation of environmental considerations may face challenges in practice (Laine et al., 2017; Testa et al. 2018; Onkila & Siltaoja 2017). The incorporation may be hindered by limitations stemming from the investment decision-making process structure and the decision-makers involved.

In addition to the scientifically novel combination of system and company level approaches, the findings of this dissertation hold practical relevance (Lukka & Suomala, 2014; Lyly-Yrjänäinen et al., 2017, p.46) for those actors wishing to promote cleaner technology investments. Thus, achieving environmentally sound investment outcomes in organizations requires supportive situational factors in the external business environment, motivated external and internal influencers fostering the change at the practical level, and supportive internal decision-making structures and interactions that allow the incorporation take place at the organizational level.

On a whole, this dissertation integrates and elaborates upon the existing understanding of the decision-making practices of organizations as presented in the sustainability transition literature, management accounting literature, and energy technology literature. The theoretical contributions to each of these literature streams are discussed in more detail in the following sections. Moreover, each of the original research articles contributed to these different literature streams with different analytical levels. To illustrate these individual research contributions, the

section ends with a summary table for the original research articles and their theoretical contributions.

Contribution to the sustainability transition research

This dissertation contributes to the discussion on achieving environmental sustainability in society, which features studies on ecological economics, socio-technical transitions to sustainability, industrial ecosystems, environmental accounting and management, and environmental psychology. In particular, this dissertation contributes to the sustainability transition literature stream in two ways. First, the case studies of this dissertation shed light on the organizational and individual actors who foster the change towards improved environmental sustainability in transportation and energy systems. This actor focus covers the intentions and actions taken by local authorities during biogas production system establishment (Article III), as well as those of active fuel supplier representatives and internal decision-makers who foster gas vehicle investments (Articles IV and V). The actor focus has been missing from sustainability transition studies, as they are typically framed from a system perspective (Farla et al., 2012). Majority of the extant literature has focused on national perspectives and developing system-level concepts, while giving only minor attention to empirical studies with an organizational and individual actor focus (Markard et al., 2012). While the systemic view has been helpful in developing understanding of the bigger picture and the need for societal change towards sustainability, this focus might have come at the expense of more actor-oriented analysis (Farla et al., 2012). The scholars have also called for introducing management studies into the discussion (Markard et al., 2012). Articles III–V answer this call by integrating the understanding of actor-oriented approaches (SPAT and pragmatic constructivism) with the understanding about sustainability transitions.

Second, this dissertation draws attention to the decision-making processes of companies in which environmental aspects are incorporated into decision-making as voluntary forerunner actions. The studied investment decisions represent early adopter decisions regarding the gas vehicle or biogas production technology in a Finnish context. Regulation does not require the adoption of such gas technologies. Instead, these investment decisions represented voluntary choices to change existing practices in transportation and energy production. This is a unique viewpoint in sustainability transition literature, which has thus far emphasized the roles of governmental agencies and other public organizations in steering this transition

(Markard et al., 2012). Previous literature provides limited knowledge on enhancing environmental sustainability at the company level and within individual businesses (Loorbach & Wijsman, 2013). This is unfortunate because, in the end, the socio-technical systems change over time when new products, services, business models, and organizations emerge and complement or substitute the existing ones. These changes require forerunner actions in practice and this action can be driven by different companies and individual actors (Farla et al., 2012; Loorbach & Wijsman, 2013).

Contribution to the management accounting research

This study contributes to existing management accounting (MA) literature in three ways. First, it provides understanding of the emerging pressures for considering environmental aspects in managerial decision-making. The traditional view of company goals emphasizes profit maximization. Therefore, the primary function of MA literature has been to aid managerial decision-making to achieve this goal (Caplan, 1966). The pressures identified for environmental sustainability set new requirements for organizations, which in turn create new needs for additional MA tools and methods. The current environmental disclosures and impact assessment tools that have been designed have only partly answered this need (Passetti et al., 2014; Bennett & James, 1998, p. 51; Räikkönen et al., 2016). Nevertheless, this development work related to the assessment tools and methods does not yet imply that environmental considerations and measures would be used in actual decision-making (Järvenpää & Länsiluoto, 2016). This study supplements the designed tools and methods by providing a more in-depth understanding about the incorporation of environmental considerations into actual decision-making processes.

Second, this study identifies practical limitations for incorporating financial and environmental information into investment decision-making processes. The identified limitations clarify the practical requirements set for MA information in practice (Ahrens & Chapman, 2007) and assist in designing more useful MA information for managerial work purposes (Hall, 2010; Miller, 2001; Wouters & Verdaansdonk, 2002). Practitioners can partly overcome the identified limitations by increasing interaction in and reflection on the decision-making process. As demonstrated by the case study in Article V, integrating different managerial views from sustainability aspects with, for instance, the investment decision-making process requires communication between decision-makers from different organizational functions. These decision-makers may, and quite typically do, hold

different perceptions, valuing certain technical, financial, or sustainability figures over others (Nørreklit et al., 2010). Often, the presented figures (such as cost impacts) and personal values (an individual's commitment to sustainability) are intertwined in the decision-makers' communication and cannot be separated easily. In such situations, MA information can serve as a communication platform for opening a dialogue about different ways of reasoning and a discussion on whether to include or exclude certain individual and strategic viewpoints (see Laine et al., 2016; Heinzelmann, 2016). It can facilitate a reflection about how well the alternatives line up with the decision-makers' intentions and responsibilities, company practices, and economic objectives. Making different viewpoints visible at each process stage can help decision-makers link their organizational goals to technology investment decisions more firmly. This suggestion is in line with the observation that both individual and collective knowledge can be expanded through dialogue and negotiation (Cuncliffe, 2004; Gherardi & Nicolini, 2001; Hall, 2010).

Third, the interventionist approach and the Switching Path Analysis Technique applied in this study answer the MA scholars' call for more research engaged with practice (Järvenpää & Länsiluoto, 2016; Adams & Larrinaga-Gonzales, 2007; Ahrens & Chapman, 2006; Van de Ven & Johnson, 2006). The interventionist approach uncovers the dynamics of introducing and actually considering different managerial values and responsibilities in non-routine, yet strategically important, investment decisions. Such investigations currently lack attention in MA literature (see Laine et al., 2016, as an exception).

Contribution to the energy research

Finally, this study makes a methodological contribution to energy research. It presents one of the rare attempts to combine the understanding about energy technologies with that of organizational theories. In particular, this study introduces SPAT as a new scientifically developed and approved methodological approach for understanding decision-making mechanisms in energy research. The knowledge gained through this approach contributes to the alternative fuel vehicle adoption discussion (Gärling & Thøgersen, 2001; Nesbitt & Sperling, 2001; Yeh, 2007). Despite the presence of behavioural elements in energy investment decision-making, social science-related disciplines, concepts, methods, and topics remain underutilized in existing energy research (Sovacool et al., 2015). This was lately illustrated by a content analysis of 4,444 energy research articles in three leading energy journals.

The analysis showed that only 12,6 percent of the energy research articles utilized any social science methods (Sovacool, 2014).

To further specify the listed contributions, each of the original research articles carries their own article-specific theoretical contributions, linked to one or many of the contribution areas discussed above. These theoretical contributions and relevant related literature sources are summarized in Table 9.

Table 9. The analytical focus, theoretical contributions, and relevant literature sources of the original research articles

Article	Analytical focus and contribution area	Theoretical contribution and relevant literature sources
I)Business environment—emerging external and internal pressures for sustainable production	Framework illustrating how pressures for improved environmental performance emerge at different levels of today's business environment Sustainability transition research	The synthesizing framework assists theory building in the research stream that studies the incorporation of sustainability aims in business (Marcus et al., 2010; Korhonen et al., 2018)
II) Sustainable competitiveness at the national, regional, and firm levels	Conceptual analysis of the notion of sustainable competitiveness and the measurement of sustainable competitiveness Sustainability transition research	Analysis clarifies the lately discovered concepts for attaining comparable results and measures that future research can build on (Bhawsar & Chattopadhyay, 2015; Weiss, 1993)
III) Municipalities applying circular economy principles: intentions and actions in establishing biogas production systems.	Analysis of the challenges that system builders face when engaging companies and municipal organizations in system development Sustainability transition research; Energy research	In-depth analysis of the system builder's roles, intentions, and actions when fostering development according to sustainability targets (Burström & Korhonen, 2001; Palm & Fallde, 2016)
IV) How do companies decide? Emotional triggers and drivers of investment in natural gas and biogas vehicles	Analysis on decision-making criteria and the triggers behind gas vehicle investments in companies Energy research; Management accounting research	New approach in utilizing the Switching Path Analysis Technique in energy research (Nesbitt & Sperling, 2001; Sovacool, 2014; Sovacool et al., 2015)
V) Utilizing management accounting (MA) information for decision making: limitations stemming from the process structures and the actors involved	Analysis on how the process structures and involvement of several managers may limit information utilization and exclude certain viewpoints, e.g., sustainability. Management accounting research	To become valuable, emission and cost information must be integrated into the processes influenced by decision-makers' values and institutionalized procedures. (Hall, 2010; Nielsen et al., 2015)

5.2.2 Practical relevance

The findings of this dissertation are relevant for practitioners that work to promote and support cleaner technology investments in companies. Such practitioners include policy-makers, sales representatives in technology provider companies, top management members who introduce environmental goals in their organizations, and analysts who support managers in investment decision-making.

For policy makes, the idea of decision-making triggers provides understanding of the decision-making mechanisms present in organizations. If policy-makers want to enhance cleaner technology adoption in organizations, they can influence the situational pressures in the business environment of these companies. Moreover, recognizing the roles of internal influencers and the practical limitations in decision-making broadens the policy-makers' perspective of companies as rational entities. These actual decision-making conditions explain why certain policy measures (e.g., increase in fossil fuel taxation or carbon allowance costs) might not have an impact on the companies' investment decision outcomes. This was demonstrated by the case study in Article V, where the decision-making process did not require information on fuel related costs.

For sales representatives working for technology providers and fuel suppliers, this study provides an in-depth understanding of the factors that affect cleaner technology investments in companies. Depending on the decision-making structure of the targeted customer company, the sales representative must be able to either influence the individual decision-makers or to direct the information in the right place of the decision-making procedure. To succeed in such influencer work, this study encourages the representatives to identify the motivated individuals that possess supporting values and organizational responsibilities for environmental considerations. These individuals are the key people to influence with information inputs. With support from the sales representatives, the individuals may also promote the solution internally by taking the message forward into the decision-making structure. However, challenges also remain in this line of work—even though the sales representatives could demonstrate the cost savings and environmental benefits of adopting the new technology, the message might not fit the customer's decision-making processes and criteria. The mismatch of the supplier's message and their customer companies' decision-making criteria can hinder the adoption of new technologies. The findings especially emphasize the importance of functionality in the decision-making criteria of customers. As demonstrated in Article V, the alternative technology promoted needs to be able to

serve the customers' operations efficiently before environmental factors can be considered.

For management, this dissertation demonstrates the roles of organizational goals, organizational responsibilities, and personal values in initiating cleaner technology investments. This dissertation also demonstrates the practical limitations that internal influencers may face when incorporating environmental considerations into decision-making processes. The decision-makers' options are limited by the criteria that stems from the purpose of use and the symbolic meaning of the investment object, as well as by the interactions and procedures present during the decision-making process. In order to improve the incorporation of environmental considerations into their decision-making processes, the managers can i) alternate the process structure so that it allows for introducing unconventional decision alternatives or ii) support collective reflection about which people and what viewpoints should be involved in the decision-making. Moreover, this study provides understanding for those organizations that are followers in considering environmental aspect in their operations. For such followers, this study demonstrates the different emerging external pressures for change and gives examples of forerunner companies that have reacted on those pressures.

For business analysts, management accountants, and other actors who support decision-making processes, this dissertation provides information about the need for new kinds of decision support. Managers need analytical tools that can enable them to demonstrate both financial and environmental impacts of investment decisions. As illustrated in this dissertation, insufficient technical capabilities can hinder decision-makers' possibilities for incorporating environmental considerations into the decision-making process. Actors who support decision-making are encouraged to apply and develop more comprehensive analytical approaches to further support the managers in decision-making. Such approaches include, for example, the Social Return On Investment (SROI) and the Life Cycle Assessment (LCA) (Testa et al., 2011). At the same time, the decision supporters are reminded that developing more detailed models and tools has an impact only in the hands of motivated and technically capable managers.

5.3 Research assessment

This section evaluates the quality of the conducted research. The research assessment considers the entire dissertation and its underlying research process.

However, the evaluations on the validity and reliability of this dissertation focus primarily on the empirical studies within the dissertation. One may argue that, with respect to the conceptual articles (Articles I–II), the reader can rather comprehensively access the original literature sources and then follow the credibility of the reasoning more transparently. In the case studies (Articles III–V), the reader has a more superficial view to the data collection and analyses of the original cases, instead, despite the attempt of the researcher(s) to unveil their data collection, analyses, and reasoning in the articles.

To assess whether the researcher's interpretations from the case analyses are trustworthy and credible, the concepts of validity and reliability are usually employed. Validity assessment questions whether the study provides an accurate representation of the situation it proposes to describe (Easton, 1992, p. 62). Reliability, instead, refers to the consistency and replicability of the research inquiry (Kihn & Ihantola, 2015). It is worthy to note that the use of validity and reliability is originally rooted in quantitative methods and positivist perspectives (Easton, 1992, p. 62). In contrast, this dissertation employed qualitative case studies that relied on subjectivist and interpretive research approaches. Therefore, the assessment of this research may also benefit from alternative evaluation criteria. Some interpretive studies even go so far as to abandon the common assessment criteria for validity and reliability, relying only on the alternative criteria (Kihn & Ihantola, 2015).

The alternative evaluation criteria can hold, for example, the assessment for the authenticity (i.e., genuine field experience) and trustworthiness (i.e., dependability, conformability, credibility, and transferability) of the interpretive study (Cresswell & Miller, 2000; Kihn & Ihantola, 2015). These alternative criteria question whether the researcher was indeed present in the field, grasping how the members understood their world (*authenticity*), whether the research process is logical, traceable, and carefully documented (*dependability*), whether the findings are supported with sufficient data and logical links between claims and observations (*credibility*), whether the findings and interpretations are linked to data in ways easily understood by others (*conformability*) and whether the findings can be applied to other contexts (*transferability*) (Kihn & Ihantola, 2015). The quality of the conducted research is next assessed based on both the above listed alternative criteria and the classic evaluation criteria on validity and reliability. That is, the assessment starts with discussing the *authenticity* of the research and continues to the *validity* and *credibility* as well as the *dependability*, *reliability* and *conformability* of the research, prior to the assessment of the *transferability* of the research.

As described in the methodology section, the researcher was engaged in close research collaboration with the fuel supplier through interventionist work. This interventionist work enabled the researcher to have in-depth discussions with company representatives and to access the phenomenon in its real-life context in the field. The data gathered from the field were analysed and reflected upon together with the company representatives and collective dialogue was arranged on a regular basis for the duration of the studies. The multiple forms of interactions and interventions in the case studies presented here increased the *authenticity* of this research (Lyly-Yrjänäinen et al., 2017; see also Laine et al., 2016). Additionally, the interpretive approach also increased the authenticity of the dissertation, as it required profound probing into the social rule systems of the participants whose communications and experiences were examined (Lukka & Modell, 2010). As field research allows for multiple voices to coexist in the research data, it also minimized the risk of misunderstanding the phenomenon based on existing theories (Atkinson & Shaffir, 1998).

To enhance the *validity* of the case studies, the studies utilized evidence from multiple data sources. All three case studies used multiple different data sources—i.e., from informal and formal documents, meetings, interviews, and literature reviews. This enabled data source triangulation. To enhance analyst triangulation (Yin 2013), all data were analysed in collaboration with other researchers for all case studies. Furthermore, the findings were discussed with the other co-authors and this research team members' check (Cresswell & Miller, 2000) also ensured the *credibility* of the researchers' interpretations. In addition, the research questions were formulated and refined together with the overall research process as a result of the largely abductive reasoning used within the case studies and the iterative data collection and analysis process (Lyly-Yrjänäinen et al., 2017). This increases the validity of the approach employed, as well as the credibility of the interpretations provided at different stages of the research process.

To enhance the *dependability* and *procedural reliability* of the research process (Kihn and Ihantola 2015), the researchers developed a coherent set of field notes from research meetings and reported all the primary and secondary data sources and analysis tools used for each article. Regarding the *reliability of the findings*, the case studies rely on the statements of key informants, thus allowing the data to tell the story. The statements were recorded and transcribed, and they worked as a basis for researchers' interpretations (Ahrens & Dent, 1998). In the articles, the interpretations were supported using illustrative and unedited quotations from the interviews, which ensured the *conformability* of the findings.

When assessing interpretive case studies, one should assess the *transferability* of the findings rather than narrowly focus on statistical generalizability. This means discussing whether some similarity can be found with other research contexts (Kihn & Ihantola, 2015). When assessing transferability, one must recognize the highly context- and time-specific nature of interpretive research (Lukka & Modell, 2010). As Ahrens and Dent (1998) note, the value of interpretive field research is in providing a depth of analysis over breadth and in the potential of having small sample field research demonstrate wider theoretical constructs. Despite the highly context-specific nature of this research, part of its rich insight can be transferred to other contexts. This requires extracting ideas from the case study findings on a more abstract level (Yin, 2013). In Articles IV and V, similar decision-making patterns and mechanisms started to saturate in the switching narratives studied (Morse, 1995). This indicates that the identified mechanisms and information utilization limitations can be transferred to other vehicle fleet decision-making contexts. Similarly, in Article III, the three biogas system cases shared similar characteristics of the system builder role, intentions, and work. In the future, these insights can be tested in other biogas system establishment contexts. As stated, the proposals created need to be tested in other research contexts to better assess the transferability of the findings. Furthermore, quantitative methods are also needed to assess the generalizability of the findings.

5.4 Limitations and suggestions for future research

As all studies, this study also has limitations. It was limited by choices regarding the Finnish research context, the research methods utilized, and the data collection. The data collection process, in particular, was both enabled and limited by the research collaborations underlying this dissertation.

First, this research applies an interventionist approach, which meant developing a close collaboration with the fuel supplier. While ensuring access to interesting phenomena in the field, such joint research effort also had an impact on the research questions and contributions to this research. The discussions with practitioners had an impact on which questions and insights from the interviews were seen as practically relevant, thus also directing the theory development to a certain extent. However, the researcher was free to formulate her own research questions and to seek the best possible answers to them during the entire research process. In addition, the search for both relevant and novel research questions also ensured the

researchers' access to authentic real-life cases. This access is a critical starting point for identifying interesting phenomena needed for theory building.

Second, the qualitative approach of the studies also limits the generalization of the findings as they might be context specific. This especially holds for the findings presented in Article V, as it relied on a single case study to examine the limitations of information utilization in investment decision making. The other two case studies, in Articles III and IV, utilized multiple cases, which increases the transferability of their findings. Moreover, the characteristics of the Finnish business environment deserve attention. In general, Finnish companies tend to have low hierarchical boundaries and high managerial freedom for independent work (Granlund & Lukka 1998b), which also affects the interpretation of the results on decision-making processes also in this study. For that reason, further research is encouraged to test the findings in other national contexts. Overall, future research is encouraged to replicate or extend these studies to alternative decision-making contexts and other industries.

Furthermore, the qualitative data collection methods also hold limitations. It is worthy to note that the findings presented in Article III rely on the interviewees' perceptions, plans, and expectations for system establishment. The actors involved in the focus groups could only envision proactive truth (Nørreklit et al., 2007) when describing the actions needed for system establishment. Proactive truth becomes a pragmatic truth when acted upon (i.e., when realized in the given biogas system case). Naturally, the more mature the system building project is, the narrower the gap between the proactive and pragmatic truths is, too (Trenca, 2016). Thus, the immaturity of the examined cases needs to be considered when interpreting the group interview data and other materials.

In some of the customer companies studied and reported on in Article IV, only one informant represented the organizational perspective of the decision-making process. This can be seen as a limitation of the study because, according to Kumar et al. (1993), multiple informant reports are needed in order to achieve correspondence between informant reports and the studied concepts at the organizational level. Especially in larger companies with multiple business units, the information about the examined phenomenon at the organizational level can be spread across multiple informants. However, the majority of the companies studied were rather small (2–25 employees) and therefore the key informants could be traced rather effortlessly. In case of the larger company studied, the close collaboration with the fuel supplier assisted the researchers in identifying the key informants involved in the investment decision-making process at that organization. Moreover, the key

informants interviewed here were responsible for vehicle investments in their organizational roles as well (e.g., Head of fleet, Chief executive officer).

Furthermore, data collection in Articles IV and V is based on the interviewee's memory and ability to make judgements based on remembered incidents (Edvardsson & Roos, 2001). It carries an assumption that there were some reasons and logics present in each of the studied investment decisions and that the interviewees can recognize and reflect on them. In this setting, memory bias may have restricted the key informants from sharing relevant information regarding the actual decisions made in the past. The retrospective nature of research data and the interviewees' ability and willingness to tell the complete narrative may limit the validity and reliability of the findings.

Finally, due to the exploratory research approach, there are several possibilities for novel and relevant further studies. Future studies are encouraged to investigate the external pressures, triggers, and limitations in other investment decision-making contexts and industries. The maturity of technology and the role of regulation may differ in other industries from those present in the Finnish gas sector. This study also encourages researchers to introduce SPAT into other sectors and B2B sales cases. Thus far, SPAT has mainly been used in consumer contexts. It seems to be able to provide practically relevant understanding also in B2B context—the fuel supplier representatives participating in this study considered SPAT to be a highly useful technique. Remarkably, an interesting scope remains for developing the understanding of the roles, intentions, and actions taken by internal key influencers who promote cleaner technology investments in organizational decision-making processes. Such actor-based approaches could benefit from participatory research methods, such as the interventionist research one.

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PUBLICATIONS

PUBLICATION I

Business environment: Emerging external and internal pressures for sustainable production

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BUSINESS ENVIRONMENT – EMERGING EXTERNAL AND INTERNAL PRESSURES FOR SUSTAINABLE PRODUCTION

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Synonyms

Competitive environment; External business environment; Internal business environment; Macro environment; Micro environment; Operational environment; Organizational environment; Sustainable production

Definition

Companies need understanding about their business environment to stay competitive, survive and prosper (Duncan 1972; Dreyer and Grønhaug 2004). Research has developed numerous methods for organizations to scan and build scenarios on their environment (see Amer et al. 2013 for overview). In general, describing the business environment requires analysing the external and internal context in which the company operates.

Companies' external environment includes relevant factors outside the boundaries of the organization (Duncan 1972). These factors can occur generally as macro level trends or as micro level changes in companies' immediate operational environment. There is a dynamic interaction between the macro and micro levels. Focusing on a specific level of analysis gives understanding of the emerging changes in the external environment and the interlinkages between those changes. Organizations can analyse their outside world at the macro level by identifying political, economic, sociocultural, technological, environmental and legislative influences on their business. These influences can occur at different spatial levels, locally, nationally or globally (Capon 2009, p. 5). At the micro level, the analyses focus on the institutions in the company's competitive and operational environment. These institutions include competitors and other stakeholders, such as suppliers, customers, shareholders, media, local communities and nongovernmental organizations (NGO).

The internal business environment describes the relevant physical and social factors within the boundaries of the company. These internal factors influence the decision-making behaviour of individuals within that company (Duncan 1972), and include structures, resources, culture and behaviour in the business organization (Capon 2009, p. 126).

Companies' business environments vary remarkably in terms of complexity, volatility and uniqueness. Neither the internal nor the external factors are stable over time (Duncan 1972), as their dynamics vary in terms of predictability and turbulence (Dreyer & Grønhaug 2004). Some of the key environmental influences are precise, quantitative and predictable (i.e. demographics in a market area), while many other factors are imprecise, qualitative and difficult to predict, (i.e. customers' attitudes, politics and financial condition) (Amer et al. 2013; Huss 1988).

External and internal pressures for improving environmental performance

There is increasing international consensus that human activities are affecting the Earth system to a degree that threatens its ability to support global societal development (Rockström et al., 2009; Steffen et al. 2015). The depleting state of the natural environment has awakened policy, governance, and citizen sectors to put efforts towards global sustainability. The increasing public awareness on climate warming, depleting natural resources and biodiversity loss is gradually affecting also the business world and companies' interpretations of their business environments.

This chapter provides a broad overview on how requirements for improved environmental performance emerge and cut across the levels of today's business environment. Discussing emerging sustainability related changes in business environment helps companies to understand the increasing physical and societal pressure to shift their strategies towards more sustainable use of resources and thus a more sustainable provision of products and services.

The chapter focuses on the environmental dimension of sustainability, contributing to the SDG 12 "Ensuring sustainable consumption and production patterns". Nations measure their achievements in this goal 12 with environmental indicators on energy consumption and production, pollution, waste generation and management and resource efficiency (see e.g. Eurostat 2018). The chapter first describes different external influences and trends that occur in companies' macro environment. The second part discusses the external influences at the micro level, focusing on the stakeholders in companies' immediate business environment. The third part briefly discusses organizational factors that influence companies' internal business environment.

Macro environment

This section discusses different environmental sustainability requirements that emerge in companies' macro environment. Macro environmental analysis describes companies' contextual environment and the general trends occurring in natural and socio-economic systems. Major European and North American strategy textbooks offer taxonomic classifications such as the PESTEL framework for analysing companies' macro environment (Burt et al. 2006). The framework classifies external influences to political, economic, sociocultural, technological, environmental and legal dimensions that can occur at local, national and global levels.

Relatively recent work from environmental economics suggests that companies' macro environment consists of natural, societal and economic systems that are composed of smaller subsystems (Figure 1). In this conception, economy is not considered equal to society or nature, as the dimensions of the PESTEL framework would suggest. Instead, economy is rather a component nested within the larger societal system similarly to other human created systems (e.g., moral, religious, etc.) (Marcus et al. 2010).

The global biophysical environment on Earth is a parenting system for all human created systems, including societal and economic systems (Figure 1). Therefore, the pressures emerging in the natural environment affect the other systems nested in the natural system. Following the view on the nested systems, this chapter first discusses macro environment from the natural environment point of view. After the natural environment, other macro level drivers for improving environmental sustainability are presented according to the PESTEL framework dimensions. The political, economic, socio-cultural, technological and legal dimensions in PESTEL describe general trends in socio-economic systems. (Marcus et al. 2010).

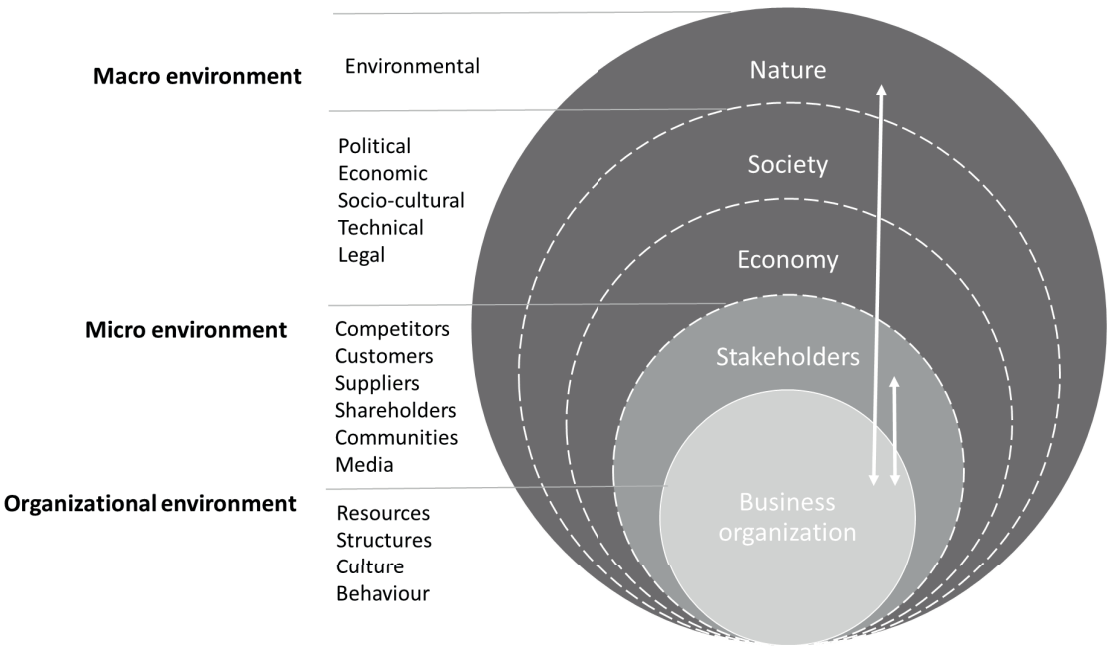

Figure 1 Macro, micro and organizational level business environment (Developed based on the works of Marcus et al. 2010, Freeman 1984 and Capon 2009)

There are pressures for improving companies' environmental performance from the **natural environment** point of view. At the macro level, researchers have identified warning signs on the key processes that are fundamental to Earth system functioning and human societies' life on Earth, including business activities and operations. The severe state of these critical processes has been presented with the concept of planetary boundaries (Rockström et al., 2009; Steffen et al. 2015), which include the depleting state of Earth's biosphere integrity, biogeochemical flows (phosphorus (P) and nitrogen (N) cycles), land-system change, freshwater use and atmospheric aerosol loading. Regional level changes in the states of these processes affect the overall Earth system at the global level, climate change and biosphere integrity being the core planetary boundaries through which the other processes operate. (Steffen et al. 2015)

Society's transition towards environmental sustainability seems inevitable from the perspective of limited resources and ecological thresholds (Rockström et al., 2009). At the same time, companies conduct business as part of the economic systems, and their business processes impact the surrounding nature, i.e., air, land and water. Therefore, all business activities result in environmental damage to some extent (Worthington and Britton 2006 p. 452) and affect the ecological degradation in human societies' natural environment.

Recently, research has developed promising approaches to enhance companies' understanding on their dependence and impact on the natural environment. Approaches such as ecosystem services and natural capital (OECD 2011) bridge understanding between business activities and the biophysical limits of the Earth. For example, degradation of natural ecosystems and the free services and raw materials they provide, such as water, affect also companies' costs and access to these inputs. Depleting state of the natural environment can also increase companies' operational risks. For example, climate change may increase the frequency and intensity of extreme weather events at companies' geographical locations.

The **political environment** for businesses holds political institutions and processes in international and domestic systems. These systems are closely interrelated in the globalized world. For example,

implementing the internationally agreed Paris agreement and Agenda2030 affects both multinational and local companies when national governments mobilize their efforts in achieving the goals. Moreover, politic and economic unions can set specific requirements for conducting business within member states. For example, the European Commission has established an action plan for circular economy, involving legislative proposals for waste recycling and management. These Europe-wide attempts to reduce environmental impacts in production imply changes in the political environment for companies operating with plastics, chemicals, waste management, food and critical raw materials (COM 2015). In addition, the existing European Union's directives, such as Eco-design Directive (2009/125/EC), set ecological requirements for products sold in member states. The tightening regulation implies that companies have to create new products or alter their existing designs in order to remain compliant with the policies.

At the national level, public authorities steer the demand side towards sustainable consumption by introducing sustainability criteria to public procurement or intervening consumer behaviour with incentives and taxation (Edquist and Hommen 2000). The political instruments for sustainable production include, for example, producers' responsibility requirements, subsidies for investments in cleaner production, emissions trading and regulation for waste management and use of natural resources. Other steering instruments include allocating national innovation funds for companies' sustainability-driven R&D activities or developing environmental permitting practices for industrial plants (see e.g. Lindström et al. 2003 on considering energy efficiency in environmental permit procedures). At the city level, the municipal authorities can influence the local infrastructure investment decisions and land use planning, which affect the companies' access and possibilities in conducting business in the area.

Economic environment describes human valuations on natural resources, human effort, knowledge and human-made capital used in the production of goods and services. It also refers to human behaviour in the use of scarce resources (Worthington and Britton 2006 p. 82). Depending on where the business activities are located, the company might operate with centrally planned economies such as China, and free-market economies, such as Europe. Operating with several monetary systems causes complexity in the economic environment, since different interest rates, inflation and currencies apply in each system run by each government's fiscal and monetary policies. At the institutional level, key influencers of companies' economic environment include both international economic organizations and national financial institutions and groupings. (Worthington and Britton 2006 p. 80).

In macroeconomic discussions, the environmental impacts of economic growth have become part of the political agenda both nationally and internationally (Worthington and Britton 2006 p. 452). The current economic system aiming at growing consumption and household spending has been criticized for not considering the ecological boundaries of the planet. It is a physically growing subsystem using linear flows of materials and energy in a shrinking parent system, the natural environment (Korhonen et al. 2018). Ecological economists argue that the human economy has passed from an era where human-made capital was a limiting factor in human development to an era where remaining natural capital is the limiting factor (Costanza et al. 1997, p. 97). In order to develop sustainably, nations need to be able to decouple trends of depleting natural resources and rising levels of pollution from economic growth (see e.g., Jackson 2009). These system level discussions have led to also increasing public concern on how companies utilize and extract the real flows (e.g. labour, timber or minerals) in the economy.

Looking at the financial capital flows in the economic system, the providers of the financial capital, such as shareholders or owners of the business, generally hold influence on the business decisions. (Worthington and Britton 2006 p. 452) There is a growing interest among investors in Western Europe and USA towards considering environmental, social and ethical aspects in their investment decisions. Socially responsible investment has become a more mainstream investment alternative, especially among institutional investors such as municipalities, labour unions and pension funds (Jansson, M., and Biel, A. 2011). Alongside

responsible investors, also lending institutions have become increasingly aware of the environmental responsibilities and risks related to polluting industries (Worthington and Britton 2006 p. 459). Incorporating environmental risk potential into lending policies puts pressure on businesses that seek funding for their investments. Investors and lenders push companies to develop strategic plans and scenarios for climate change by asking for disclosures on climate-related transitional and physical risks (FSB TCFD 2017).

Understanding how environmental concerns emerge in companies' **socio-cultural environment** helps companies in predicting future behavioural patterns and preferences in the consumer population, and public acceptance of business operations. Companies can analyse trends in their socio-cultural environment by describing the demographics of a population, the ways the population behaves and the ways the culture of the population develops. Demographic factors include information on population age and structure, while social factors include information on the levels of education and inequality of income in the society. Cultural factors hold information on the norms, values, language, religion, and lifestyles in the society (Capon 2009, p. 54). In the globalized world, companies meet and collaborate with people from different national cultures that act in the roles of local communities, customers, suppliers, competitors or public authorities. However, access to travel, global brands and communications media have changed societies in a way that socio-cultural influences are less bounded to the nations' geographical location. Lifestyle messages and other socio-cultural influences reach people globally to greater extent. (Capon 2009, p. 134)

When analysing emerging values in society, commitment to pro-environmental behaviour and environmental protection seem to appear more among younger, higher educated people (Klineberg et al. 1998). Additionally, pro-environmental values partly originate from childhood, as people care about the nature more when they are more familiar with it (Lekies 2006; Chawla 1988). The global trend of urbanization might make this opportunity less and less available in the future. On the other hand, improving economic prosperity can imply higher levels of education and thus improving environmental awareness in the future. The discovered connection between gender and environmentalism also suggest that improvements in gender equality may increase environmentalism in future societies (Nordaard and York 2005).

The technological environment for business describes the advances in artefacts (such as tools, products and their components) and processes that are innovated to assist people to fulfil their needs (such as food, shelter, health, mobility and communication). Together these technologies form engineering systems that aim at fulfilling important functions in society, such as energy production and distribution or water treatment (de Weck et al. 2010, p. 167). In these systems, companies act as both technology users and providers. As technology providers, companies innovate, develop and manufacture technological solutions for society's needs by collaborating and competing with other technology providers. The level of technological performance sets standards for industries, affecting the customers' and society's expectations on cost, quality and environmental performance.

The megatrend of digitalization is one example of a change that occurs in companies' technological environment and has implications for environmental sustainability. Digitalization is currently reshaping companies' information and communication systems and structuring its stakeholders to three groups: big data generators, collectors and utilizers (Lock and Seele 2016). Digitalization has opened new ways to shape, communicate, monitor and govern information on sustainability (Seele and Lock 2017), which has implications to organizations' digital surveillance. The improved metering technologies and big data analytics enable improving the transparency and accountability in business world. Digital technology enhances analysis on data generated from companies' money, information and knowledge flows in social networks and financial systems. Moreover, the generated emission and material flows in supply chains can be analysed in more detail. Making the most of digital data promoting sustainability, digital solutions bear potential in promoting company-stakeholder dialogue for example by facilitating public e-participation (He et al. 2016). In the future, both the technical development in reporting and laws requiring more detailed environmental information

disclosure (Gunningham et al. 2004) can empower environmental groupings and local communities even more.

The legal environment for business influences companies though laws, juridical decisions of the courts and statues enacted by governments. It offers a framework that constrains and regulates companies' operations and competitive environment, but can also enable certain entrepreneurial activity. The laws evolve over time in response to changing social, economic and political circumstances and pressure coming from different interest groups (Worthington and Britton 2006 p. 172). Each nation has its own legal system that establishes minimum standards and rules for establishing the organization (company laws), acquiring resources (planning laws and property laws), conducting business (employment laws, health and safety laws) and selling outputs for consumption (consumer laws) (Worthington and Britton 2006 p. 179).

The globalization of business means that organizations operate in different countries with differing environmental standards, legislative controls and requirements. There is an ongoing discussion whether the laws and regulation provide a greater level of corporate responsibility. Alternatively, the companies can voluntarily change their actions to meet societal expectations (Worthington and Britton 2006 p. 453). One regulatory approach to environmental responsibility is the polluter pays principle, where causing environmental damage increases costs in running the business (Worthington and Britton 2006 p. 456).

Altogether, the environmental, political, economic, socio-cultural, technological and legal dimensions are strongly interlinked in companies' macro environment. The dimensions have causal relationships (Burt et al. 2006), as the elements of modern society are densely interconnected and interdependent (Astley and Fombrun 1983). For example, rising public concern on climate change and biodiversity loss can affect international and national political environment. The more pro-environmental political attitudes can cause changes in national innovation policies that again have effect on the nation's long-term technological development.

Microenvironment

At the micro level, the analytical focus is on the organizations, institutions and relationships in companies' immediate business environment. In the micro level investigations, relevant individuals and organizational actors are company specific, whereas the above discussed macro level trends influenced business organizations in general. Related concepts for describing the external environment at the micro level include competitive environment, operational and collaborative environment.

Traditionally, Porter's five forces (Porter and Millar 1985) have been used to describe competition in an industry or sector where the company operates. These forces cover companies' current and potential competitors, maturity of the market as well as bargaining power of suppliers and customers (Capon et al. 79). Stakeholder theory (Freeman 1984; Palmar et al. 2010) extends the analytical focus from competition to collaboration and legitimacy, as it covers also interest groups that do not hold direct transactional relationship with the company. The theory identifies the institutions, individuals or groups that "affect, or are affected by, the achievement of an organization's mission" (Freeman 1984, p.52). Such stakeholders cover shareholders, customers, suppliers, regulators, the media, local communities and non-governmental organizations (Capon 2009, p.376; Worthington and Britton 2006 p. 450). Each group can have different expectations regarding companies' social and environmental performance, and their motives for pressuring companies to engage in responsible practices vary (Aguilera et al. 2007).

Customers are one of the key influencers in companies' immediate business environment. As buyers, they have power to require better environmental performance from products and services. Customers can be public or industrial organizations or individual consumers. Public sector is responsible for a substantial level of consumption, and public organizations' rising interest on green public procurement (Ambec and Lanoie 2008) indicates that more tendering processes will include environmental criteria in the future. These

requirements shape the market conditions under which the companies operate, giving competitive advantage for greener products in the market. Together with green consumers (Peattie and Charter 2003) these customer groups can form more environmental aware income flows, providing companies with a way for differentiation and premium pricing.

Consumers constitute an essential part of the market forces in immediate environment, either directly as companies' customers or indirectly as customers' customers. Many of the contemporary environmental problems are rooted in unsustainable consumer behaviour, which makes consumers a crucial customer group having impact on the ecological degradation. Research disciplines such as environmental sociology and environmental psychology offer approaches to understand consumers' pro-environmental attitudes and behaviour and the structures hindering them (see e.g. Fransson and Gärling 1999; Kemmelmeier et al. 2002; Steg and Vlek 2009; Gifford and Nilsson 2014). In practice, understanding consumers' pro-environmental actions can help companies in explaining or intervening green buying behaviour. Examples from public sector and forerunner companies point towards adapting sustainable choice architectures that can nudge (Thaler and Sunstein 2008; Gunn and Mont 2013) consumers towards proenvironmental choices.

Today companies compete with their rivals in a globalized world. Enhancing competitive advantage over **competitors** is increasingly rooted in location related capabilities, such as access to skilled workforce, wise use of material resources and technology cooperation in cluster areas (Porter 1998, Hart 1995). If a company makes an early move or a large-scale move towards resource efficiency, it can gain competitive advantage from the gained cost reductions. The improved environmental performance can also set new standards for the industry or gain better access to critical raw materials, locations, production capacity or customers (Hart 1995). Moreover, better environmental performance of a product may reduce threat for substitution (Peattie and Charter 2003, p. 732).

The power of **suppliers** on a company depends upon the nature of the products being supplied. For example, highly specialized products or reliable services can make the suppliers more significant to the company. Reducing stock levels can make companies more dependent on supplier relations, while having competencies to make components within the company can reduce suppliers' power. (Worthington and Britton 2006 p. 356) The pressures for improving environmental performance in supply chains are often discussed from a top-down perspective, as a wish from the customer company to green its supply chain. In this approach, suppliers develop more environmental friendly technologies as a reaction to customer needs (see Vachon and Klassen 2008 for the role of upstream and downstream collaboration in greening the supply chain). Green delivery companies have proved that the pressure can also emerge bottom-up, when offering their services to companies that are followers in environmental issues.

Alongside regulation, **community, environmental advocacy groups and media** act as effective watchdogs that demand companies to be accountable for pollution and waste issues. Today companies are often expected to go beyond compliance with regulation in order to sustain their social license to operate in society. Instead of only avoiding legal penalties, the focus is increasingly in meeting the expectations of society and in avoiding activities that society deems unacceptable. The social license emerges from the demands and expectations of neighbourhoods, environmental groups, communities and other levels of surrounding civil society. Social license demands, if not met, can be translated into new legal requirements or threaten a company's access to essential resources (permit to build, operate and access to energy, water and natural resources). Good reputation for environmental citizenship is also risk management for companies, as it can be beneficial in gaining fast tracked permit applications, access to resources, minimizing disruptions from NGOs or boycotts, and minimizing risks in violating unexpectedly the permitted pollution levels. (Gunningham et al. 2004)

As indicated above, different stakeholders can influence the practices of companies by exerting pressures on them. The degree to which the company is dependent on the interest group and its resources

defines the power the group has on the organizational outcomes (Kassinis and Vafeas 2006). For example, poorer communities may be more dependent on the company for its resources (such as jobs and taxes), but as nations reach greater prosperity, their citizens demand that more attention to be paid on environmental standards and stricter enforcement of environmental laws (Grossman and Krueger 1995).

Organizational environment

The organizational environment describes the relevant physical and social factors within the boundaries of the company. These internal factors include structures, resources, operations, culture and behaviour in business activities (Capon 2009, p. 126). Such organizational activities can be divided according to various structures depending on the size of the company and the nature of business. In general, the activities may take place in different business functions, such as marketing, finance, accounting, purchasing, research & development, operations and human resource management.

Organizational studies have applied different approaches to study the internal environment, some examples being resource-based, knowledge-based and competence-based views. From the resource-based perspective, internal business environment represents the entity where tangible, intangible and human resources are acquired, and thus processed and converted into outputs that are delivered to customers (Capon 2009, p. 107). In this view, managerial attention is in finding a unique bundle of idiosyncratic resources and developing the resource base for the future (Barney et al. 2001; Grant 1996). The competence-based view concentrates on the human resources and human capabilities in selecting, developing and utilizing the other resources in companies' asset base. Managerial attention is finding unique, valuable and meaningful competences for companies' success. (Mosakowski and McKelvey 1997) The knowledge-based view focuses on companies' knowledge requirements and knowledge integration mechanisms. The approach sees knowledge as the most strategically important company resource and the issues of creating, acquiring, storing and deploying knowledge as fundamental organizational activities (Grant 1996). Overall, human resources and interactions have a central role in all three views (Barney et al. 2001; Mosakowski and McKelvey 1997).

Human resources are the critical organizational resources that make the difference in identifying, interpreting and responding to companies' external pressures. Internal factors, such as organizational culture and identity, shape both interpretations of the external pressures and organizational responses to them (Howard-Grenville 2008). Therefore, shifts in employees' and management's values can internally create pressure for change. Analyses on cultural and behavioural environment focus on better understanding the nature of the human resource, meaning the people conducting the organizational activities (see e.g. Howard-Grenville 2008). These studies investigate the cultural or behavioural aspects of individuals, groups and organizations, involving insights on skills, habits, norms, power structures, values, attitudes and worldviews.

Currently, the increasingly environmentally aware younger generation is joining the work life, shaping the value base of companies' human resources. These young employees appreciate working for an environmentally friendly organization (Senge et al. 2010, p. 111) and the prospective job applicants are more likely to pursue jobs from socially responsible firms than from firms with poor social performance reputations (Greening and Turban 2000). Companies can adopt green human resource management practices (Renwick et al. 2013; Tariq et al. 2016) to attract the young talent. The changes in values and practices indicate changes to the organizational environment. In the long run, the attitudes of the young indicate the future orientation of the whole business community (Shetzer et al. 1991).

Key Issues

As illustrated above, the internal and external influences on a company are interrelated and interdependent. The environments at different levels are not separate entities, and the interaction between the internal and external environment is a two-way influence. For example, the macro level changes in the natural environment put pressure on society and political decision-making, which have impact on companies' inputs, processes or outputs. Changes in companies' internal factors, such as available inputs, may engender further changes to customer or supplier relations at the micro level. (Worthington and Britton 2006 p. 13)

Companies can control the internal organizational changes to some extend but their chances are limited in steering the trends occurring at the market or societal level. On one hand, the influences emerge through intentional actions, e.g., when public authorities push companies towards sustainability through regulation instruments, subsidies and public procurement. On the other hand, some influences are more latent, e.g., when younger generations shape the business community internally by entering the work life with stronger pro-environmental values than their preceding generations.

Integrating environmental thinking into business studies and decision-making faces limitations in practice. The limitations stem from dominant institutional structures, norms and expectations. (Marcus et al. 2010) Business textbooks represent one example of such dominant worldviews that hinder the integration: Even though research disciplines such as ecological economics recognize that socio-economical systems are nested in nature, the shrinking parenting system,, many business strategy textbooks treat the natural environment as a comparable dimension to the economic environment. Taking steps toward the more sustainable production of goods and services requires overcoming such practical limitations.

Future Directions

The fundamental societal level changes towards environmental sustainability imply fundamental changes also within businesses. Companies are increasingly motivated to incorporate environmental sustainability into their strategic management. This way companies can build resilience towards the economic and social trends that stem from the ecological degradation.

Companies can increase their ability to adapt to the emerging changes and interruptions by proactively acknowledging and acting on them. This strategic behaviour can range from reactive and adaptive to proactive and transformative approaches (Boons 2009). The businesses can create sustainable strategies by linking economic profit essentially by creating social and ecological value instead of only mitigating the negative impacts of the existing production systems with efficiency efforts (Loorbach and Wijsman 2013). Examples of such sustainable strategies include incorporating sustainability into business models and R&D operations (Bocken et al. 2014).

Steering companies' strategic thinking towards sustainable production requires support from institutional structures in the society. Alongside regulation, education plays a crucial role in creating and shaping such institutional structures. Business schools can be understood as management education systems that socialize students into belief systems and then acting according to those beliefs (Ferraro et al. 2005; Khurana R. 2007). Supporting sustainable production requires a pedagogical shift in business and engineering schools towards a more critical and interdisciplinary view. In practice, such shift means reflection on the frameworks presented in business textbooks. Currently the frameworks rely on key metrics on economic growth, markets and return on investment. (Kurucz et al. 2014) The 21st century management education needs to be able to discuss the challenges related to climate warming, depleting natural resources and biodiversity loss, and what these challenges mean for companies.

Cross references

Carrying capacity; Circular economy; Competitiveness; Corporate social responsibility; Green finance; Sustainable procurement; Sustainable production

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PUBLICATION II

Sustainable competitiveness at the national, regional, and firm levels

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SUSTAINABLE COMPETITIVENESS AT THE NATIONAL, REGIONAL, AND FIRM LEVELS

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Synonyms

Competitive advantage; Competition; Firm-level competitiveness; National competitiveness; Regional competitiveness

Definition

The survival and success of organizations and various agents increasingly depends on competitiveness, broadly defined as the ability to compete. Competition enables the efficient functioning of markets, and adds pressure on organizations to improve their existing goods and services and innovate new ones (Berger 2008). The term competitiveness originates from the Latin word *competer*, which according to Webster's English Dictionary means involvement in a business rivalry for markets. However, competitiveness is a complex and multidimensional concept commonly applied at multiple levels, for example those of national, regional and firm. A common conception is that competitiveness is by its nature a relative notion, inherently implying the aim of competing to perform better compared to rivals in terms of for example access to resources. The meaning and relevance of the concept have been under discussion especially during the past few decades, but the debate has gained increased momentum in recent years, as the notion of sustainable competitiveness has emerged as a new research direction.

Both competitiveness and sustainable competitiveness have been defined in various ways, and though dozens of researchers from differing disciplines have contributed to their research, a consensus on the definitions has not been reached. However, following Porter (1990), many researchers do agree, that productivity is at the very heart of competitiveness (Bhawsar & Chattopadhyay 2015; Doyle & Perez-Alaniz 2017; WEF 2011). Porter defined competitiveness at the firm level as productivity growth reflected through lower costs or differentiated products enabling premium prices (Porter 1990). On a national level, some commonly cited definitions have been those of the World Economic Forum (WEF). The WEF defines competitiveness as *"the set of institutions, policies and factors that determine the level of productivity of a country"* (WEF 2011), measuring it through national determinants of competitiveness such as infrastructure, higher education and training, and technological readiness. Sustainable competitiveness, in turn, is defined as *"the set of institutions, policies, and factors which make a nation productive over the long term while ensuring social and environmental sustainability"*, and measured through e.g. management of renewable resources, environmental degradation, and access to sanitation and healthcare in addition to the original determinants of competitiveness (WEF 2015). Notably in this context, sustainable competitiveness refers to social and environmental sustainability, while previous literature has also discussed sustainable competitiveness as a time-related concept, i.e. competitive advantage is only temporary, or the organization is able to maintain or improve its competitive position. These definitions serve as a starting point for discussing the diversified dimensions of competitiveness and sustainable competitiveness.

Different levels of competitiveness

Global warming, the loss of biodiversity, depleting natural resources, pollution, and other severe problems deriving from human activities and the unsustainability of the present lifestyle have risen to political agendas globally. Consequently, nations, regions, firms, and consumers are increasingly starting to acknowledge the importance of competing and consuming in an environmentally and socially sustainable fashion.

This chapter provides an overview on competitiveness and sustainable competitiveness at different levels of analysis. One of the reasons for the lack of clear definition for competitiveness is the concept's application at these various levels of analysis, for example those of national, regional, and firm (Bhawsar & Chattopadhyay 2015). In fact, some researchers view the concept of competitiveness as applicable only for firms, while others find nations and regions better suitable. As a result, the definition and meaning of the concept are best discussed separately at each level, though the concepts are heavily interlinked. Laws, regulations, and incentives at the national level drive or hinder the development of regional and firm-level competitiveness as they create the preconditions for regions and firms to build their competitiveness. Similarly, regional politics steer and create better conditions for improved firm-level competitiveness. This chapter will first describe competitiveness at the national, regional, and firm levels, and then move on to address each of them from the perspective of competing sustainably. The measurement of the concepts and future directions are also discussed (Figure 1).

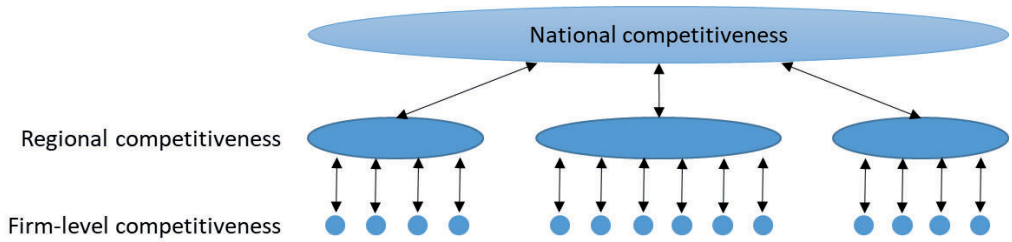

Figure 1. The inter-relations between national, regional, and firm-level competitiveness

National-level competitiveness

The reasons behind the success and prosperity of nations have been a central area of interest for researchers since the seminal works of political economists Adam Smith (1776) and David Ricardo (1817). National competitiveness has received growing interest in particular in politics and academia, despite its elusive and complex nature. The elusiveness of the concept stems from the fact that national competitiveness has no clearly defined meaning nor can be measured and captured by unambiguous indicators (Cellini & Soci 2002). The very existence of the concept of national-level competitiveness is sometimes questioned, as some researchers follow Krugman's (1994) well-known assertion that only firms, not nations, compete with each other (e.g. Cellini & Soci 2002). Krugman's argument is based on the idea that countries do not have a bottom line and do not go out of business like firms do. Additionally, international trade is not a zero-sum game, unlike the competition for market shares between companies (Krugman 1994). Others argue that nations do compete over investments and key resources, which makes competitiveness a vital aspect to analyze and consider (Camagni 2002). Regardless, politicians and governments around the world have adopted this concept as part of their vocabulary, attempting to develop policies for promoting the competitiveness of their countries at both regional and national levels (Berger & Bristow 2009).

Early theories upon which research on competitiveness has later built, were Adam Smith's (1937) theory of absolute advantage dating from 1776, and David Ricardo's (1971) theory of comparative advantage dating from 1817. Smith saw trade as a positive-sum game, where each nation could benefit from international division of labor, i.e. concentrating on what it could do best, instead of attempting to produce and manufacture everything by themselves. In Smith's view, a country had an absolute advantage over other countries in the goods in which it should concentrate. Ricardo challenged this view by coining the concept of comparative advantage. According to the theory of comparative advantage, an inferior country might not have absolute advantage in any good, but it should then specialize in the area where it has the least absolute disadvantage, enabling it to still benefit from international trade with other nations (Cho & Moon 2001, p.7).

In the 1990s, the significance and definition of competitiveness were under intensive debate. Krugman (1994) argued that focusing on national competitiveness was dangerous, possibly resulting in misguided economic policies, protectionism and trade wars. Others countered his arguments (Thurow et al. 1994). Again, the difficulty of defining competitiveness and finding descriptive measures for it hindered the debate (Cho & Moon 2001, p.22). For this purpose, Michael Porter constructed the diamond model (Porter 1990).

Porter's framework proposes four country-level factors that shape the competitive environment of companies in ways that either promote or restrain their competitiveness, determining their competitive advantage: 1) factor conditions; 2) demand conditions; 3) related and supporting industries; and 4) firm strategy, structure and rivalry. Additionally, government and chance are also viewed as significant outside variables. *Factor conditions* refer to the inputs needed to compete in an industry: e.g. skilled labor, natural resources, capital, and infrastructure. *Demand conditions* are composed of the nature of customer needs, the magnitude of demand and its growth rate, as well as the rate of internalization of domestic tastes. Thirdly, the existence of internationally competitive *related and supporting industries* play a major role in improving national competitiveness through access to components and machinery as well as expertise and cooperation in e.g. innovation. Finally, *firm strategy* and the national environment where firms are founded, managed, and organized, as well as the nature of domestic competition all have an effect on national competitiveness. Combined together, the diamond represents the interrelationships between each of the factors: the effect of one attribute often depends on the state of the others. (Porter 1990) The diamond model has been criticized over understating the government's role and not taking into account multinational activities, and it has been extended later (Rugman 1991)(Figure 2).

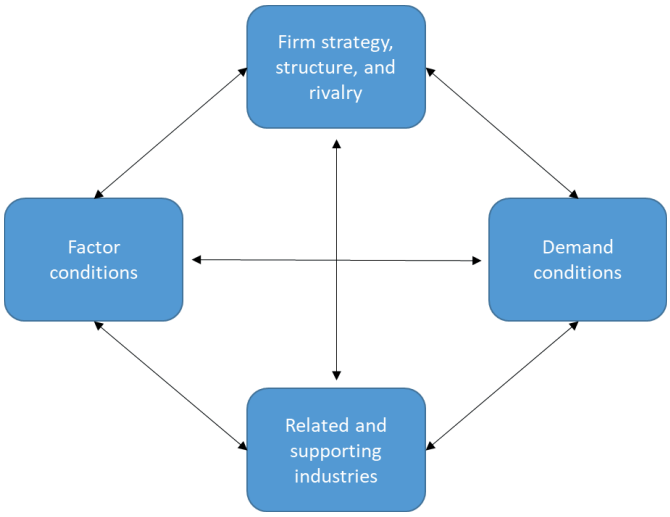

Figure 2. The diamond model depicting the determinants of national competitive advantage (Porter 1990)

Presently many authors follow Porter's assertion, and agree on the definition of competitiveness as productivity (Annoni & Kozovska 2010), though there are a number of other measures, and some view the simplest notion of productivity as output per worked man hour as too narrow. According to the productivity view, the main goal of a nation is to increase the productivity in the use of a nation's resources in order to raise the standard of living for its citizens (Annoni & Kozovska 2010).

However, some of the most publicly discussed views on national competitiveness are often not those of researchers, but those of institutions the likes of The US Council on Competitiveness, and The World Economic Forum (WEF). The US competitiveness council defines competitiveness as productivity, which is measured as output per worked man hour. Both the quality and features of the output and the efficiency of its production determine productivity (Thore & Tarverdyan 2016). The WEF, on the other hand, recognizes twelve pillars it regards as having a causal effect on national competitiveness. These pillars include institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation (WEF 2011). The two perspectives of these institutions may be seen as competing or complementary. Following the complementary view, the other one emphasizes the outputs of the competitiveness process, whereas the other stresses the explanatory factors, the inputs, of the process (Thore & Tarverdyan 2016). WEF's measurement of national competitiveness also covers the productivity perspective comprehensively and in detail (Doyle & Perez-Alaniz 2017).

Regional-level competitiveness

A stable and well-structured context at the national level improves the opportunities for competitiveness and wealth-creation at the firm level but does not create value by itself (Annoni & Kozovska 2010). Between these two layers resides the concept of regional competitiveness. Regional competitiveness is analyzed at the city, locality, urban, or territory levels, or as bloc competitiveness, such as in the EU, BRIC countries, or the Scandinavian countries (Balkytė & Tvaronavičienė 2010). A common definition for regional competitiveness is that adopted by the European Commission, where it is a region's "ability to offer an attractive and sustainable environment for firms and residents to live and work." (Annoni & Dijkstra 2013). In this definition, sustainability refers to the temporal aspect of a region being competitive in the long term (Dijkstra et al. 2011). As mentioned when defining the concepts in the beginning of this chapter, the concept of sustainable competitiveness has also been widely studied as time-related. Strategy scholars have attempted to identify ways for gaining sustainable, i.e. durable, competitive advantage to outperform competitors (Barney 1991), which is what is described by the aforementioned definition at the regional level, too.

Similarly to the competitiveness concept as a whole, regional competitiveness has also been enthusiastically adopted as one of the most important concepts of regional politics. The aim is to create policies that foster the determinants of regional competitiveness (Bristow 2010, p.4). However, like the competitiveness concept itself, the definition and operationalization of regional competitiveness are not unanimously agreed-upon. Krugman's (1994) critique on national competitiveness applies correspondingly to this concept, as there is dispute on e.g. whether regions actually compete with each other. Regions are entities that do not enter or exit markets or by themselves act, like organizations do (Boschma 2004).

The two central differences between national and regional competitiveness are (Aiginger & Firgo 2017, p.159): firstly, absolute (dis)advantages, following Smith, are more important than relative advantages, following Ricardo, at the regional level (Camagni 2002), and secondly, spatial interrelations play a more significant role, as well as the connections between different levels of networks, such as local, regional, and inter-regional (Cellini & Soci 2002). One of the central arguments of the regional competitiveness literature is that non-economic factors such as cognitive, social, cultural, and institutional ones are essential for knowledge creation, learning, and economic development (Boschma 2004). Though spatially bounded and more enduring than the

economic factors, these are less concrete: they are shaped and reproduced through the interaction between local actors in the region (Lawson 1999).

Regional competitiveness has been increasingly the focus in policy making since the 1990s, and a number of related indicators for measuring and operationalizing the concept have been developed (Bristow 2005; Boschma 2004). Regional competitiveness affects firm competitiveness in the global economy, as for instance geographical concentrations of linked industries, clusters, increase their importance, and the availability of knowledge and technology based tools vary heavily both within and between countries (Annoni & Kozovska 2010). The importance of regional competitiveness is reflected also in the notion that geographical proximity facilitates innovation and interactive learning between actors (Boschma 2005). E.g. high regional concentrations of innovation capabilities foster the national rate of technological change and increase technological innovations (Antonelli 2000). Knowledge networks, e.g. between universities and the business community, are recognized as important to the economic success and competitiveness of regions (Huggins & Johnston 2009). Attracting creative, educated workforce is one of the key considerations of regional policies in maintaining and improving a region's competitiveness (Malecki 2007).

Firm-level competitiveness

Competitiveness as a concept is most commonly applied on the firm level (Berger 2008). Firms, not nations, are understood to compete in international markets (Porter 1990), leading to the argument that competitiveness of a nation stems from companies within that nation. Thus, the competitiveness of a nation is not simply based on country-specific factors but strongly influenced by firm- and industry-specific factors as well (Cho 1998). On a very basic level, a firm is seen as competitive, if it is able to serve a market and obtain profits (Cellini & Soci 2002). Otherwise it will go out of business.

At the firm-level, especially the market-based view and the resource-based view explain how to achieve competitiveness (Berger 2008). The market-based view asserts that environmental conditions such as the structure of a market influence companies and their conduct. A firm's ability to adjust its strategy following changes in the external environment leads to different performances (Porter 1981). The resource-based view, on the other hand, sees the competitiveness of a firm as a result of successful utilization of internal resources (Wernerfelt 1984). Only certain types of internal resources act as a source of competitive advantage (Prahalad & Hamel 1990). In the firm-level competitiveness literature, competitive advantage is needed in order to achieve competitiveness. The view of productivity as a measure of competitiveness regards productivity either in terms of lower costs compared to competitors, or the ability to offer superior products in terms of customer value, justifying a premium price (Porter & van der Linde 1995).

There are numerous ways of achieving competitive advantage, and in this vein, especially temporally sustainable competitive advantage has come to be something seen as worth pursuing. The traditional framework suggests that firms may obtain sustained competitive advantages through responding to environmental opportunities and neutralizing external threats, implementing strategies to exploit their internal strengths, and avoiding internal weaknesses (Barney 1991).

Sustainable competitiveness

Sustainable development has often been broadly defined as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). As global warming, the loss of biodiversity, pollution and other crucial issues deriving at least partially from the harmful actions of companies have risen to political agendas globally, the demand for sustainable business practices by governments, regions, communities, and consumers has increased. To this end, in 2011 the WEF developed a framework for assessing the sustainable competitiveness of nations, defining sustainable competitiveness as

"the set of institutions, policies, and factors that determine the level of productivity of a country while ensuring the ability of future generations to meet their own needs" (WEF 2011). Thus, sustainable competitiveness implies ensuring economic development through being productive while utilizing natural resources in a way that future generations will be able to benefit from them as well.

The concept of sustainable competitiveness as a combination of sustainable development and competitiveness (Weiss 1993) has not been very extensively researched so far, although both notions have received ample interest as separate entities. Similarly to competitiveness, sustainable development is a broad and complex concept, for which there is no unanimously agreed unambiguous definition. Earliest views on the topic stressed the combination of environmental protection and economic growth, and this is also the stream that has received most attention from scholars (Thore & Tarverdyan 2016). More recently, scholars have started to take into account also the social aspect of sustainability (Doyle & Perez-Alaniz 2017).

Traditionally, at the firm-level the relationship between competitiveness and environmental sustainability goals has been seen as a tradeoff between costs to the industry and benefits to the society (Porter & van der Linde 1995; Wade-Benzoni 1999). However, the notion that sustainable, specifically eco-friendly practices can in fact act as a source of competitive advantage has been advanced since the 1990s (Elkington 1994; Porter & van der Linde 1995). These early articles on the positive environmental sustainability-competitiveness relationship can be viewed as predecessors to the contemporary concept of sustainable competitiveness, which comprises of economic, environmental, and socio-political dimensions (WEF 2011; dos Santos & Brandi 2014; Doyle & Perez-Alaniz 2017). In fact, from a national competitiveness perspective, according to WEF's (2012) Global Competitiveness Report 2012-2013, there might not often be any trade-off between acting sustainably and achieving high competitiveness. They conclude that many of the countries topping the competitiveness rankings also perform best in many aspects of sustainability, so aspiring for sustainable competitiveness is by no means a self-contradictory goal.

National and regional sustainable competitiveness

On a national level, sustainable competitiveness is studied through identifying related success factors and the key drivers promoting it (Balkytė & Tvaronavičienė 2010). The debate has moved on from the perspective of a tradeoff between economic and environmental factors, as notions such as circular economy and inclusive growth have supported the discussion on considering both consumption and production systems and the environment and society as a whole (Doyle & Perez-Alaniz 2017). However, the concept has so far received relatively little attention, and only a handful of articles have addressed national sustainable competitiveness (e.g. Thore & Tarverdyan 2016; Doyle & Perez-Alaniz 2017).

Nevertheless, national sustainable competitiveness is seen as an important area, since finding a suitable combination of technology and the planet's carrying capacity could enable sustainable growth in spite of the limitations on resources (WEF 2014; Wade-Benzoni 1999). National-level laws and regulations play a critical role in emphasizing sustainability and steering regions and firms towards pursuing it, and the same is true on a regional level. Currently it seems that the most notable progress on national sustainable competitiveness has been achieved at an institutional level, and very few critical research articles have been published, evaluating and testing the validity and robustness of the concept and its measures.

On a regional level, sustainable competitiveness has received almost no attention so far, with the exception of the construction of a European Regional Sustainability Competitiveness Index (RSCI) (Bilbao-Terol et al. 2017). Regional sustainable competitiveness needs more consideration, as it is likely to be one of the key areas of progress in this field in the future. Furthermore, sustainability concerns have not been addressed nearly at all on a regional level even in the institutional rankings and indices, although regional competitiveness is a key topic in current policymaking in many countries.

Firm-level sustainable competitiveness

In terms of firms, the beginning of the 1990s saw researchers engaging in a debate over whether "it pays to be green" (Porter 1991; Walley & Whitehead 1994; Porter & van der Linde 1995). The argument was that searching for environmentally superior solutions increases innovation and results in applying more efficient and effective technologies (Porter & van der Linde 1995). In addition to motivating factors such as potential competitive advantage, potential differentiation advantage and a genuine concern for the environment, legal and regulatory actions by nations and regions, as well as societal attitudes pose challenges for companies and may prompt them to innovate in an environmentally-conscious manner to improve and secure their competitiveness (Porter 1991; Varadarajan 1992). Eco-friendly actions may improve firms' efficiency and provide cost advantages (Hart & Ahuja 1996). It has, however, been questioned, if eco-friendly practices actually yield competitive advantage in the long term, and if greener products are able to compete against traditional products on their technical performance (Wong et al. 1996; Walley & Whitehead 1994). Later on, the debate progressed into analyzing the circumstances under which firms may be able to offset the costs of cleaner technology investments (Reinhardt 1998).

As sustainability has become an increasingly critical factor to consider, corporate social responsibility (CSR) practices, green innovations, and legislation have gained importance as ways of creating or prompting firms to create competitive advantage through sustainable actions (e.g. Smith 2007; Triebswetter & Wackerbauer 2008; Ambec et al. 2013). Firms are developing environmental innovations driven by regulatory pressure, customer pressure, and the quest for competitive advantages and technological leadership (Triebswetter & Wackerbauer 2008). Firms are also increasingly starting to recognize the potential negative effects of pollution, climate change, and resource scarcity, and have begun to take more of an interest in sustainability issues (WEF 2014).

The notion that well-designed policies regulating the actions of firms can actually enhance competitiveness, also known as the Porter Hypothesis (Porter 1991; Porter & van der Linde 1995), countered the until-then traditional view of environmental regulation restricting the options and profits of firms. According to the Porter Hypothesis, tighter but thoroughly designed regulation can trigger firms to innovate in ways that may offset the costs of complying with them at least partially or even more than fully. The reasons for this include e.g. the fact that regulation reduces the risks and uncertainty related to investments into environmental innovation, regulation generates pressure thus motivating innovation, and regulation points out likely resource inefficiencies and potential avenues for technological improvement. Especially in the short term, the costs of complying with the regulations may not be completely offset until the costs of new products or processes can be reduced through learning (Porter & van der Linde 1995).

More recent research on the Porter Hypothesis is divided into two parts: research on 1) whether regulation actually stimulates innovation, and 2) whether this innovation actually yields better firm performance. In terms of the first part, researchers have mostly found a positive link between environmental regulation and innovation, while the second part has led to more mixed results, although more recent studies have found more supporting results (Ambec et al. 2013). Still, discussion on the Porter Hypothesis has been heated, and especially the second part of the research has received ample criticism (see e.g. Jaffe & Palmer 1997).

What then, does the Porter Hypothesis mean, when it stresses well-designed regulation for improving competitiveness? According to Porter and van der Linde (1995), regulation should be flexible enough to maximize the opportunity for innovation and to allow the industry itself to choose its approach. It should also foster continuous improvement, instead of determining a particular technology for adhering to the standards, and there should be little to no uncertainty in the regulatory process. In general, regulations should be flexible, market-based instruments, such as emission taxes, tradable emission allowances, subsidies or performance standards, since these allow firms in pursuit of minimizing the compliance costs to innovate the technological solutions freely themselves (Ambec et al. 2013). These market-based solutions may offer powerful incentives

for firms to adopt environmentally sound processes, since they receive extra benefits for doing so (Jaffe et al. 2002). Strict technology standards, on the other hand, are problematic, since they tend to slow down or halt the development of alternative technologies that might have higher performance potential in the future (Jaffe et al. 2002).

Measurement of competitiveness

Measurement of competitiveness and sustainable competitiveness is of critical importance for two reasons. First, the measurement of the concepts enables the setting of targets and following up on them, making it possible to determine the current or past level of competitiveness, and whether that level has improved or deteriorated. Consequently, it allows comparing the achieved performance level to others, recognizing best practices and benchmarking (Berger 2011). As competitiveness is by its nature a relative concept, it implies the need to compare one's performance to others (Balkytė & Tvaronavičienė 2010). Second, how the concepts are measured is also one way of perceiving them. The variables that constitute the indices and rankings largely determine how competitiveness is perceived as and to what attributes one attempts to influence in pursuit of improved competitiveness and sustainable competitiveness. This is in part the result of significant media attention often given to these types of rankings, though their validity and reliability in steering policymaking is sometimes questioned (Berger 2011). Thus, it is undisputedly important to understand at least on a general level, how these concepts are being measured and what are the variables linked to them.

Over the past decades, a multitude of indices have been constructed aiming to capture competitiveness, sustainability, and more recently both of them combined into sustainable competitiveness. In terms of national competitiveness, WEF measures national competitiveness through Global Competitiveness Index (GCI), and International Institute of Management Development (IMD) utilizes various criteria in its World Competitiveness Yearbook (WCY). In addition, also national productivity, a nation's trade balance, labor productivity, foreign exchange rate, and foreign direct investment (FDI) have been utilized (Bhawsar & Chattopadhyay 2015).

In 2011, WEF began measuring national sustainable competitiveness through the Sustainable Competitiveness Index (SCI). They recognized that the GCI focused on short and medium term drivers of productivity, whereas sustainability requires a long-term approach, as some drivers might have a neutral or positive effect on productivity in the short term, but are not sustainable and might even be detrimental in the long term (WEF 2011). In the SCI, the 12 pillars of the GCI were retained, but organized under five separate subindices: human capital, market conditions, technology and innovation, policy environment and enabling conditions, and the physical environment. New categories for capturing sustainability include social cohesion, environmental policy, resource efficiency, management of renewable resources, and environmental degradation, which are all composed of a variety of individual variables. These include e.g. the stringency and enforcement of environmental regulations, change in forest cover and forest loss, and CO2 intensity. In terms of social sustainability, the SCI includes variables such as access to sanitation, healthcare and drinking water, extent of informal economy, and youth unemployment (WEF 2012).

Another move towards combining the measurement of economic performance and sustainability on a national level was that of the Commission on the Measurement of Economic Performance and Social Progress in 2009 (Stiglitz et al. 2009). They wanted to measure not only economic activity, but also social wellbeing and quality of life as integral parts of sustainable development.

Measures for regional competitiveness have surged since the late 1990s as policy-makers have enthusiastically adopted the concept and aim to devise policies for promoting and enhancing their region's competitiveness to attract new businesses (Berger 2011). Firms use rankings and indices to make investment plans and assess locations for new facilities (Ochel & Röhn 2006). Composite indices, which combine several input, output and outcome variables into a single measure of competitive performance, have been popular in

both national and regional competitiveness measurement. However, their construction is often challenging in terms of variable and model selection, and aggregation into a composite measure. Despite this, until the end of 2009, Berger (2011) found 217 indices related to regional competitiveness, 126 of which he classified as composite indices. Regional measures that are most often utilized include: e.g. the employment/unemployment rate in the region, the quality of labor force, innovation capacity in terms of patents and/or R&D expenditures, quality of educational institutions, and tax burden.

In terms of firm level sustainability, the triple bottom line (TBL) was one of the first attempts to capture the concept (Elkington 1997). TBL aimed at creating a reporting framework for companies to take into account both environmental and social performance, in addition to the traditionally reported financial performance. Especially the measurement of the environmental aspects of sustainability has also seen some progress, as Environmental Performance Index (EPI) and Ecological Footprint have been crafted. A few institutions have also focused on the social aspects, including European Commissions Sustainability Report, the World Bank's Worldwide Governance Indicators, and the International Monetary Fund (IMF)'s Global Financial Stability Report.

Future directions

Competitiveness and sustainable competitiveness are complex and multidimensional concepts. Considering sustainability from both environmental and social perspectives alongside economic considerations seems imperative and urgent, but so far research on the topic is rather scarce. However, as the European Commission's Europe 2020 strategy aiming for smart, sustainable, and inclusive growth (European Commission 2010), and the United Nations' 17 Sustainable Development Goals (SDGs) to end poverty, protect the planet and ensure prosperity for all (UN 2015) quite clearly demonstrate, there is growing concern over the sustainability of our current lifestyle. Aiming to improve competitiveness sustainably at the national, regional and firm levels is thus increasingly important.

Especially at the national and regional levels, new measures and research on the topic could help politicians and leaders make more informed decisions in the pursuit for sustainable competitiveness. Advances in sustainable development research could benefit the construction of even more reliable measures for sustainable competitiveness. Further research on the drivers of and barriers to increased sustainable competitiveness is needed, as identifying these could in addition to benefiting policy-making, also motivate nations, regions and firms globally to pursue it more vigorously.

The role of consumer choices and requirements is pivotal in promoting sustainable competitiveness at each of the three levels. At the national and regional levels, consumers can influence by voting and actively taking part in the formation of policies and regulations, that in turn influence the sustainable competitiveness at each of the levels. Firms and consumers also play a key role, as they have the possibility to encourage sustainable buying behavior and make the pursuit of sustainable competitiveness a truly lucrative one. If customers demand more sustainable products, it will be beneficial for firms to attempt to meet these needs and gain competitive advantage through environmentally and socially concious actions. On the other hand, firms may adapt sustainable choice architectures that encourage consumers towards environmentally sound choices (Thaler & Sunstein 2008).

The characteristics of sustainable development, competitiveness and sustainable competitiveness all require further clarification in order to attain comparable results with comparable measures on which further research can build. New theoretical models describing the relationship between sustainability and competitiveness at each of the levels of analysis is needed.

In all, especially the indices related to competitiveness and sustainable competitiveness at national and regional levels are efficient at steering policymaking and target setting, and thus their importance and influence should not be understated, and they should be taken into account more widely. Further research is needed to

evaluate the validity and robustness of the most common measures, and to construct new and reliable composite measures taking sustainability into account. In the future, evaluating and improving competitiveness should be based on more than economic metrics, as also sustainability and sustainability-related metrics will need to be more comprehensively and commonly considered.

Cross references

Business environment; Corporate social responsibility; economic competitiveness; economic growth; Environmental accounting; Local and Global Environmental Sustainability

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PUBLICATION III

Municipalities applying circular economy principles: intentions and actions in establishing biogas production systems

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PUBLICATION IV

How do companies decide? Emotional triggers and drivers of investment in natural gas and biogas vehicles

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Original research article

How do companies decide? Emotional triggers and drivers of investment in natural gas and biogas vehicles

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ABSTRACT

Management research recognizes that companies' investment decisions are driven not only by objective techno-economic models but also by emotion. Alternative fuel vehicle (AFV) investments offer an appealing context in which to study this interaction in energy source decisions, as they are influenced by a diverse set of analytical and emotional elements ranging from fuel costs to environmental values. This study examines companies' vehicle investment decision making in Finland and focuses on the interaction between objective facts and subjective feelings along with the process of choosing the vehicles' energy source.

This article is based on an interventionist case study. Switching path analysis technique (SPAT) was used to investigate companies' switches from conventional fuels to natural gas or biogas. This article contributes to the discussion of AFV adoption by unveiling companies' decision-making triggers, investment criteria and the use of information sources in the decision-making processes. The findings regarding the decision-making dynamics between these factors are transferable to other energy investments. However, the content of the triggers and drivers varies across contexts and may change over time, because vehicles as investment objects have different meanings for different organizational actors depending on their organizational role, investment use context, and personal preferences.

1. Introduction

1.1. The decision-making process is a black box

Energy research has studied energy-related behavior and decision making in the consumer and public sector, but research on such behavior in companies is rather limited [1] despite companies' large impact on the world's energy investments and use. The actual role of different information sources as objective and subjective inputs[1] in companies' energy source decision-making processes is unknown [3]. Traditionally, energy research interprets energy source choices, such as transportation fuel choices, as techno-economic comparisons (see e.g., [4–8]). These comparative calculations include market information (e.g., fuel costs) and measured factors (e.g., technological performance or emission data). These comparisons give companies suggestions about suitable and optimal investment alternatives. However, these suggestions do not necessarily lead to an investment decision according to the found optimum. Often, these calculations are simply used by suppliers to persuade customer companies to make investments. Even though a supplier can demonstrate the cost savings and environmental benefits of adopting the new energy solution, the message might not reach or convince the customer or even fit the customer's decision-making process and criteria. The customer may invest in the new technology for environmental reasons, as a pioneering project, or to differentiate itself from competitors. The mismatch of the supplier's message and customer companies' decision-making criteria can hinder the adoption of new energy technologies.

Broadly speaking, the paper builds on and extends the existing human-centered energy research, where companies' decision making is driven by individuals who collect and interpret information about the business context and related energy aspects [1; 3]. More specifically, the contribution of the article is related to the following questions explicitly outlined in the agenda of *Energy Research and Social Sciences* [9]: "What types of information and feedback are most effective at influencing energy producers and users? (Question 20 in [9])" and "How do people make decisions about energy when those decisions necessitate tradeoffs? (Question 30 in [9])" The article focuses on the dynamics of decision making, involving information about complicated phenomena

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[1] The subjective and objective inputs are distinct in this paper: Objective inputs represent the shared understanding of information in the field, including mainly quantitative facts on prices, emissions, and technologies, as well as shared calculation practices. Subjective inputs include the given meanings and interpretations of this information as well as perceptions, values, and emotional triggers. Subjective inputs shape the communication on the objective information; together, they affect the actual investment behavior [2].

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as well as other triggers and drivers of decisions.

In the context of energy source choices, alternative fuel vehicles (AFVs) represent an interesting case example of decision making. Despite the progress in developing necessary technologies and infrastructure, as well as the increased public interest in sustainable solutions, challenges remain in promoting the wider acceptance of AFVs by the general public [10]. The factors hindering the diffusion of new vehicle technologies can be understood more thoroughly by looking at the individual companies' investment decision-making processes. AFV investments represent an example of an energy source decision with multiple criteria, including various facts and valuations. In addition to the techno-economic optimum found through emission and financial calculations, subjective elements such as the vehicle brand, origin of the fuel, and maturity (e.g., pioneer nature) of the technology can also affect the investment decision. However, little is known about the actual inputs and their effects on companies' AFV investment decisions. Instead, the academic literature has studied in detail several crucial factors affecting vehicle purchases and related fuel choices in the consumer context (see e.g., [11–14]), as well as consumers' sensitivity to fuel prices (see e.g., [15–17]).

This study examines the triggers and other inputs in companies' vehicle fleet investment decision-making processes. The research objective is to empirically explore the interaction of objective and quantifiable factors (i.e., facts) and subjective emotions and values (i.e., feelings) initiating and affecting the AFV investment decision-making process. The study aims to answer the following research question: What kind of interaction between objective and subjective inputs influences companies' AFV investment decision-making processes? We used the switching path analysis technique (SPAT) [18] to trace the chain of events, triggers, and decision-making criteria that made the parties involved realize the investment. The empirical data in this paper consist of in-depth analyses of seven investment cases based on qualitative interviews of the decision makers (customers). An investment calculation tool was designed for visualizing the costs of different vehicle alternatives, thus allowing interviewees to focus on non-quantitative factors. The interviews are supplemented with extensive analyses of the technology under examination, the technology provider (case company), and the use context in Finland.

The case is not merely about Finnish AFV investments, but also about the triggers and drivers underlying innovative energy investments in a broader sense, unveiled by the SPAT analysis. In practice, the content of the triggers and drivers may vary across contexts and change over time, but the results of the paper regarding the dynamics of those decisions are transferable to other contexts. Finland is an example of a country with ambitious environmental targets. Lately, it has exerted much effort into promoting biogas production and utilization. A major part of these efforts comes from the government-owned case company (i.e., technology provider), which is currently also the largest biogas provider in the Nordic countries. There are still very few gas vehicles in Finland, and only a few companies have switched to biogas from conventional fuels. Thus, the interviewed companies represent true early adopters in the field. In decision making, Finnish companies tend to have low hierarchical boundaries and high managerial freedom to work independently [19], which affects the interpretation of the results on decision-making processes also in this study.

The remainder of this paper is structured as follows. The literature review begins with outlining the current understanding of AFV adoption. Then, it presents the existing discussions on subjective and objective inputs in managerial decision-making processes and introduces and elaborates upon SPAT as a critical incident technique to unveil the characteristics of a decision-making process. The research methodology presents the interventionist work in a case context (i.e., the engagement with the technology provider and the customer interview strategy for unveiling the decision-making processes). The findings from the technology provider and the interviews are synthesized at the end. The discussion and conclusion section presents the implications of this paper and discusses the interaction of subjective and objective inputs as well as their influence in triggering investment behavior. Lastly, this paper discusses the limitations of this research approach and provides suggestions for future studies, emphasizing the need to understand the impact of subjective inputs on energy-related decision-making behavior.

2. Literature review

2.1. Companies as early investors in alternative energy sources

The adoption of AFVs is considered one of the most important strategies to address the issues of air quality, climate change, and energy dependence on oil-exporting nations. For example, in Finland, road transportation accounts for approximately 20% of the total greenhouse gas emissions per year [20]. This figure highlights the large potential of new technologies with a lower greenhouse gas economy, especially now that their cost competitiveness compared with conventional solutions has improved.

To enable the wider adoption of AFVs, Garling and Thogersen [21] suggested three promising early adopter groups that should be targeted first with marketing actions: (a) public sector organizations, (b) "green" companies, and (c) multicar households whose transportation need, values, and lifestyle are compatible with owning an AFV. To date, the academic literature has focused on studying the consumer sector as early adopters of AFVs [22]. It has studied in detail the factors affecting vehicle purchases in the consumer context (see e.g., [11–14,23]) and consumers' sensitivity to fuel prices (see e.g., [15–17]). Moreover, there is an ongoing discussion on the aesthetic, emotional, and sensory responses to driving [24] and the effect of different automobile cultures on individuals' car driving [25]. Consumer choices are affected by the influence of both subjective and objective elements. For early consumer adopters of hybrid electric vehicles (HEVs) or electric vehicles (EVs), savings from fuel efficiency constituted only a small part of the reason for adoption [26]. Other justifications included symbolic meanings, such as a strong ethical belief in protecting the environment or opposing war, a desire to reduce dependence on foreign oil, gaining social standing though commitment to the environment, an assertion of individualism, and embracing new technology [26]. Heffner et al. [26] underlined the importance of understanding the meanings as well as their construction and communication for policy makers and others hoping to promote these new types of vehicles.

Green public procurement serves as one instrument for countries developing greener vehicle markets [21]. The procurement procedures follow legislation, formal structures, and routinized mechanisms with an underlying motivation for treating potential suppliers fairly and transparently. One way to enhance the adoption of greener vehicles in public organizations is to incorporate green criteria into the already criteria-based and bureaucratic procurement process [27]. In the European Union, the Directive on the Promotion of Clean and Energy-Efficient Road Transport Vehicles (2009/33/EC) requires public authorities to take into account the lifetime energy and environmental impacts of vehicles, including energy consumption, CO_2 emissions, and other pollutant emissions. However, recent research has noted that information asymmetries and diverging interests between the legislator ("principal") and the procurement departments ("agents") [28] have hindered AFV adoption in the public sector.

By focusing mainly on decision-making mechanisms on the consumer and green public procurement side, academic research has neglected companies as the third significant group of potential early adopters of AFVs. For example, 30% of new passenger car registrations and 91% of new light-duty truck registrations are made by companies in Finland [29]. Company cars play a remarkable role in renewing countries' passenger car fleets, as they operate with faster renewing volumes than consumer cars. In many segments such as employee cars, delivery services, and taxi businesses, used passenger vehicles are

quickly released to the after-market after a few years of intensive driving. In a rather short period, new technology becomes available to other users in the after-market with a decreased purchase price, thus lowering the barrier to trying the new technology. After being released to the after-market, the vehicles stay in use for over 10 years, with the average passenger car age being 12 years in Finland [30]. When large companies renew their vehicle fleet, one investment decision can include, for example, tens to hundreds of vehicles. In contrast, in the consumer sector, the decision usually concerns only one vehicle at a time. In comparison to the public sector, which also operates with large volumes, companies are permitted to use the decision-making criteria they like with the control procedures they find appropriate for the decision-making process [27].

For a technology provider investing in refilling infrastructure, the long-term profitability of an irreversible investment [31] is highly dependent on the demand for the new AFV technology and the development of the after-market. The supplier may invest in infrastructure by first aiming at increasing demand in the future, or users may adopt the technology, trusting that a wider infrastructure will follow. In earlier literature, this was called the chicken-egg dilemma [10,11,32]. In discussions of AFVs, the lack of wide supply infrastructure and cost- or technology-related barriers have usually been considered the primary reasons hindering wider AFV adoption (see e.g., [32,33]). For example, Romm [32] identified six major historical barriers to the success of AFVs: (a) the high first cost of the vehicle, (b) on-board fuel storage issues (i.e., limited range), (c) safety and liability concerns, (d) high fueling cost (compared with gasoline), (e) limited fuel stations (chicken-egg dilemma), and (f) improvements in competition (better, cleaner gasoline vehicles).

One may also consider other infrastructure limitations as barriers. For example, potentially higher maintenance costs (including spare parts) due to the low AFV volumes may also be considered a barrier. Both Yeh [10] and Romm [32] suggested governmental actions to overcome the adoption barriers. Based on case comparisons in eight countries, Yeh [10] named reduced fuel prices and shorter payback periods as key means to incentivize the wider adoption of AFVs in companies' vehicle fleets. Separately, in the context of biogas vehicles, the wider use of biogas in transportation is expected to be achieved through reductions in CO_2, reductions in energy taxes and other fees, and investment subsidiaries for private users [34,35]. Finding the right indicators for studying the performance of political actions might remain challenging, as large time delays exist between strategic policy actions and frequently used market penetration indicators (e.g., car sales and infrastructure expansion). The delays might limit the ability of policy makers to assess the performance of their strategy [36].

Any effective policy intervention strategy must be designed based on knowledge of the stakeholder groups, their decision making, and how the intervention would affect the same. Fri and Savitz [37] argued that the value of mitigating climate change is a public good and not one that markets can easily capture. According to them, energy transition will need more than market forces to encourage individuals and organizations to adopt and use the new technology that must be deployed. They also noted that governance structure is an essential element of the energy innovation process and that existing structures are not necessarily designed to respond to the climate problem. They called for more profound changes in individual decision making and institutional behavior. By first understanding the objective and subjective elements behind companies' investment decision processes, the current research can also support policy makers in finding appropriate ways to influence the adoption of natural gas vehicles (NGVs), or more broadly, any AFVs.

2.2. Investment decision making in companies also relies on subjective inputs

Business research has shown that managerial decision making also relies on emotion and feeling [38–41], suggesting that optimal decision making alternates between fact-driven rational thinking and feeling-driven intuition. Allowing decision making to alternate between rational analysis and intuition allows each mode to reinforce the other until an optimal judgment can be made. This optimal decision satisfies both the "hard" elements, namely the facts and figures, and the "soft" elements, namely the hunch or gut feel. However, in their study on enabling wider adoption of EVs, Garling and Thogersen [21] saw a company's energy source choice as a rather rational and analytical decision, as the barriers to adoption are related to governmental subsidiaries, perceived promotional value compared with price, and expected improvements in technology. Emotional aspects have been noted to influence companies' investment outcomes through personal experiences and contacts [42]. Emotional aspects also influence companies' tendency to avoid making the investment decision through negative feelings caused by choice difficulty [43]. In the energy sector, unconscious attitudes toward renewable versus nonrenewable energy sources influence investment behavior and attitudes to risk and return [44].

Investment decisions are often made in interactive groups that share and discuss common and individually known qualitative and quantitative information [45]. Depending on how centralized and formalized the decision-making structure is, the information flow and discussion may be hierarchic, autocratic, bureaucratic, or democratic in nature [46]. Objective and quantitative inputs of the decision-making process (i.e., facts) are based on observations of phenomena or things that exist independently of their observation. However, they are also social constructs, as something can be considered a fact only when it has been carefully recognized and established as such by a group of actors, such as a research community and R & D departments [47]. Alongside objective inputs, subjective inputs influence the decision-making process through values and emotions. Individual values determine people's preferences and likes [47], and emotions influence individuals' thought content and depth of information processing related to decision making [48]. In group processes, emotions also influence interpersonal decision making through their adaptive and interactive character [49]. While investment actions in companies require factual grounding from technical, financial, or scientific figures, facts need support from decision makers' values to create real possibilities for action. These real possibilities are recognized though communication among the decision makers [2,47].

In companies, energy source choices are planned in contexts with high uncertainty regarding future fuel prices and insufficient objective information on the life-cycle costs (LCC) of the investment. One way to address these uncertainties is to model them using real options that take into account the future flexibilities in decision making (see e.g., [50,51]). In this kind of uncertain decision-making context, managers need to trust their experiences and sensing (i.e., intuition) [39,41]. Despite the presence of intuitive and subjective elements in energy sector investments, most articles have investigated "state-of-the-art" innovations such as hydrogen fuel cells or offshore wind turbines. More attention has been paid to the hardware than to the "software" (i.e., human factors behind the technology) [9,52]. The number of empirical studies concerned with energy-relevant investment decisions remains limited [53].

Companies' energy source decisions can be understood more thoroughly by looking at their communication on the recognized possibilities and the inputs that trigger their investment action. Little is known about the objective and subjective inputs affecting companies' AFV investment decisions (except for the work of Nesbitt and Sperling [46] studying how companies' fleet decision-making structures affect AFV adoption). The effect of available technical information and fuel economy, as well as their interaction with subjective inputs, remains unknown in the energy source decision context, particularly in the AFV context.

2.3. Switching path analysis technique for explaining investment behavior and technology adoption

Earlier research has recognized that aside from technical and financial information, subjective inputs also affect the decision-making outcome and the level of energy technologies adopted. Technology adoption theories such as the widely applied unified theory of acceptance and use of technology [54] have been used to map the factors affecting technology diffusion in the consumer context. However, these theories do not explain the decision-making dynamics in organizational settings (e.g., the details of investment decision-making processes). They are insufficient for explaining the actual criteria of the final investment action and clarifying the triggers of the company's investment in the vehicle technology.

The dominant theories in marketing are based on the premise that customers follow a conscious decision-making process in choosing to purchase a good or service from a particular provider. However, it is often difficult to trace back the path of "reasoned actions" that lead a customer to end an incumbent relationship; for example, a long-term commitment to a certain provider may end without any apparent evidence of prior consideration [55]. To gain more understanding of the reasons for companies' investment actions, the supplier can investigate the actual investment behavior. SPAT is one suitable theory for studying the customers' investment behavior [18]. The key idea behind SPAT is to recognize that the switching event is affected by incidents that call for reaction, situational factors, and the influence of the active and passive roles of both supplier and customer [18]. These critical incidents are called triggers. Selos et al. [56] developed the technique further by applying SPAT to business-to-business (B2B) supplier switching processes. B2B case narratives were relatively easily translated into SPAT terminology without the need for notable sacrifices in content.

In this study, SPAT is used for investigating energy source switches in the context of company investments. A switch is considered a decision to invest in vehicles using different fuel technology from what the company used earlier. For instance, a company switches the fuel technology and fuel supplier when investing in AFVs instead of conventional fuel vehicles. SPAT can assist in identifying the switching paths that lead to the adoption of NGVs as part of the vehicle fleet—in other words, switching from conventional fuels to investing in new technology. It is also possible to distinguish the role of subjective and objective inputs in this process when understanding the triggers that lead to the investment decision.

3. Research methodology and material

3.1. Overview of research process and empirical material

This study applies an interventionist approach in a case study setting [57–59], meaning the empirical material is gathered by cooperating closely with a chosen case energy company (i.e., technology provider). The setting is supposed to yield practically relevant yet scientifically novel results. The corresponding author was engaged with the technology provider in creating investment calculation tools to be used with customers to enhance the discussion and understand the factors affecting the profitability of an energy investment. Two of the authors also conducted interviews in customer companies and in the technology network to deepen the understanding of different perspectives and internal facts and feelings in investment decisions. By interviewing (customer) companies about their actual investment cases (using SPAT analysis, see e.g., [18,56,60,61]), the researchers had the opportunity to discover the factors and triggers behind decision making and place them in a wider business context.

The empirical work reported in this paper consists of two parts: (1) designing an investment calculation tool with a focus on the vehicle's LCC with different fuels and (2) conducting interviews among the technology provider's customer companies. The interviews focused on the switches to and from using NGVs and the role and content of management accounting (MA) information in the switch.

The intentionally participatory [59] role of the researchers also came up through steering group meetings, R & D workshops, and informal meetings in which the researchers offered their expertise for the technology provider's use. This work aimed to outline a relevant research problem and then present an approach to solving this problem. The acquired information was relevant to practical questions related to the marketing strategy and infrastructure network planning. The built trust enabled the researchers to join discussions in the company almost as an insider.

The research material consisted of documented email, phone, and face-to-face discussions; customer surveys and marketing material provided by the technology provider; customer companies' Excel calculation tools; and 12 interviews. During the research period from January 2015 to August 2016, the researchers also closely followed the public discussion on AFVs. The technology provider and customer files contain all the received documents and meeting notes prepared immediately after each visit. The variety of information sources enabled triangulation of the results.

3.2. Intervention in the technology provider

The technology provider is a relatively large player in the Finnish energy industry, with a little over 300 employees and net sales of over €1.2 billion. This company offers biogas and natural gas for use as a transportation fuel, for electricity and district heat production, and for industrial processes and energy production. It offers liquefied natural gas (LNG) for use as a shipping fuel and LNG or liquefied biogas transported by truck to customers outside the natural gas pipeline network. The company is currently planning to develop the gas car infrastructure to provide NGVs to the market. The profitability of the network investment is highly dependent on the future demand for NGVs, which are not yet widely adopted. The supply infrastructure investment is a so-called irreversible investment; it is very specific and has a long lifetime. If this kind of project fails, then it will tie down corporate resources for a long time and will be difficult to get rid of at moderate costs [31].

The company searches for support in ensuring the quality of upcoming large network decisions. Assistance is welcomed in better understanding the decision-making processes on the demand side as well as in identifying and studying the institutions guiding the internal processes. The technology provider is hoping to identify meanings and assumptions affecting decision making in a business environment bearing a conventional engineering mindset. This wish was clearly stated in a meeting with the company's CEO, technology manager, development manager, business development manager, and vice president of strategy and public affairs:

> Discussing feelings [in a business context] is somewhat new for us. We are an engineer-led company and commonly used to think that we make decisions based only on facts. It would be valuable for us to comprehend that both have their place.

3.3. Interviews about investment decision making

The interview invitations were sent to relevant companies that have been involved in AFV investments. The choice of the companies was exploratory. New companies were invited and interviewed until the major results were saturated (snowball sampling). The exploratory process benefited from recommendations given by the technology provider, who was extensively aware of the business context. As a result, the interviews saturated to rich data [62] from eight companies of different sizes and industries, all with experience in NGVs (Table 1). Another private delivery company was willing to share information

Table 1
Interviewees.

Company	Title	Relation to technology provider	Interview type
Energy	Sales manager	Technology provider	Face to face
Energy	Network development manager	Technology provider	Face to face
Waste management	Head of fleet	Customer	Face to face
Delivery (state owned)	Head of sustainability Development manager Senior asset manager Heavy duty vehicle manager Asset manager Category manager	Customer	Group discussion
Delivery (private)	Chief executive officer	Customer	Face to face
Delivery (private)	Chief executive officer	Former customer	Phone interview
Church welfare foundation	Chief financial officer	Customer	Video interview
Driving school	Owner and Chief executive officer Owner	Customer	Group interview
Taxi A, NGV	Entrepreneur	Former customer	Face to face
Taxi B, NGV	Entrepreneur	Former customer	Face to face
Taxi C, HEV	Entrepreneur	No relation	Face to face
Taxi agency	Chief executive officer	No relation	Face to face

Four out of the seven interviewed companies had changed most of or their entire vehicle fleet to NGVs as the switch had occurred (Table 2). The two largest customer companies and the driving school had adopted NGVs as a pilot project. The pioneer status of NGVs also came up in the other four companies that had switched their entire fleets. The taxi entrepreneurs saw the lifetime of one car as being so short that it allowed quick trials of the technology and, if needed, switching back after a short period.

about the fuel switch but not to participate in the study. These answers served as useful background information. The interviews with the taxi agency and the taxi entrepreneur using an HEV assisted in identifying the dominant institutions in the taxi business. However, these answers were not comparable with those of other interviewees who had experience investing in NGVs. Therefore, seven companies were eventually chosen for the analysis and findings section.

The interviews had a semi-structured "storytelling" nature and followed a question list, but the interviewees were encouraged to share their views using their own words and structure. The question design followed the idea of SPAT [18], in which the interview questions led the interviewee to recall and describe the switching event. The design of the SPAT interview model guided the interviewee to answer the questions from the organization's viewpoint. Thus, this methodology provided information about the behavior in the customer organization instead of representing only individuals' viewpoints. All interviewees held positions in which they were responsible for the vehicle investment decisions in the organization.

The general focus of the interviews was on identifying the triggers and perceived critical reasons for switching. The interviews were divided into four themes: (1) background information, (2) switching situation, (3) used information during the decision making, and (4) refueling network and other potential barriers. The interviews lasted 1–2.5 h, with most lasting around 2 h.

In the first section, the interviewees described their roles in the company and how vehicles were related to company operations and to interviewees' work. The second section asked them to describe the switching situation and the factors affecting the process. This included questions on the parties and prerequisites involved, the duration of the decision-making process, and specific related events or uncertainties. The researchers asked about interviewees' prior knowledge on different fuel options and whether they independently searched for information to support their choices. Discussing the external parties affecting the decision making, the interviewees also analyzed their/their supplier's active/passive roles in initiating the switching action. The third section discussed the content and role of management accounting information sources, calculations, and measures during the switching process. This section also asked about the role of feelings and intuition during the decision making. Lastly, the interviewees analyzed their experiences in the refilling station network, its perceived effect on decision making, and other potential barriers hindering future NGV adoption.

The interviewees were not asked directly about the criteria behind their vehicle investment. Asking direct questions would probably have resulted in a standard prerecorded answer drawn from the company's annual report without any real reflection on the process. One of the interviewees commented on the use of SPAT in her own words:

> It was quite a good experience to start reflecting on this decision again. This interview has brought up for discussion many things that I didn't even remember. Some answers popped up during the next question as the interview went on: Oh, and then there was also this influential factor too!

All interviews used the same set of questions and were recorded and transcribed. This study was described in the same way to each interviewee. Two of the authors were in charge of conducting the interviews. To meet the requirements for validity, the authors used multiple sources of evidence. First, three interviews were conducted collectively, with another researcher participating as an observer. Then, the interviewer's and observer's notes and conclusions were compared. In almost all cases, the interpretations were equivalent. Another cross-check was done with one of the interviewed companies. The largest group interview included 10 participants and was recorded and documented on the spot by the observing researcher. The notes were completed by the rest of the research group and handed to the company for comments. The notes returned with only minor adjustments to word choices, so the 10-person group shared the same understanding of the key points.

The corresponding author analyzed the interviews using Atlas.ti, a program for qualitative data analyses, by coding and grouping quotations from transcribed interviews. The coding was piloted with one transcript, and the notes were cross-checked by the authors of this paper. After discussing interpretations of each selected trial quotation, the researchers agreed on the code families. The switching stories were coded in an iterative process, where new codes were created accordingly based on emerging data. The analysis first listed the emerging criteria and their hierarchy in decision making. The initial coding also recognized if the criteria was brought up in discussion as a negative/neutral/positive fact or feeling. Since facts and feelings were brought up hand in hand in the discussion, the researchers did not classify the quotations as representing only facts or feelings, as this would not do justice to the interviewees' statements. However, it was possible to identify and code the triggers from the switching story, as they were clearly stated by the interviewees.

The code families were labeled *company, investment criteria, triggers,*

Table 2
Interviewee background.[a]

Company	Personnel	Competitive advantage	Vehicle fleet	Fuel costs/revenue (approx.)
Waste management	Large	Cost-competitive and trustworthy partner supporting customers in recycling, waste management, property maintenance, and cleaning services	Confidential and large, a few heavy-duty garbage trucks are natural gas vehicles (NGVs)	15%–20% of total costs
Delivery (state owned)	24,600	Reliable, available, and high-quality service	4000 delivery vehicles, 40 NGVs, and 10 heavy-duty NGV trucks	2%
Delivery (private)	25	Combination of competitive price and quality in fast delivery and food delivery services, professional appearance, and emphasis on environmental values	20 NGVs and 3 EVs	10%
Church welfare foundation	240	Local home care service provider offering good-quality service that uses environmentally friendly and locally produced fuel	7 NGVs and 1 gasoline van	2%
Driving school	6	Driving education and licenses provided by professional teachers and good customer service	12 vehicles and 1 NGV	not known
Taxi A	2	Taxi services with good cars	NGV for two years, have switched back to diesel	7%–10%
Taxi B	2	Taxi services and some product delivery, good relations with customers, offering extra services to get more hits through taxi agency	NGV for two years, have switched back to diesel	not known

[a] Acronyms used in the table: Natural gas vehicles (NGVs), Electric vehicles (EVs).

facts, feelings, and *content and role of management accounting*. The complete Atlas.ti code list can be found in Appendix A.

4. Findings

4.1. Initial situation of the technology provider

The aim of supporting the technology provider's planning procedures provided the researchers with access to discussions on the planned supply infrastructure investment decisions. The decisions were affected by the internal processes of collective analytical thinking (e.g., internal profitability calculations, investment cost evaluations, and demand forecasts) and collective intuitive feeling (e.g., courage to take risk, faith in the product, and assumptions about the customers' decision making). Moreover, the technology providers' planning process is affected by several external stakeholders including consumers, other customers' customers, inhabitants, municipalities, and politicians (e.g., through land use planning, complaints, and regulations and taxes on motive power).

The technology provider has a certain impression of the customers' decision-making criteria for applying the AFV technology. Hypothetically, the customers make investment decisions rationally based on facts such as LCC analysis, in which fuel costs play an important role. In general, the perception is that most customers invest in NGVs owing to lower fuel costs, whereas the rest do so owing to their environmental friendliness. The company has tried to boost demand by basing its marketing on these hypothetical criteria. Rather simplified and clear Excel calculations on yearly fuel costs or total cost of ownership (TCO) have been used to demonstrate the cost benefits gained from the switch to NGVs. According to management, "If the customers were entirely rational, the facts related to the technology should speak for themselves."

The costs included in the company's initial sales tool are the monthly leasing cost and the monthly fuel cost. In sales meetings, it was important to be able to present the TCO figures for the potential customer. When only fuel costs were presented, there were doubts over whether the total costs would be lower than those of the conventional solutions. When the sales team was able to submit a leasing company's offer for all costs except fuel, the leasing price being the same for gas and conventional vehicles, it had greater success in convincing customers.

In addition to the arguments over lower TCO, the technology provider has marketed the gas ideology to companies through arguments on environmental friendliness and the domestic origin of the biogas. Furthermore, the technology provider promised the customers that the current network would be made wider in the future. The arguments seem to be proven facts in the internal discussion within the organization: Gas vehicles are seen as a clearly more cost-efficient and environmentally friendly solution owing to their lower fuel cost and CO_2 emission. However, the technology provider is not entirely sure how the customers see NGVs. Parts of the decision process have remained unclear, such as the triggers and effect of subjective inputs in the decision. One of the managers stated,

> There is some sort of a black box in the investment process that we do not understand. Something happens after the door closes and we leave the sales meeting. Even though we agree on facts during the meeting and there is interest in lower fuel costs, the deal is not always realized in the end.

To truly understand the cost structure of the customers' vehicles, the corresponding author created a comparison tool that recognized and estimated the following costs:

Fuel specific

- Capital cost
- Fuel/electricity cost

- Maintenance cost
- Motive power tax
- Vehicle tax
- Extra fuel cost (caused by the limited refueling station network and deviation from usual route)

General

- Tires
- Parking/garage
- Insurance

The calculation tool was used as a facilitator in meetings to open the discussion, question the dominant viewpoints, and enable development by shedding light on concerns and uncertainties concerning the new vehicle technology. The newly provided information also started the internal reflection on the company's pricing principles and marketing messages.

One result from the created tool was that the costs of deviations from the usual route caused by the limited supply network were minor or negligible compared with other costs. The length of the refueling round caused only infinitesimal changes in the total costs, even with long distances to the station—for example, an extra round of 20 km per refill. More significant costs arose from losses in the personnel's working time and reduced vehicle utilization rates, as vehicles did not create any revenue during refueling. The anxiety over limited infrastructure might have also emerged from being dependent on only one refueling station operator or from a station's unsuitability for daily routines. More attention should be paid to overcoming the subjective elements to widen the adoption of NGVs. The development manager reflected on the current procedures as follows:

> When we go to the first sales meeting with the customer, we usually load the potential client full with factual information. Sometimes it could work better if we went to ask about the customers' operations and genuine customer needs. Then we could see if there was any place for adopting the gas option.

4.2. Investment decisions at the customer end

Vehicle investments represented a meaningful decision for all companies. The companies provide services for transporting waste, goods, and people, which is only possible using vehicles. In the church welfare foundation, vehicles had been bought for transporting the foundation's employees between client households. The key business was to provide home care services; however, it was equally essential for the company to be able to move its personnel efficiently, flexibly, and safely.

As road transportation was important to the interviewed companies' operations, it was also closely connected to their strategies. Vehicles were linked to companies' competitive advantages by enabling cost competitiveness, reliable and flexible service, environmental friendliness, differentiation as a domestic operator using domestic fuels, and outstanding customer service by offering an effortless, clean, spacious, and safe way to travel.

The significance of NGVs for companies' operations came up through marketing, pilot projects, and funding. From the marketing viewpoint, the domestic origin of biogas and lower CO_2 emissions were seen as two positive marketing arguments for the customer companies' use. Domestic origin was considered a positive attribute, but this point was tricky in public tender invitations, in which favoring domestic origin was not allowed. Therefore, even though domestic origin was a positive feature of fuels, it could not easily be used in marketing. At the same time, the delivery companies, the welfare foundation, and the driving school used environmental friendliness as an explicit marketing argument. According to the waste management company, neither environmental nor domestic origin aspects could be seen as a source of competitive advantage as long as using heavy-duty NGVs was a more expensive solution for them. Waste management customers are not ready to pay extra for these aspects. Both taxi entrepreneurs saw that the slogan stickers communicating that the cars were "driving on domestic biogas" stimulated interest but did not lure additional customer flow at the taxi stand. All companies had made their action of investing in NGVs rather visible by using slogan stickers in marketing. The two largest companies had received funding from the government for investing in heavy-duty NGVs. The involvement of the innovation funding agency implies that the adoption of NGVs is in the early adapter or pioneering phase of the technology adoption curve.

In the larger companies, the capital invested in vehicles was mentioned as a notable asset in the balance sheet. When looking at the cost structure of the companies, fuel costs accounted for 1%–20% of the company revenue. In other words, when investing in vehicles that have better fuel economy and use less expensive fuel, companies are trying to affect this part of the costs. A decrease in fuel cost directly affects the company's key figures through an increase in gross margin, as fuel costs are usually marked as a variable cost in the income statement. All the taxi entrepreneurs mentioned staff cost as a more noteworthy expense item than fuel cost.

4.3. Nature of the vehicle investment determines the criteria

Vehicle investment can represent various aspects depending on the nature of the company's business. The discussed decision-making processes were never only fact-based, rational, and straightforward processes in which only financial facts mattered. The conversation on vehicles' importance included both fact- and feeling-based argumentation, with an emphasis on feelings.

In the large waste management company, garbage trucks were an asset that tied down a large amount of capital. In this business, vehicles were seen as machine investments, and the process was considered rational and fact driven. To improve the profitability of the machine, utilization rates and capital costs were followed closely. At the other extreme, for the taxi entrepreneurs, the vehicle represented an investment in working space and customer premises and, in some cases, even a status symbol. The taxi was a place for serving customers, which set special requirements for the back seat: It should feel luxurious, spacious, and comfortable. In the case of taxi companies, the same person worked in the roles of investment decision maker and driver. The taxi entrepreneurs were demanding, especially in terms of the driving experience, and expressed feelings attached to different car models and brands during the interviews. Taxi entrepreneur A pictured the decision in the following way: "If you spend all your working time in that driver's seat, the car should definitely be to your liking!" Table 3 summarizes how the vehicle investment was viewed in each company.

The discussions brought up several switching reasons for each customer company, and the decision criteria of each participant became clearer as the interview continued. The criteria also seemed to form hierarchies, as some criteria were more important than others for the decision maker. The hierarchical criteria levels included both fact and feeling aspects, which were constantly mixed up in interviewees' statements.

The criteria hierarchies determine the order in which the possibilities are used in action [47]. For example, when facts (e.g., available models) and feelings (e.g., preferences for certain brands) meet, a real possibility for action is born. Other real possibilities can also arise, such as choosing the environmentally friendly fuel. The hierarchy of real possibilities—in other words, the order of decision criteria—indicates which subset is chosen first. For instance, a company can choose the least expensive fuel option among the environmentally friendly vehicles that were first chosen from suitable vehicle models (see the case of the driving school). The criteria hierarchies are presented based on the researchers' own construction from interviews.

Table 3
Vehicle as an object for investment.

Company	Fuel used in NGVs	Vehicle as an object for investment
Waste management	Natural gas	Machine that maximizes utilization rate and minimizes capital cost
Delivery (state owned)	Biogas	Part of a large flexible fleet with high requirements for technical performance and ergonomics
Delivery (private)	Biogas	Environmental choice, provides means for differentiation
Church welfare foundation	Biogas	Enables operations, safety risk for users, needs to be effortless and easy to use
Driving school	Natural gas	Teaching tool, first contact for youngster to learn safe driving and experience natural gas vehicles
Taxi A	Biogas	Working space and customer premises
Taxi B	Natural gas	Working tool

Companies' operations set several specific requirements for the car model and features. For many, the use purpose was the starting point for decision making. Certain model features are essential for the vehicle to be able to serve the user's needs sufficiently. For example, automatic gears are fundamental to saving taxi drivers from back pain, a post delivery driver needs right-hand drive and front windows installed at an ergonomically low height, and food delivery sets requirements for the shape of the boot space and attached equipment. Moreover, personal preferences, such as favoring brands from German automobile manufacturers, limit the decision maker's options. In this light, finding a suitable car model with the appropriate brand, usability features, and purchase price can be a challenge even before considering the fuel type or fuel cost.

In three cases—the waste management company, the state-owned delivery company, and the church welfare foundation—safety was emphasized as a core value. The vehicles constituted a safety risk for the companies' employees through unsuitable ergonomics, accidents in traffic, and negligence when parking or during use of devices attached to the vehicle. When realized, these risks caused material and maintenance costs as well as losses in workforce and healthcare expenses. In all cases, the decision makers considered natural gas an equally safe alternative to other fuels.

Table 4 shows that there were cases in which the fuel cost did not appear in the criteria discussion at all (e.g., private and state-owned delivery companies) or came after other factors (e.g., driving school). In the state-owned delivery company, the effortless and flexible use of the fleet mattered most. Thus, parameters with a direct impact on usability, such as performance, technical features, warranty issues, and infrastructure availability, formed the top criteria in decision making.

Overall, the decision-making criteria varied across the companies. Typically, similar themes came up, but in different orders as the storytelling on switching paths progressed. The most mentioned criteria among the companies' top three themes were model features and usability, fuel/LCC, environment, personal interest/values, and infrastructure/driving range issues. One explanation for these different criteria can be drawn from the ownership structures. Entrepreneurs can effortlessly bring their personal values and vehicle preferences into the decision-making process. In contrast, state-owned companies get strict value-driven requirements for their corporate social responsibility policies from the government. Alternatively, the exchange-listed waste management company expressed its principles in the following way: "The reality is that the decision needs to be economically reasonable. And if some other good additional value is achieved on the side, it is all extra."

Table 4
Criteria for vehicle choice.[a]

Company	Fuel used in NGVs	Criteria
Waste management	Natural gas	• Safety • LCC • Technical performance/range/usability • Infrastructure • Environment
Delivery (state owned)	Biogas	• Model features, technical performance, and warranty agreements for a flexible fleet • Maintenance and refueling infrastructure density • Personal interest in environmental pilots
Delivery (private)	Biogas	• Environment, for differentiation and personal reasons • Domestic origin, for differentiation and personal reasons • Range (out of EVs/NGVs)
Church welfare foundation	Biogas	• Model features, usability, and safety • LCC savings 3. Infrastructure • Marketing value from environmental benefits
Driving school	Natural gas	• Model features • Environmental values and concerns over fine particles • Purchase price • Fuel cost
Taxi A	Biogas	• Model availability and features • Personal interest in new technologies • Fuel cost
Taxi B	Natural gas	• Fuel cost • Brand loyalty and model availability in that brand • Environmental concerns

[a] Acronyms used in the table: Life-cycle cost (LCC), Natural gas vehicles (NGVs), Electric vehicles (EVs).

4.4. Triggers of investment action

In SPAT, the decision maker can play an active or passive role in searching for information about current and possible solutions. Current and potential suppliers can play active or passive roles in convincing the customer about the benefits of the offered solutions. This influence can affect the customer's switching behavior, thus acting as an influential trigger for a switch. In addition to being an influential trigger, reactional or situational reasons can make customers change their actions [18]. Situational triggers are defined as changes in the customer's situation that cause the customer to re-evaluate the current solution. Reactional triggers are critical incidents causing a customer to switch suppliers.

After first actively searching for information or being passively used to the current situation, a fuel switch occurred in the customer companies. When describing the switching situation, namely investing in NGVs, the interviewees cited various reasons for taking action. These triggers explain why the customer company decided to switch to or from using NGVs. Table 5 summarizes the reasons that triggered the company to move from decision-making discussions into investment action.

Some of the companies emphasized fact-driven attributes when reflecting on the reasons for the switch. Facts, such as capital cost or figures predicting the vehicle's technical performance, determined whether the investment option was recommendable in the waste management company. In line with the criteria, the reason for investing

Table 5
SPAT analysis: Triggers to switch to or from NGVs.[a]

Company	Switch to/from NGVs	Trigger to switch
Waste management	To	**Influential:** The company expected lower LCC with good technical performance and had a general interest in piloting different technologies.
	From	**Reactional:** Technical problems lowered the utilization rate, and the limited maintenance network caused difficulties in operations. Technology was a big disappointment and will not be used in future investments for heavy- and light-duty vehicles.
Delivery (state owned)	To	**Influential:** Employees had interest in environmentally friendly pilot projects. **Situational:** Governmental initiatives for pilot projects and time pressure from regulation (last chance to try gas in Euro 5 type vehicles) set situational triggers for the switch.
Delivery (private)	To	**Influential:** Customer activity through interest in using NGVs for differentiation and personal activity due to valuing biogas for its domestic and environmentally friendly origin initiated the switch. **Situational:** Infrastructure and technology were available.
Church welfare foundation	To	**Influential:** The retirement of a personal contact from the former vehicle retailer enabled the open-minded consideration of different options. Chief financial officer searched actively for cost and CO_2 savings. **Situational:** Available locally produced biogas, required availability of models and infrastructure
Driving school	To	**Influential:** Because of environment and cost savings, the decision was made to keep one NGV in the fleet. Close training collaboration with the fuel supplier strengthened the investment decision.
Taxi A	To	**Influential:** Based on own active information search, the entrepreneur expected lower fuel costs, and lower taxation for NGVs; active interest in piloting combined with availability of a suitable model triggered switching action.
	From	**Situational:** No suitable models were available, and investment needed to be done before the estimated unfavorable change in taxation. **Reactional:** The entrepreneur reacted to the rumors on rising taxation
Taxi B	To	**Influential:** Expected fuel cost savings based on own active search and promises from technology provider
	From	**Situational:** Manual gears caused back problems and anxiety for quick change. The preferred model and brand was not available with automatic gears in NGVs. **Reactional:** Rumors on changing taxation caused anxiety and set a deadline for fast decision making. Switching back to fossil fuels was a reaction to the disappointment with the earlier NGVs that had higher than expected fuel consumption, which did not compensate for the higher purchase price.

[a] Acronyms used in the table: Life-cycle cost (LCC), Natural gas vehicles (NGVs), carbon dioxide (CO_2).

in NGVs was therefore the aim of achieving savings in LCC with no tradeoff with technical performance, safety, or usability. Similarly, the taxi entrepreneurs and church welfare foundation emphasized the significance of expected fuel cost savings during the switch decision. The simplest way of evaluating the cost differences between conventional vehicles and NGVs was to compare the purchase price and annual fuel costs of each fuel type. This was seen as already including the life-cycle perspective and was described as a TCO or LCC evaluation. For example, when the church welfare foundation was asked about the appropriate price difference between gas and conventional fuels, the answer was "We haven't calculated that precisely. But it must be cheaper than diesel and gasoline, as the purchase price for the vehicle is higher."

In contrast, in other companies, values and personal preferences played a clear role in directing the investment decision. The driving school viewed the NGV investment as one way to affect the company's environmental footprint through reductions in produced fine particles and CO_2 emissions. The decision of fixing one out of the 12 vehicles as an NGV was based on the combination of facts related to the emission information of each fuel type and the value of being a responsible company:

> I don't think it is advisable to drive with a diesel car in the city center area because of the fine particle emissions. You can't influence much of what is happening in the world—you are a tiny ant, but you can do your small bit for this environmental cause.

Although they are available, economic facts may not affect the decision if they are not considered as important as other values. The private delivery company saw environmental values and domestic origin as such meaningful attributes that the whole business strategy was built on using domestic biogas and wind power in transportation:

> I don't want to think about it too much [laughter], but I pay 10,000 euros extra yearly for that choice. There, now I said it. And this year the amount will be even more. We would be a different company if we talked only about fossil fuels. I can tell you that the customer can't understand the difference between the fuels. I would probably get as many customers with the fossil fuel. If I had a similar concept, it would be enough.

Personal interest in pioneer projects also seemed to affect decision making regardless of how large the company was. Ranging from the large state-owned delivery company to a taxi entrepreneur, decision makers' interest in trying new technologies and piloting alternative fuels furthered the NGV choice. In the state-owned delivery company, the operations set special requirements for the model features. As no suitable NGV models were available, some engineering curiosity was also needed. The company modified its 40 conventional vehicles to NGVs.

In summary, quantitative information such as LCC or emission information was used as input in the vehicle investment decision-making process. However, quantitative information strongly interacted with other inputs in the process. The values and decision criteria of the organization determined the role of quantitative inputs.

Four out of seven customers cited their own interest in being aware of the newest technologies and participating in pilot projects as reasons for switching to NGVs. These active customers were affected by influential triggers [55]. Situational triggers were related to governmental funding incentives by the Finnish Funding Agency for Innovation, features in vehicle models, technology and infrastructure becoming available, and competitive positions in the market. Personal relationships also mattered, as one situational trigger causing the switch was the retirement of a personal contact in the former vehicle retailer company. As the salesperson retired, it became possible to reconsider the car brand and models used.

In cases where the supplier had been active, the importance of personal contacts during sales work came up. The interviewees remembered the supplier's sales representative by name and described in detail the steps of the cooperation. The supplier, in the role of information provider, influenced the customer by talking about available models and costs as well as introducing the NGVs as an option. Customers played active roles in all the companies except the church welfare foundation and driving school, whereas suppliers played active

roles in all the companies except the taxi businesses. The state-owned delivery business did not specify the role of its suppliers.

4.5. Barriers to wider adoption of NGVs

In the cases of switching from NGVs, both taxi entrepreneurs share similar stories. The quick response to uncertainties in future taxation combined with the situation of limited vehicle model availability triggered the taxi companies to switch back to conventional vehicles. Similar reactions have been recognized in the consumer context [63], where the motivations for the switch to more energy-efficient vehicles were not detailed economic analyses but simple reactions to sharp increases in fuel prices.

The customers clearly expressed their satisfaction and dissatisfaction with NGV investment. All the companies were satisfied with their investment decision, except for the waste management company and taxi entrepreneur B. The negative experience of natural gas as a fuel can arise from several elements: In the case of the waste management company, the maintenance network was not sufficient to serve the company's needs, and the technology in heavy-duty garbage trucks was not reliable. This decreased the utilization rate and return on investment, especially when the NGV option had been considerably more expensive than the conventional one. Although the interviewee pictured the company decision making as rational and driven by financial facts, the bad experience with the pilot influenced future investments. The interviewee stated that he was not interested in passenger NGVs either, owing to the company's bad history with natural gas for heavy-duty vehicles. As the NGV technology is in different phases of development in passenger cars compared with the heavy-duty side, this argument can be considered feeling driven.

Another unsatisfied investor, taxi entrepreneur B, was disappointed with the fuel and maintenance costs of the NGV. The NGV's maintenance interval was tighter, and the promised fuel cost savings did not materialize. It is possible that the fuel cost savings caused disappointment owing to the car manufacturer's very low consumption promises compared with actual consumption levels. Alternatively, it is possible that the promised savings did exist, but they were too small in relation to the unfavorable difference with conventional solutions in terms of maintenance costs and purchase price.

Contrary to the technology provider's hypothesis, the infrastructure density seemed to be a key issue only to some customer companies. The fuel supply network was a key issue for the state-owned delivery business and had some impact on the waste management company and driving school.

Three other barriers were mentioned as equally important or even more significant in hindering NGV adoption: First, the lack of general knowledge and awareness about NGVs and their benefits hinders adoption by the general public. Second, the availability of limited vehicle models and corresponding model features is a barrier, especially in the B2B context. Vehicles are bought to serve specific needs in companies' operations, and it is not advisable to make tradeoffs with practicality for small cost savings. Problems with usability quickly overcome the benefits received from savings. Third, the price difference with diesel was considered too small, as the LCC was viewed to be the same or even lower for diesel. The cost savings compared with diesel are not large enough to compensate for the inconvenience caused by the limited model range or limited refueling and maintenance network availability.

5. Discussion and conclusion

5.1. Overcoming the barriers to investing in alternative energy sources

In practice, the study broke the technology provider's prior assumption of B2B customers being rational, fact-driven, and analytical vehicle fleet investors. The findings also explain the current understanding of the barriers to AFV adoption [32,33]. The results emphasize the importance of enhancing general awareness of NGVs as well as overcoming the chicken-egg dilemma on the vehicle model availability side to satisfy customers' diverse needs and use contexts. The chicken-egg dilemma is more of a problem on the automobile manufacturer's side than on the supply network side. NGVs are already left out of the proposed options in earlier decision-making phases; therefore, the station network does not become a problem. The availability of suitable models and features as well as a maintenance network is important for both large and small companies. As one manager in the state-owned delivery company summarized, a whole network of partners is needed to support successful adoption:

> The wider adoption of NGVs is not a result of one or two parties cooperating. Many partners are needed: It is the importer, the vehicle retailer, the maintenance supplier, and the fuel supplier that are required for the whole planned vehicle's lifetime. Otherwise, we can't take the risk of investing in them.

This message is especially essential for actors aiming at enhancing biogas utilization in biogas ecosystems, where transportation use is seen as the most favorable option in terms of achieved environmental benefits [34].

Lastly, investing in NGVs was associated with being a pioneer in the industry. The pilot status had a positive connotation in conversations. However, it can turn into a stigma or burden when aiming at boosting the wider adoption of NGVs. As long as NGVs are seen as pilot projects, they might not have a place in institutionalized investment procedures and might not become a natural part of vehicle fleets.

5.2. SPAT explains investment behavior and technology adoption

The research objective was to empirically explore what kind of interaction between objective and subjective inputs influences companies' AFV investment decision-making processes. The interaction between objective and quantifiable factors (i.e., facts) and subjective emotions and values (i.e., feelings) can be understood by looking at the triggers initiating and affecting the AFV investment decision-making process. In all cases of switching to NGVs, the influential triggers initiated the process. Either the customer company's active information search or the technology provider's activeness in information provision initiated the path of events leading to investment. As a new and not yet widely institutionalized alternative, AFVs require active informing and notifying to become recognized as investment options. The activeness on the customer side originated from customers' interests; subjective inputs such as valuing the pioneer spirit, domestic origin of the energy source, or environmental friendliness; and objective inputs such as interest in achieving cost savings.

In the switching cases, situational triggers could either hinder the investment decision or enable it to actualize. Situational objective inputs, such as available refilling infrastructure and vehicle models, interacted and coexisted with more subjective situational inputs, such as the decision maker's preferences for certain vehicle models or personal relationships with the retailer's contact person. Together, the subjective and objective inputs created a potential environment for the switch. In two cases, NGV adoption was abandoned owing to reactional triggers, initiated by anxiety (subjective) over the possibly changing taxation (objective). Overall, the objective and subjective inputs seemed to be strongly intertwined, and together, they affected the decision-making processes. The findings strengthen the viewpoints of Sovacool [64], suggesting that in business settings, energy systems are chosen for both their technical and social compatibility, and the choices are made by actors with various concerns and interests.

5.3. Energy source choices in companies' investment decision-making processes

In line with the recent understanding of managerial decision making [39,41,48], companies' energy source investments seem to follow a decision-making process influenced by both subjective and objective inputs. Prior literature has recognized the existence of subjective inputs in the energy sector, such as unconscious attitudes toward fossil fuel or renewable energy sources [44]. This research revealed subjective and objective inputs in actual energy source decision-making cases by studying companies' investment behavior using SPAT. The findings show that AFV investment in companies is a complex decision-making process guided not only by the number of filling stations, maintenance infrastructure, and residual value of the vehicle [34,35], but also by subjective, non-rational elements such as personal interest in the technology or value for domestic fuel origin, piloting, and the environment.

When making investment decisions on energy technology, the decision makers usually also fix their choice on the energy source or fuel type being used. The fuel choice affects, for example, the vehicle's technological performance, environmental friendliness through exhaust discharge, and driver safety. Technological performance includes engine power, efficiency, and durability [65]. These aspects affect a company's operations, financial performance, and emission footprint. From a company viewpoint, the energy source choice is often not related to the company's core business, and companies would rather use their resources on their core business activities [64]. The delivery companies were concerned with delivering packages to people on time, and the church welfare organization was interested in moving its employees effortlessly and safely to customers' premises. To win the cooperation (and acceptance) of people, AFVs need to be designed such that lifestyles and behaviors are not altered [64].

Although the companies expect financial value from their investments, the vehicles may be related to the peripheral activities of the companies; therefore, the decisions are made by managers who do not focus on vehicles and their technologies in their work [64]. Thus, AFVs would need to more easily fit the overall business context, values, and valuations of these managers. If AFVs represent the company's core business, then AFV investments would need to provide direct financial benefits, be in line with the company's brand, or be appealing in other ways. The technology providers would need to understand the decision-making processes [46], use context, and institutions (e.g., public opinions on certain car manufacturers) [66,67] affecting the customers to successfully promote investments in the new technology.

5.4. Conclusion and future research

The article identified the dynamics underlying the companies' AFV investment decision making, which were previously unknown to energy research. The major findings of the paper are about the triggers and drivers of innovative energy investments, unveiled by the SPAT analysis. Although the aspects brought up in individual cases are not necessarily surprising or new to the existing body of knowledge, the dynamics underlying the investment decisions are structured as triggers in a novel yet meaningful way. This enables an extensive examination of the priority and emphasis placed on individual aspects. The fuel price difference or the uncertainties related to those prices are not self-evidently major drivers of the investment decision across the cases, but in some cases, they are overshadowed by other, more subjective considerations. Unveiling the dynamics behind the investment decision making is especially important because companies' formal routines seem to affect the decision making so that the outcomes of the energy source choice can be unexpected or difficult to anticipate from the outside.

When considering the obstacles to and drivers of AFV adoption, more attention needs to be paid to the impact of subjective inputs on the investment decision. Future energy research should aim at developing a better understanding of the decision-making behavior by, for example, applying SPAT to other energy-related investments or switching contexts (e.g., solar panels on office rooftops or biogas plants in the agricultural sector). SPAT could also look at actual AFV investment cases in the public sector, where it has the potential to bring more insights into, for instance, how the roles of policy entrepreneurs [68] initiate the adoption decisions.

Finally, more research is needed to find ways to get the cost (and other financial) information message through in these settings, to provide a comprehensive view on the impacts of the AFV investments to decision-makers. Moreover, if a more sustainable energy source decision is a public good rather than a direct economic benefit for the investing company [37], then we need to find ways to integrate the indirect benefits from sustainability as recognizable and equally acceptable inputs in the decision-making processes. This could help markets capture indirect benefits from sustainability in the future. More research is also needed on the interaction of personal and shared organizational values and their role in triggering energy-related investments.

Appendix A. Atlas.ti code list

Company
- Com_Supplier
- Com_Delivery Private
- Com_Church Welfare Foundation
- Com_Driving School
- Com_Waste Management
- Com_Delivery State Owned
- Com_Taxi A
- Com_Taxi B
- Com_Taxi C

Investment criteria
- **Customers**
- ITop_Customer_ Decision Maker
- ITop_Customer_ Easiness
- ITop_Customer_ green supply chain
- ITop_Customer_ marketing
- ITop_Customer_ Savings
- ITop_Customer_ Service price
- ITop_Customer_more demand with NGVs?
- **Environmental factors**
- ITop_Env_CO2
- ITop_Env_Differentation
- ITop_Env_Fine Particle
- ITop_Env_Impact
- ITop_Env_smell/clean
- ITop_Env_Value
- **Financial factors**
- ITop_fin_depreciation
- ITop_Fin_Fuel Consumption
- ITop_Fin_Fuel Cost
- ITop_Fin_Fuel Cost difference BG NG
- ITop_Fin_leasing cost
- ITop_Fin_Life Cycle Cost
- ITop_Fin_Lifetime
- ITop_Fin_Lost revenue during maintenance
- ITop_Fin_Maintanance Cost
- ITop_Fin_Marketing agreement with Supplier
- ITop_Fin_Purchasing Price
- ITop_Fin_Regulation/Incentives
- ITop_Fin_Resale
- ITop_Fin_Stable Fuel Price
- ITop_Fin_Taxation
- ITop_Fin_revenue_loss_during_refill

- ITop_Fin_warranty
- **Fuel supply network**
- ITop_Netw_Biogas Availability
- ITop_Netw_Density
- ITop_Netw_Distance
- ITop_Netw_Location
- ITop_Netw_Maintanance Service Stations
- ITop_Netw_Refill
- ITop_Netw_Refill_Machine
- ITop_Netw_Refill_stations service
- **Fuel origin**
- ITop_Origin_Domestic
- ITop_Origin_Waste
- ITop_Origin_Verifiability
- **Supporting trends**
- ITop_Trends_Clean Cities
- ITop_Trends_Common Awareness/knowledge
- ITop_Trends_Customer Value
- ITop_Trends_Environment
- ITop_Trends_Vechicles
- **Values**
- ITop_Personal_Values
- ITop_Pilot_Pioneer
- ITop_value_environment
- ITop_Value_reliability
- ITop_Supplier_Vehicle_Personal Contact
- ITop_Tradeoff_fin and practical
- ITop_references_creating_realiability
- ITop_shareholder targets
- **Vehicle factors**
- ITop_Vehic_Driving Experience
- ITop_Vehic_Fleet
- ITop_Vehic_Model Availability
- ITop_Vehic_model_features
- ITop_Vehic_Origin
- ITop_Vehic_Range
- ITop_Vehic_Safety
- ITop_Vehic_Technical Performance
- ITop_Vehic_Used_Car
- ITop_Vehic_Volumes

Triggers

- Trig_Influential
- Trig_Reactional
- Trig_Situational
- **Influential trigger: Passivity and Activity**
- SPATIF_Customer_Active
- SPATIF_Customer_Passive
- SPATIF_Supplier_Active
- SPATIF_Supplier_Passive

Facts

- IFa_Negative
- IFa_Neutral
- IFa_Positive

Feelings

- IFeel_Negative
- IFeel_Neutral
- IFeel_Positive

The Content and Role of Management Accounting in the decision-making process

- **Management Accounting Content**
- MAC_tech and cost experience from pilots
- MAC_actual cost
- MAC_bottomline
- MAC_capital
- MAC_certificates
- MAC_CO2 emission trading
- MAC_CO2 savings
- MAC_driver_performance_meters
- MAC_fuel cost
- MAC_fuel cost difference with diff. fuels
- MAC_goal
- MAC_guideline/norm
- MAC_optimal lifetime
- MAC_payback
- MAC_price_quality_ratio
- MAC_route optimizing
- MAC_service pricing
- MAC_supplier comparison
- MAC_TCO
- MAC_technical features
- MAC_utilisation rate
- MAC_vehicle model comparison
- MAC_vehicle_ROI
- **Management Accounting Role**
- MAR_affect
- MAR_after check
- MAR_break assumption
- MAR_clarify
- MAR_comparing_CO2
- MAR_comparing_fuel cost
- MAR_comparing_vehicle_models_required_turnover
- MAR_controll
- MAR_customer relations
- MAR_customer service from supplier company
- MAR_customer service from supplier company's customer
- MAR_gutfeeling
- MAR_justifies decisions
- MAR_links actions to strategy
- MAR_makes visible and concrete
- MAR_marketing
- MAR_motivator
- MAR_neutral/reliable information provider
- MAR_not needed
- MAR_outsourced
- MAR_planning
- MAR_raporting
- MAR_recommendation for decisionmakers
- MAR_scenarios

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PUBLICATION V

Utilizing management accounting information for decision-making: Limitations stemming from the process structure and the actors involved

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Utilizing management accounting information for decision making: limitations stemming from the process structure and the actors involved

Abstract

Purpose—To be utilized effectively in decision-making processes, management accounting (MA) information should fit the business context and at the same time reflect the roles, responsibilities, and values of the actors taking part in the decision making. This study investigates the limitations for MA information utilization in decision making. In particular, the study explores limitations stemming from the decision-making process structure and the involvement of several managerial actors.

Design/methodology/approach—An exploratory case study of an energy company and its customer company illustrates the current challenges in providing and integrating MA information into decision making. The analysis is focused on the analytical and actor-based features of the decision making and thus the limitations for MA information utilization. As a part of the broader research process, the researchers facilitated a meeting in the customer company, where the actors relevant to investment decisions discussed the current limitations in utilizing MA information.

Findings—Analytical and actor-based features may take different forms in the decision making. Some relevant MA information may not be included in an organization's decision-making process structure that allows merely conventional, yet analytical, decision alternatives. At the same time, certain actors' viewpoints (such as sustainability metrics) can be excluded from the process without considering the logic behind the exclusion. The case study identified the following limitations, largely related to insufficient actor-based features in the decision making: 1) managers may lack expertise in the use of MA tools, 2) managerial interaction may lack reflection on taken-for-granted assumptions, 3) different managers may appreciate different scope, content, and timing of MA information, and 4) the process structure can ignore the required managerial viewpoints.

Research implications—This study demonstrates that both the decision-making process structure and the needs of the several actors involved may lead to limitations for MA information utilization. Although many limitations stemmed from the insufficient actor-based orientation in the case study, introducing new MA analyses and extending the validity of analytical approaches may also help overcome some of the limitations. Further research should address possibilities to 1) integrate different actors' viewpoints with MA information already in the decision-making process structure, 2) find ways to introduce MA information on unconventional decision alternatives, and 3) enable reflection among and about relevant actors with respect to decision making. These means

could lead to more effective utilization of MA information for decision making and, consequently, economically viable decisions.
Originality/value—This study addresses the limitations in MA information utilization by combining the viewpoints of analytical decision-making processes and reflective actors, and thus unveils possibilities for enhancing MA practice.
Keywords Management accounting information, Analytical and actor-based decision-making, Decision-making process, Limitations, Process structure, Actors, Reflection
Paper type Research Paper

1. Introduction

One of the key functions of management accounting (MA) information is to support managers in decision making. Depending on the uncertainties and other characteristics related to the decision-making situation, MA information may have different roles, ranging from an answer machine to serving as a source for inspiration (Burchell *et al.*, 1980). As the potential roles of MA information in decision making vary, so do the requirements for supportive MA information. It is noteworthy that MA often fails to sufficiently support managers: irrelevant or useless information is produced and supplied, or the presentation of information hinders its application (Wouters and Verdaansdonk, 2002; Hall, 2010). To better understand the requirements for supportive MA information, this study investigates (practical) limitations for its utilization in decision making.

The literature distinguishes two different approaches for utilizing MA information in managerial decision-making: analytical and actor-based (Arbnor & Bjerke, 2008; Nielsen *et al.*, 2015). The analytical approach has its roots in calculative, rational decision making, with the assumption that comprehensive MA information is available or can be made available for decision making. The approach involves stages in the analytical decision-making process from problem definition to data collection and analysis (Arbnor & Bjerke, 2008, p. 88; Nielsen *et al.*, 2015). In the analytical approach, the process stages are defined objectively on the basis of contextual variables. The desired contingency fit between the business context and the decision-making process then ensures the most effective practice (Chapman, 1997). In this approach, MA information should be utilized objectively among decision makers to analyze alternatives for a given decision (see, e.g., Thyssen *et al.*, 2006). More specifically, the literature on analytical decision making stresses the importance of cost comparisons and their importance in the final choice (Nielsen *et al.*, 2015).

An actor-based approach emphasizes interactions between participants to cover the different managerial viewpoints in the organization (Arbnor & Bjerke, 2008, p. 152). The approach engages decision participants to actively develop alternatives and to produce information to evaluate these alternatives. This approach emphasizes reviewing, discussing, and appraising modifications to the information used in the decision-making process (Nielsen *et al.*, 2015). The actor-based approach emphasizes the fact that the majority of decision-making processes involve multiple managers with different intentions (Trenca and Nørreklit, 2017) and ways of reasoning. Each participant's action is driven by his/her own way of perceiving the decision-making context (*topos*, as discussed in Nørreklit *et al.*, 2010), and the participants hold unique pieces of information designed to serve different purposes (Ang and Trotman, 2014). Even the analytical MA tools used for decision making feature value-based choices on what scope and content should be included in the tools. Thus, communication enables collaboration among participants with conflicting values, different preferences (March, 1962), and constrained information provision capabilities (Nielsen *et al.*, 2015; Cohen *et al.*, 1972). Similarly to the analytical approach, the actor-based approach can also involve systematic methodological steps aimed at the best possible choice and a functioning practice (Nielsen *et al.*, 2015 p. 77). However, in the actor-based approach, these steps emphasize interactive and reflective techniques to utilize MA information for decision making.

The two approaches for decision making may take different forms, and they may even be combined to some extent in practice. Nielsen *et al.* (2015) presented two interesting outsourcing decision making cases, one representing the analytical approach and the other one the actor-based approach, to outline the possibilities for improving decision-making practices in different contexts. By building on Nielsen *et al.* (2015), we argue that meeting the requirements set for MA information requires understanding the limitations of existing practice, which may contain features of both approaches. The need for interpretations and interactions is present in translating complex phenomena into economic calculations in the analytical approach (see, e.g., Chapman, 1997). On the one hand, producing supportive MA information for analytical decision-making processes requires reflections and interactions to genuinely support decision making; on the other hand, an actor-based approach may also sometimes benefit from thorough reflections on the comprehensiveness and objectivity of the comparisons, emphasized in analytical decision-making procedures (Arbnor & Bjerke, 2008).

Both analytical features (such as decision-making procedures or calculation sheets) and actor-based features (such as intentions or other behavioral aspects) deserve attention when discussing the utilization of MA information in actual decision-making contexts. To understand the limitations for supportive MA information in the existing practice, this study seeks to answer the following research question:

What kinds of limitations in MA information utilization stem from a structured decision-making process involving different managers?

To thoroughly understand the existing practice and its limitations, a qualitative, in-depth approach is desired. Empirically, this study is based on an interventionist case study (see, e.g., Jönsson & Lukka, 2005; Suomala *et al.*, 2014; Lukka & Suomala, 2014) with a focus on investment decision making within the network of a technology provider, which we refer to as the Energy Company, and its customer, referred to as the Delivery Company. The researchers were engaged in an active and close collaboration with the Energy Company (see Van de Ven & Johnson (2006) for a discussion on engaged research) to ensure their access to research data, and this engagement yielded both practically relevant and scientifically novel results. In practice, the current limitations in MA information utilization were first recognized in the Energy Company's sales function, which intended to communicate the financial impacts of investing in a particular vehicle technology to its potential customers.

Later, the antecedents of the current limitations in MA information utilization in investment decision making were identified and further elaborated upon. As a part of the broader research process, the researchers facilitated a group meeting of the managers involved in investment decisions in the Energy Company's important customer company, the Delivery Company. The meeting in the Delivery Company focused on vehicle investment decision making and discussed the role and content of MA information in the vehicle technology investment process. The group meeting served as a forum for managers' collective sense-making (see e.g., Laine *et al.*, 2016b) and reflection on the investment decision-making process in the Delivery Company. The managers also expressed their needs for new kinds of MA information in this process. Similarly to Nielsen

et al. (2015), the present study explores the use of MA information in strategically significant decisions. Vehicles and their supporting infrastructure represent strategically important investments for both the Energy Company and the Delivery Company.

This study contributes to the understanding of supportive MA information utilization for decision making and holds implications for developing better functioning MA information utilization. In particular, the insights from the Delivery Company demonstrate the different managerial needs for MA utilization for decision making. The Delivery Company's representatives had different roles, responsibilities, and expectations for the investment decision outcome. MA information must fulfill these managerial needs to bring value to the decision-making process. The Delivery Company's seemingly analytical decision-making procedure may exclude certain viewpoints that are relevant from different managers' perspectives or strategically important for the organization. The relatively narrow use of MA information in the Delivery Company serves the immediate needs of the present analytical procedure without additional reflection and dialog. Introducing more actor-based features to the decision making would enable determining whether the investment alternatives align with the decision makers' values, company practices, and economic objectives. Although many limitations stemmed from the insufficient actor-based orientation in the case study, introducing new MA analyses and extending the validity of analytical approaches may also help overcome some of the limitations. Thus, further research should address possibilities (1) to integrate different actors' viewpoints with MA information already in the decision-making process structure; (2) to find ways to introduce MA information on unconventional decision alternatives; and (3) to enable a reflection on relevant actors' values, roles, and responsibilities during the execution of the decision-making process. These actions could lead to more effective utilization of MA information for decision making and thus to more economically viable decisions.

The remainder of this paper is structured as follows. Section 2 gives an overview of the literature on MA information utilization in decision-making processes. In Section 3, the requirements set for MA information in actual decision-making processes is empirically demonstrated, and then the current challenges hindering the use of MA information in managerial decision making are elaborated in Section 4. The discussion in Section 5 focuses on the implications of the findings to further improve the understanding of MA information utilization in theory and practice. The paper ends with concluding remarks.

2. Utilizing management accounting information in the decision-making process

2.1 Approaches to the decision-making process

The utilization of MA information in organizational decision making has been addressed both from the analytical and actor-based approaches. We discuss first the analytical approach, which involves analytical stages in the decision-making process, from problem definition to data collection and analysis. The approach aims at observing and describing the decision-making situation objectively by using quantifiable terms whenever possible (Arbnor & Bjerke, 2008, p. 88; Nielsen *et al.*, 2015). This objective view of situational components is closely related to contingency theory.

Contingency theory suggests that the decision-making process should be structured on the basis of contextual variables (Chenhall, 2003; Waterhouse & Tiessen, 1978), and the contingency fit would then ensure the most effective practice (Gerdin & Greve, 2004). Contextual variables cover the external and internal conditions in which the company operates, the externals spanning the organization's operational environment, and the internals including elements such as size, strategy, and culture. The approach, at least implicitly, suggests implementing a decision-making process structure that best fits a given organizational context. While doing so, the organization enables efficient and straightforward decision making that suits its internal practices and external environment.

Contingency theory perceives MA information as a rather static tool designed to assist managers' decision making (Chenhall, 2003). Analysis on related future actions and their financial consequences is supported by MA information that should translate complex business phenomena into calculations as efficiently as possible (Chapman 1997, see Thyssen *et al.*, 2006 as a practical example). In this approach, the decision makers involved are assumed to be guided by goals derived from their roles and responsibilities (Nielsen *et al.*, 2015; Nørreklit *et al.*, 2017, p.100). Thus, the decision-making process follows a somewhat structured step-by-step path in organizations. These steps involve identifying the need for a decision, gathering information, choosing and analyzing alternatives, and taking action. However, as the business contexts evolve, so do the needs for financial analyses and metrics that would inform decision making in different ways (see, e.g., Henri, 2010; Korhonen *et al.*, 2013). Especially strategically important decision making (e.g., investment decisions) requires acknowledging alternative opportunities because the various changes in different business contexts and within organizations set pressures for decision making.

Some decision-making models question this image of decision making being a matter of structured process steps and temporally well-ordered choices. For example, the garbage can model by Cohen *et al.* (1972) proposes that organizational decision making results from a complex mixture of problems, participants, choice opportunities, and solutions. These are fitted together by timing and chance, rather than through a linear, structured process of finding a solution to a problem. This view emphasizes the fact that actors have different access to information, to defining the problem, and to the decision-making process. Actors' ambiguous preferences and limited abilities for information processing affect the decision outcome.

The actor-based approach takes a sociological orientation toward organizational decision making (Nielsen *et al.*, 2015). It calls for a focus on actors as individuals and groups in the decision-making process. These actors act and cooperate though their intentions, values, and ways of reasoning. With their constrained information processing capabilities, individual actors partly trust their own views, estimates, and judgments (Wouters and Verdaasdonk, 2002) in decision making. Intuition is especially used when there is no time, expertise, or willingness to properly analyze all the available facts (Soll *et al.*, 2015, Sadler-Smith and Shefy, 2004). The reasoning from the provided information is also affected by individual actors' unconscious attitudes (Chassot *et al.*, 2015), emotions (Lerner *et al.*, 2015; Sawers, 2005), and personal experiences and contacts (Van de Laar and De Neubourg, 2006). Additionally, interaction with other actors in the group

shapes the actions of each individual decision maker, which leads to complex joint behaviors that could not have emerged had individuals acted alone (Hasson *et al.,* 2012).

In the actor-based approach, decision making is an interactive process that adjusts to the actors' practices accordingly. The process serves as a forum for actors to express their interests related to the decision. Organizational decision making takes place in a complex or even chaotic context (Cohen *et al.*, 1972), in which internal politics on different goals, preferences, and values affect the decision making (March, 1962). The utilization of MA information is perceived to play a role in enhancing communication (Nørreklit *et al.*, 2010; Laine *et al.*, 2016a) and collective sense-making (Tillmann & Goddard, 2008; Hall, 2010) in this complex environment. MA information offers a way to help with collective sense-making and communication, especially at the boundaries of different organizational functions. MA tools help in choosing, constructing, elaborating, and communicating accounting figures (Laine *et al.*, 2016a). Decision makers communicate on the accounting figures, the possibilities derived from them, and the logic used in information generation (Nørreklit *et al.*, 2010). The presence of multiple actors in decision making also highlights the need for group discussions when identifying ambiguities regarding to the given decisions (Laine *et al.*, 2016b).

The context of organizational decision making may be characterized by both analytical and actor-based approaches. Established organizations, which our case companies represent, usually have a functioning decision-making procedure that can emphasize either the analytical or the actor-based approach. In this study, the decision-making processes are addressed by first recognizing the existence of certain decision-making process structures with given stages and responsibilities (analytical) in the organizations. Second, we recognize that managers as decision makers are individual actors with specific roles, values, and intentions (actor based). The contribution of this study, in particular, is a better understanding of what kinds of limitations these two perspectives together set for MA information utilization in practice, as well as how these limitations could be overcome in enhancing MA support for decision making. Recognizing these limitations increases our understanding of the requirements set for MA information in practice (Ahrens and Chapman, 2007) and, more broadly, the requirements for MA information supporting managerial work (Hall, 2010).

2.2 Effective utilization of management accounting information through collective sense-making

Utilizing MA information for decision making requires reflections at the individual and group levels. This study focuses on the settings where multiple managerial actors reflect upon the decision-making situation. The managers seek to make decisions as effectively as possible in their organizational contexts with the help of MA information.

Reflection refers to complex, active, and purposeful mental processes of becoming aware of meanings, exploring alternative interpretations, and engaging in dialog (Hildén and Tikkamäki, 2013). Through reflection, actors can question and evaluate their existing ways of thinking, feeling, and existing in institutions. Reflective processes are the key to maintaining continuous development both at the individual level (Schön, 1983) and in collective sense-making (Weick *et al.*, 2005), and they have been found to be central to transformational learning and managerial

practice changes (Boud *et al.*, 1985; Crossan *et al.*, 1999; Lipshitz *et al.*, 2002; Cope, 2003). In other words, reflective processes are required to overcome the practical limitations of given decision-making situations and to find avenues for the further development of supportive MA practices for decision making (see also Ahrens & Chapman, 2007).

In an organizational context, reflection is not merely an individual's internal process, but also a social one that involves dialog and negotiation (Cuncliffe, 2004; Gherardi and Nicolini, 2001). Klimoski and Mohammed (1994) proposed a concept of shared mental models to determine the specific needs of group learning (Van den Bossche *et al.*, 2011). Drawing upon collective reflection is a way to illuminate subjective mental models and shared frames of reference. Collective reflection has the potential to make visible, and thus more manageable, the hidden processes of socio-political adaptation and negotiation within organizations. However, we still lack empirical evidence involving this type of collective reflection in business organizations (Boud *et al.*, 2013; Hildén and Tikkamäki, 2013; Jordan *et al.*, 2009; Vince, 2002; 2004). Existing research on reflective processes focuses on decision making in training or high-reliability organizations, such as in hospitals, where reflective capability is considered an integral part of professional competence (Jordan, 2010). Reflective inquiry has the potential to transform the processing of MA information because of its ability to disrupt routine thinking and enable novel ideas. As argued in this study, reflections on the limitations in using MA information for decision making may pave the way for the further development of MA practices.

The following observations can be made based on the existing literature:

- Organizational decision making is a structured process with certain steps and responsibilities. This structure has been shaped by the organization's internal and external contexts (Chenhall, 2003; Waterhouse & Tiessen, 1978).
- Organizational decision making refers to interaction involving multiple actors with intentions. Such interaction sets requirements for the decision-making process (Wouters and Verdaasdonk, 2002; Laine *et al.*, 2016a).
- MA information needs to fit this decision-making context that involves actors and the process structure so that managerial decision making is influenced and facilitated (Wouters and Verdaasdonk, 2002; Laine *et al.*, 2016a).
- Integrating MA information into the decision-making process in a meaningful way requires communication and reflection on managerial needs and contextual requirements (Laine *et al.*, 2016a).

The observations made regarding the existing literature highlight the need for reflections and interactions among the actors in the decision-making process. At the same time, the literature reminds us about the fit between the decision-making process, MA information, and the business context. Despite the overall understanding of the prerequisites of an effective MA practice for decision making (Ahrens & Chapman, 2007), too little is still known on the limitations of utilizing MA information in existing decision-making practices. Decision making in practice may contain both analytical and actor-based features. More particularly, the dynamics of introducing and actually considering different managers' values and responsibilities in non-routine, yet strategically important, decisions lack attention in the MA literature (see Laine *et al.*, 2016a as an exception). Thus, the desired features of analytical and actor-based approaches for decision

making in a given context (Nielsen *et al.*, 2015) could be more thoroughly understood with the help of practical cases. Examining investment decision making and related procedures in practice would provide a new understanding of managerial needs for MA information as well as the obstacles preventing MA information from being used to address such needs.

3. Methodology

Our empirical case study examines a decision-making process between the Energy Company and the Delivery Company. The exploratory study was conducted at the boundary of the Energy Company's sales function and its largest customer, the state-owned Delivery Company, in two years, 1/2015–12/2016.

A qualitative, in-depth research approach provides a thorough understanding of the existing practice and its limitations. Obtaining data in the real-life decision-making context requires researchers' engagement with practice as interactive actors (Ahrens & Chapman, 2006). This requirement was achieved through an interventionist case study setting (Jönsson & Lukka, 2005; Suomala *et al.*, 2014) in the Energy Company and its customer, the Delivery Company. The interventionist research setting included an actor-based approach (Laine *et al.*, 2016a), as the researchers worked as active and participating actors in the case. The interventionist work enabled building an interactive dialog between the researchers and the research participants. Instead of observing the flow of events and reactions from a distance, the interventionist research provided opportunities to facilitate analyses of and reflections on the material produced by the researchers. In this case, the interventionist approach allowed the researchers to encourage managers' reflections on their responsibilities and intentions in relation to the decision-making process.

The work began with the researchers and the Energy Company jointly recognizing the current development needs for MA information utilization in the sales function. Next, we jointly identified the processes and elements hindering the utilization of the provided MA information at the customer end. The intentionally participatory role of the researcher was utilized during steering group meetings, R&D workshops, and informal meetings, in which the researcher offered her expertise to the Energy Company (Table 1). The secondary research material consisted of documented phone, e-mail, and face-to-face discussions related to investment decision-making, as well as marketing materials and customer surveys provided by the Energy Company.

Table 1: Primary and secondary research data

Research data	Input for the study
1. Case work at the Energy Company Primary: • Four formal interviews: 20/3/2015, 8/4/2015, 6/6/2016, and 1/7/2016 Secondary: • Joint creation of investment calculation tools, 1/2015–3/2015 • Internal R&D workshop: Feelings in decision making, 2/11/2015	Internal reflection on the role of MA information in customers' investment decision-making processes

• Dozens of informal meetings, e-mails, and phone calls, 1/2015–12/2016	
2. Interviews at the customer companies Primary: • Group meeting at the Delivery Company, 10/4/2015	Internal development discussion on the role and content of MA information and related managerial needs in vehicle investment decision making
Secondary: • Nine interviews at other customer sites: 27/3/2015, 5/4/2015, 7/4/2015, 16/4/2015, 16/4/2015, 21/4/2015, 26/5/2015, 7/3/2016, 25/4/2016	Reflection on the desired role of MA information in decision-making processes

The researchers conducted simultaneous interviews at the Energy Company, its customer companies, and within its technology network (Table 1). The interviews helped deepen the understanding of the different perspectives affecting MA information utilization during investment decision making. The researcher could discover the actual role and content of MA information during the process by interviewing the companies about their experiences in switching to new vehicle technologies. The information acquired during the customer interviews had practical relevance for the Energy Company because it helped in its marketing strategy and infrastructure network planning.

The interviews at the Energy Company and the group meeting at the Delivery Company (Table 2) served as the primary data for the analysis. The group meeting worked as an intervention on the Delivery Company's investment practices by offering a forum for internal development. When we called the Delivery Company's Quality Manager to introduce the topic "facts and feelings behind gas vehicle investments in companies," the manager's spontaneous response was enthusiastic. The invitation resonated with the manager's thoughts on the theme being topical in the organization and requiring more collective reflection. The topic required discussion with other decision participants from different functions. The Quality Manager saw the group meeting as a forum to introduce the topic to other managers and recognize how each manager's work was related to vehicle investments. Therefore, the intervention initiated by an interest in theoretical contribution had immediate links to practical development (see Lukka & Suomala, 2014 and Lyly-Yrjänäinen *et al.*, 2017 on intellectual virtues in interventionist research). In other words, the intervening researchers worked as boundary subjects (Laine *et al.*, 2016a) when offering a discussion forum for the managers working in the Delivery Company's different functions, and quite essentially, the research data represented a rather authentic interplay between the different managerial actors involved in the decision-making process.

This particular Delivery Company was chosen because of its large fleet, consisting of more than 1000 vehicles, indicating that it was likely to have established investment procedures. In addition, vehicle investment decisions consider sustainability, operational efficiency, and profitability targets, all of which partially overlap in managers' responsibilities. The Delivery Company has officially committed to considering environmental aspects in its procurement, subcontracting, and investment decisions, and has established an official sustainability agenda aimed at reducing its

CO_2 emissions by 30% by 2020. It is voluntarily compensating for its carbon emissions, and it recently announced a target of 40% of its vehicle fleet running on alternative fuels.

Table 2. Interviewed managers at the Energy Company and the Delivery Company

Company	**Title**	**Relation to the case company**	**Interview type**
Case Company	Sales Manager	-	Face-to-face interview
Case Company	Network Development Manager	-	Face-to-face interview
Case Company	Head of Business Support, Strategy	-	Face-to-face interview
Case Company	Business Controller	-	Face-to-face interview
Delivery Company	Head of Sustainability, Development Manager, Senior Asset Manager, Heavy Duty Asset Manager, Asset Manager, Category Manager, four researchers	Customer	Group meeting

The group meeting consisted of the following four themes:

- An overview of the business context and decision-making process: The company representatives explained the significance of the vehicle fleet and its role in company operations. They also discussed their roles, interests, and responsibilities in the investment decision-making process.
- An example of investment decision making: The investment decision-making procedure was thoroughly examined by describing the recent switch to the new vehicle technology. This part of the discussion focused on the criteria used, the influence of external parties, and the uncertainties during the switching decision.
- The role of MA information in decision making: The company representatives discussed the content, role, and sources of MA information in the decision-making process. They also reflected on their use of MA information during the switch.
- Refueling infrastructure as a specific example of the technology switch: The representatives explained the details of the current refueling station network and what potential barriers they saw for the new technology.

Each interview and meeting lasted, on average, for two hours. The interviews and the group meeting were recorded, transcribed, and coded using Atlas.ti, a program for qualitative data analysis. The researchers conducted the group meeting at the Delivery Company collectively to

enable them to observe and document the meeting as it happened. Afterward, the observers compared notes and conclusions, and the interpretations were extremely similar. Additionally, a member check (Creswell and Miller, 2000) was conducted with the Delivery Company representatives. The meeting participants reviewed the documented notes, and the notes came back with only minor adjustments in terms of word choice.

4. Exploring the utilization of management accounting information in practice

4.1 Use of management accounting information for the customer company's decision-making process

This section first presents the Energy Company and its current assumptions regarding its customers' MA information use in decision-making. After that, the Energy Company's important customer, the Delivery Company, is analyzed more closely. We investigate the Delivery Company's decision-making process by looking at the analytical and actor-based features in the process. These discoveries unveil the limitations of utilizing MA information in a real-life decision-making context. Section 5 further elaborates upon the several practical limitations identified in the case study.

The Energy Company plans to make large investments in refueling infrastructure to find new distribution channels and markets for its products. The profitability of the infrastructure investment is highly dependent on the future demand for a new alternative fuel vehicle technology. The technology has not yet been widely adopted, but successful business-to-business sales work can increase the demand in the future. Companies' vehicle investments play a significant role in renewing national vehicle fleets and shaping the after-market for used vehicles. For example, in Finland, companies create 30% of new passenger car registrations and almost all new light-duty truck registrations (The Finnish Information Center of Automobile Sector, 2016).

Currently, the Energy Company's sales function is working to promote the adoption of a new vehicle technology. The Energy Company's previous business-to-business customers have mainly represented electricity producers and manufacturing industries. Now, the new vehicle technology is being promoted to other industries as well, such as delivery operators. The Energy Company's sales function is driven by an assumption that most of its customer companies consider vehicle investment decisions based on lower fuel costs. A few customers are assumed to invest in new technology because of lower CO_2 and fine particle emissions. Marketing arguments speak for the *profitability* of the technology, with the assumption that customers' investment decisions are made based on MA tools and facts, such as life-cycle cost (LCC) analysis or, more specifically, fuel cost comparisons. The sales function has focused on demonstrating a good factual grounding for investment action when justifying the decision based on *profitability* and *sustainability*. Customers' decision-making processes could lead to choosing the Energy Company's new technology if the reasoning followed facts on *profitability* and *sustainability* logically and analytically. According to the sales manager,

> If the customers were entirely rational, the facts related to the new technology should speak for themselves.

The marketing arguments related to *profitability* and *sustainability* seemed to be treated as proven facts in the internal discussions. The company representatives viewed the new vehicle technology as a more cost-efficient and environmentally-friendly solution compared with conventional solutions. However, parts of the customer companies' decision processes have remained unclear to the Energy Company, and the assumption on *analytical reasoning* has been questioned lately. Using other approaches to customers' decision making, such as the actor-based approach, is also possible. The actual role that MA information plays in the final investment decision in unknown, according to the sales manager:

> There is some sort of a black box in the investment process that we do not understand. Something happens after the door closes and we leave the sales meeting. Even though we had agreed on the facts during the meeting and there was interest in lower fuel costs, the deal does not always get realized in the end.

The researchers facilitated the company representatives' reflections on customers' decision-making processes. Internal development work questioned shared assumptions on how customers reasoned about their investment actions, such as the belief that fuel cost was the main factor prompting customers to invest in the new technology. The joint internal development work included creating LCC analyses on different vehicle fuels, which facilitated reflections on the *profitability* of the technology. The work also included holding an internal R&D workshop on feelings affecting decision making, which questioned the assumption on *analytical reasoning*.

The internal reflections triggered the company's interest in studying the actual role of MA information in its customer companies' decision-making processes. To what extent does the MA information provided (e.g., financial figures, CO_2 emission factors, and technical performance indicators) guide customers' decision making, and how is the utilization of MA information hindered? An interview round (Table 1) was organized to better understand the reasons behind customers' switch in vehicle technology.

After clarifying and identifying the role of MA information utilization in its customers' investment decision-making processes, the Energy Company could gain new knowledge to positively affect customers' willingness to switch to the new technology. Extending the provision and use of MA information among all parties involved may positively affect a company's central processes and future investments. Next, the utilization of MA information for decision making is analyzed at the Energy Company's customer, the Delivery Company. The limitations in utilizing MA information in the decision-making process are also analyzed more closely by looking at the process structure and different managerial viewpoints involved.

4.2 Customers' organizational goals for decision making

The Delivery Company operates a large vehicle fleet of over 1000 vehicles, less than a hundred of which are alternative fuel vehicles. The company has been operating with a large fleet for many decades, indicating that it has established investment decision-making practices and process structure.

During the past decade, digitalization has shaped the Delivery Company's operational environment in postal and package delivery. The company is partly operating in a regulated natural monopoly, which means that it has to meet service quality standards stipulated in national and EU postal legislation. Simultaneously, the company is competing with private companies offering other courier, shipping, and packaging services. Postal and package delivery has changed remarkably because of decreasing mail volumes and the growing demand for online shopping delivery. These decreasing volumes have set requirements for achieving savings and ensuring the *profitability* of the business. The vehicle fleet needs to adjust to changes in operations while also meeting *efficiently* and profitably the duties set by regulations.

The Delivery Company has officially committed to considering environmental aspects in its procurement, subcontracting, and investment decisions. It has established an official *sustainability* agenda aimed at reducing CO_2 emissions, and is voluntarily compensating for its carbon emissions. Recently, it has also announced a target of 40% of its vehicle fleet running on alternative fuels in the future. The Head of Sustainability expressed her concerns about current investment practices and the challenges of reaching their sustainability goals on time:

> We have a pretty ambitious goal of reaching 30% CO_2 savings by 2020. It looks a little bad at the moment, as with these our current actions and operations, we are not going to achieve the goals. Then, we will have to state in public that we need to lower our goals or take more action. This is the specific part for which I join the discussion. In general, CSR is a collaboration between support functions, procurement, and operations, so we now have the right people around this table to discuss the topic. It is fun to do this sort of more systematic exercise about this so that all viewpoints are taken into account.

The changing internal and external conditions put pressure on the Delivery Company to update its current investment criteria and decision-making process. The Asset Manager summed up the situation that the changing conditions required decision outcomes that meet the *sustainability* goals while allowing *flexible* vehicle use in operations:

> All in all, this is a new situation for us. Our operations and sustainability values are in transition, and the vehicle fleet needs be more flexible to adjust to these changes in the future.

4.3 Current decision-making process structure

The current decision-making process at the Delivery Company seems to follow a sort of analytical process structure. The current vehicle investment process is applied twice a year (Figure 1). The investments follow a bureaucratic decision-making process, meaning that several people at different organizational levels, instead of a single decision maker, influence the decision, with the final choices are subject to formal authorization. The process follows a structured step-by-step path that involves forecasting the need for a decision, specifying criteria, gathering and analyzing information in a Total Cost of Ownership (TCO) calculation, preparing a proposal on the chosen alternatives, creating tender invitations for the fixed alternatives, taking action, and obtaining feedback from operations.

The Category Manager elaborated on the process stages:

We do pretty large analyses for demand forecasts every five years. These are such significant investments that the decisions are introduced to the Board each year, according to the company's decision-making principles. The decisions also need to make it through the normal conditions, certain decision-making levels, before they can even reach the Board.

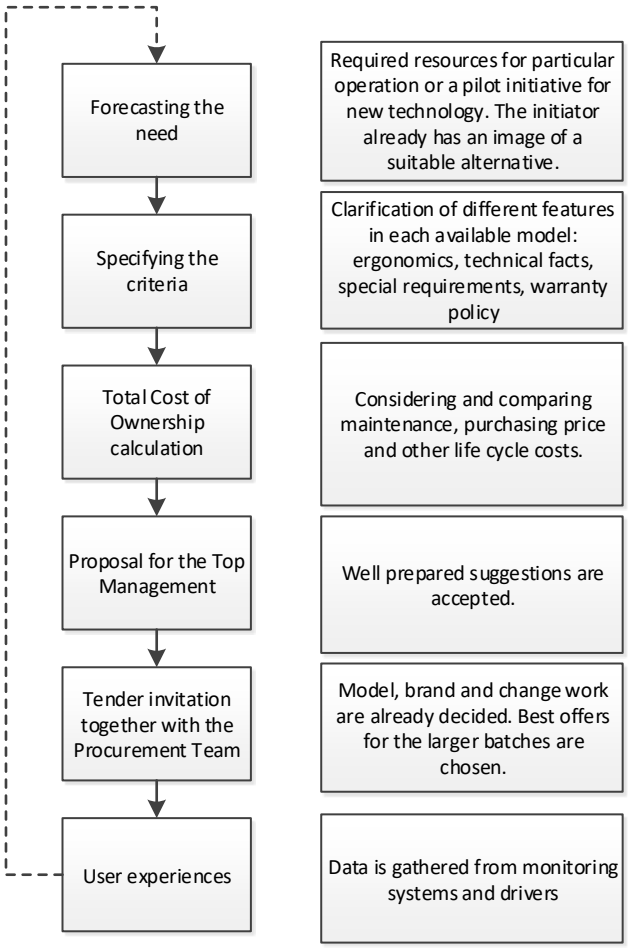

Figure 1. The Delivery Company's investment decision-making process

Fixed decision-making cycles reduce *flexibility* and *operational efficiency* in delivery operations, as the delay between the approved investment decision and the time the vehicles are available can amount to six months. This gap between the need for a vehicle and its delivery is filled by using rental or leasing vehicles. The Senior Asset Manager stated his concern about the current procedures:

> We aim to get rid of the cyclical process so that the growing business could be quickly and flexibly supported by the needed investment decisions.

While the analytical features in the decision-making process bring structure and traceability to the Delivery Company's practices, they can also have their drawbacks on other organizational goals.

4.4 The decision-making procedure hindering the utilization of management accounting information

A closer look at the stages of the decision-making process offers an interesting insight into the limitations stemming from the analytical procedure. Certain pieces of MA information might not have a natural place in an organization's decision-making procedure, although the organization has recognized the overall importance of MA information. While Figure 1 presents the overall decision-making process, Figure 2 presents the particular limitations stemming from the use of the analytical procedure in this particular decision-making context.

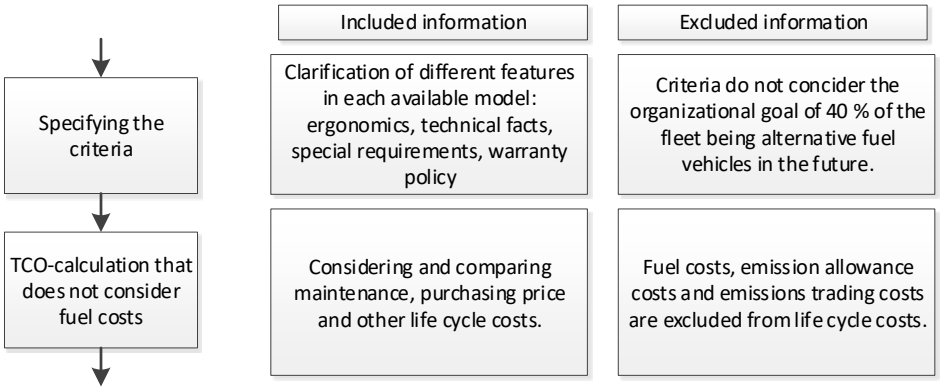

Figure 2. Process stages excluding information on emissions and fuel costs

Figures 1 and 2 show that the investment decision can go through several organization levels. It is compared, evaluated, and finally accepted without fuel cost or CO_2 emission information being considered, although both are regarded as important and are linked to organizational goals. While fuel costs are a major component of a vehicle's life-cycle costs, representatives excluded them from the TCO calculation (Figure 1). Finding correct fuel consumption figures was considered impossible; consumption varied according to too many different factors, such as the route, stops, traffic, and drivers.

The Asset Manager commented on the decision criteria used that were now mainly defined according to the needs of *operational efficiency*. The defined decision criteria did not allow alternative technologies to enter the investment discussions. These analytical features limited the use of other information sources than those directly linked to criteria. The current decision-making

tools were unable to provide alternative options for the decision making. Therefore, a separate decision-making track was used to adopt disruptive technologies outside the routine options:

> Our company guidelines have precise definitions of the features that each vehicle model should have when it is ordered from the factory. We have, for example, the following: "the vehicle's window profile needs to suit delivery operations and be approved by the company." We do not have any investment criteria for fuel origin or alternative fuels at the moment. Alternative fuel vehicles have been considered as separate decisions, but, of course, these should also be included in the criteria in the future.

Similarly, linking the costs from carbon emission compensation to vehicles' TCO calculations was considered too complicated. Therefore, CO_2 costs were excluded from the comparisons. Managers' constrained information provision capabilities hindered linking the *sustainability information* to the decision-making process. In addition to this actor-based limitation, the managers considered the CO_2 allowance costs too small to have impact on organizations' vehicle fleet decisions. The CO_2 information itself did not motivate the managers to integrate the information into the decision-making process. The Quality Manager pointed out that CO_2 compensation costs had fallen too far to have any impact on organizations' vehicle fleet decisions:

> In recent years, the cost of CO_2 emission allowances has been rather low. In fact, it has not brought us the incentive we initially thought it would—that when CO_2 costs us X euros, it would create an internal motivation to lower the costs. Lately, the allowances have been cheap.

The Energy Company may not have had an opportunity to communicate the less-expensive fuel costs or eco-friendliness of the new technology because the Delivery Company's institutionalized internal process did not require such information. Both the decision-making process and the supporting MA tools provided predictable outcomes rather than directing the decision maker to consider more sustainable or alternative solutions. These analytical features in the used criteria, process structure, and MA tools limited integrating other information into the decision-making process. Instead, the alternative solutions provided by the Energy Company were adopted through case-by-case decisions, according to the Asset Manager of the Delivery Company:

> All the alternative fuel vehicles have been handled as separate decisions. They are special cases within the larger investment decision. So far, there have not been any cases in which we had been looking for a vehicle with certain specifications and an alternative fuel vehicle popped up and was chosen. Each time, we have clearly aimed at [purchasing] them.

The Delivery Company did not utilize MA information to integrate fuel costs and emissions into the process, although these were considered important in achieving the organizational goals of *profitability* and *sustainability*. The managers found the integration too difficult, or simply had not considered its impact on the cost comparisons and decision making. The decision on vehicle type was made before preparing the calculations, and the calculations were not used to question or raise new viewpoints. Even if CO_2 and cost-friendliness pointed toward the new vehicle technology, MA information would not suggest this idea for the decision-making process. Although analytical

and logical, the procedure seemed to lack reflection on certain managerial viewpoints and even ignore some of the organizational goals.

4.5. Different managerial needs for management accounting information

While the analytical procedure and criteria can ignore information on certain managerial viewpoints, actor-based features can also limit MA information utilization. Managers have different organizational roles, which affect how they see the desired decision outcome. Different personal intentions and organizational roles set different managerial needs for MA information in the process. In their roles, different managers need or appreciate different scope, content, and timing of economic information regarding a decision.

The Delivery Company's decision-making processes involved managers from different organizational functions. The managers had different organizational responsibilities and intentions related to, for instance, the *sustainability* and *operational efficiency* of the vehicle fleet. The Head of Sustainability and the Quality Manager were responsible for *sustainability*-related development work, whereas asset management was more concerned with improving *operational efficiency* and *flexibility* of the fleet. The different expectations for investment outcome mean different expectations for the MA information regarding the decision: what information should be included in the criteria and when?

Additionally, managers viewed the preferable means to achieve the desired outcomes differently. These different ways of reasoning resulted in different managerial needs regarding the scope, content, and timing of MA information. At the Delivery Company, the managers had different views on how to achieve the *sustainability* targets while ensuring the *profitability* of delivery operations. The representatives considered two ways to integrate fuel cost and emissions-saving considerations into vehicle decisions—either integrate the considerations into the decision-making process before the investment decision or optimize operations after the decision.

The Quality Manager emphasized the importance of integrating sustainability considerations into the vehicle investment criteria before making the decision:

> We have tried to integrate corporate social responsibility themes more genuinely into our vehicle investments and our investment decision-making processes, in general, so that they would truly affect the decision making. My personal wish is that they would become even more visible there.

The Head of Sustainability wanted to integrate sustainability factors into the calculation stage of the decision-making process. MA information could serve this need by providing an appropriate decision-making template. A large set of variables, which changes over time, appears to have affected the vehicle investment decision. Making these variables visible in the decision-making process could help position the vehicle investment in the larger decision-making context:

> I would be interested in a template presenting all the variables that we should take into account when making a large-scale vehicle investment decision that goes up to the Board. We have interesting factors: a changing market, decreasing volumes, pressure from the company, and municipal customers saying that we should be greener. Therefore, which variables do you include in the calculations? How can you value CSR and eco-friendly procurement, as well as all [other aspects]? That sort of a template would be needed. In the planning

> phase, we would need material linking our vehicle fleet costs and sustainability management, as well as scenarios that take into account oil prices and costs from carbon trading, which is a continuous and major cost for us.

The Quality Manager had already tried to create such a template using the LCC perspective. However, even external experts could not provide a practical solution to the problem. The variety of different information sources available made the template complicated and thus hindered its use as a helpful and practical tool. This case illustrates the challenges involved in such a complex case and the need to create solutions using MA information. However, lack of expertise in MA tools, an actor-based feature, limited MA information utilization in practice:

> I have discussed with Motiva [a government agency offering expertise in energy and material efficiency] how to actually do life-cycle cost analysis so that we could really base our decisions on it. We did not receive a direct answer because there are too many variables involved. I personally hope that we can take a step forward with this in the future.

Contrary to the viewpoints of the Head of Sustainability and the Quality Manager, the Senior Asset Manager did not view the investment decision as a way to decrease costs and emissions. Savings received more attention when the vehicle was already in use. The operative and asset management side believed that driving performance indicators, optimizing routes, and using bicycles for delivery were more direct means of reducing the company's fuel costs and emissions. Increasing utilization rates and lengthening the lifecycles of vehicles in use had already improved the Delivery Company's vehicle sustainability, according to the Senior Asset Manager:

> We have already lengthened the life cycles by adding those vehicles with ending leasing deals to our own balance sheet and by continuing to drive them after that.

Integrating different managerial views from, for instance, sustainability aspects, to the investment decision-making process requires communication among different organizational functions. Making the different viewpoints visible at each stage in the process can help link organizational goals to vehicle decisions more firmly. MA information should therefore facilitate a reflection on how well the alternatives line up with decision makers' intentions and responsibilities, company practices, and economic objectives. One practical solution to finding an appropriate decision-making template would be to create a standardized template for the whole industry, which could agree on the included variables and their updating procedures. This standardization would help decision makers focus on the relevant variables, thus enhancing investment practices within the industry.

To articulate the vehicle solution by using MA information (such as TCO, fuel cost, or CO_2 compensation savings), the Energy Company's message needs to appeal to decision makers' values, intentions, and responsibilities. In practice, this sales work would include delivering suitable MA information and/or tools to the Quality Manager and the Head of Sustainability, as they have already emphasized their commitment to sustainability. The Energy Company should create an investment calculation template that considers the CO_2 savings gained with the decision.

This would help with integrating the beneficial MA information into the decision-making process. Finally, the Delivery Company should reinvent its decision-making process structure to include sustainability considerations. This redesign would include persuading the Asset and Procurement Managers to consider fuel and emission savings prior to the actual investment decision, not only during operations.

5. Discussion

5.1 Limitations in the utilization of management accounting information

The aim of this study was to explore *what kinds of limitations in MA information utilization stem from the structured decision-making process involving different managers.* The case analysis focuses on identifying and reflecting upon the analytical and actor-based features of the decision-making in order to unveil such limitations. The case findings suggest that analytical and actor-based features may take different forms in the decision making, and that several practical limitations can hinder MA information utilization. Some relevant MA information may not be included in an organization's decision-making process structure that allows merely conventional, yet analytical, decision alternatives. At the same time, certain actors' viewpoints (such as sustainability metrics) can be excluded from the process without considering the logic behind the exclusion.

We use Figure 3 to structure the discussion on these limitations related to the analytical and actor-based features of decision making (Nielsen *et al.*, 2015; Arbnor, & Bjerke, 2008). The decision-making process in Figure 3 presents a certain process structure with given stages (steps 1–n). Different groups of managers are involved in each stage, as represented by dashed lines. These managers have different organizational responsibilities related to the whole process or to a specific stage. Essentially, the managers as decision makers are individual actors (a) with values (Nørreklit *et al.*, 2010) and intentions (Trenca and Nørreklit, 2017). MA information is utilized for collective sense-making (b) at the boundaries of different organizational functions (Laine *et al.*, 2016a). In this interaction, the managers reflect on how well the used MA information includes viewpoints regarding their responsibilities and perceived organizational goals (c). Such a reflection evolves and may take different forms during the decision-making process, as the configuration as well as the roles and responsibilities of the different managers may evolve along with the process (d).

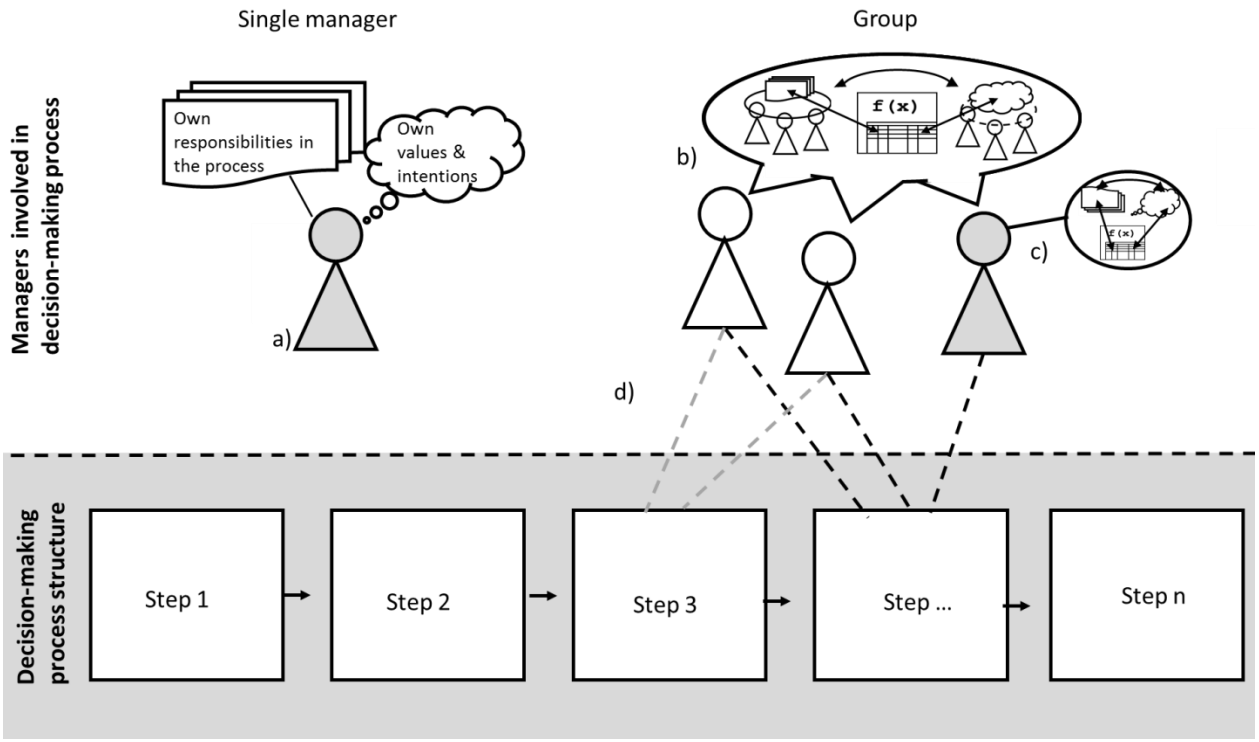

Figure 3: Utilizing MA information for decision making: limitations stemming from the process structure and the managers involved, developed based on the works of Nørreklit *et al*. (2010) and Nielsen *et al.* (2015).

The case study represents a decision-making setting with a well-established decision-making process featuring multiple managerial actors in different roles. The following limitations in MA information utilization were recognized based on the case study in the Energy Company and the Delivery Company:

First, a *lack of expertise in MA tools* hinders managers' ability to link their (or other managers') viewpoints to decision making (a). Managers' constrained information provision capabilities can hinder converting managerial responsibilities and individual intentions into financial terms. Obviously, the overall limitations of human beings in including all the possible aspects into a decision-making situation, such as translating complex phenomena into calculations (Chapman, 1997), always apply. However, the case study findings reveal that decision making featuring multiple managerial actors with different viewpoints may lead to situations in which the most important factors from certain managers' viewpoints become excluded. Excluding these viewpoints from the calculations limit the use of MA information as an "ammunition machine," as in Burchell *et al.* (1980). From the analytical decision-making perspective, this limitation may hinder the validity of MA analyses and thus their utilization. However, this limitation in the case study was largely related to the insufficient involvement of and the reflections among the actors with respect to the relevant MA information.

In the case study context, although fuel costs and emission allowances were considered as strategically important information, they were not utilized in the decision-making process. The Delivery Company representatives lacked the capabilities and resources to convert sustainability information into financial terms. Individuals in the decision-making group called for integrating such information into the decision-making process, but they lacked a suitable template for the integration. On the other hand, including strategically important non-financial information, such as the CO_2 emissions of the vehicle fleet, into the decision-making process did not have the desired steering impact toward alternative technologies. Individual managers need to obtain expertise in using MA tools so that they can link their strategic aims to the decision-making process in financial terms (Nielsen *et al.*, 2016). For example, finding ways to integrate sustainability themes to the decision-making process requires knowledge of management accounting tools.

Second, *managerial interaction can lack reflection* on taken-for-granted assumptions, or exclude discussions on unconventional solutions (b). Therefore, MA information regarding unconventional decision alternatives is not required or needed in any stage of the decision-making process, and, thus, the decision-making process results in relatively expected decisions. Of course, routine decisions require efficient analyses to allow a smooth decision-making process. However, in the case, the investment decision making is related to the renewal of the company's operations, and thus there is often a need for exploration of unconventional perspectives and alternatives.

In the Delivery Company, MA information was utilized primarily for routine decisions. Calculations compared customary options that differed only slightly from one another in terms of technology and financial impact. The MA tools justified the decisions that were already made and delivered these justifications to the Delivery Company's Board (see, e.g., the rationalization in Burchell *et al.*, 1980). These routines indicate that at points of technological disruption, MA information is unable to introduce potential alternatives into the decision-making process, such as the solutions offered by the Energy Company. Such alternatives would be particularly helpful in this case, especially since Delivery Company representatives expressed interest in integrating sustainability options into future decision making.

Additionally, certain industry-wide assumptions (Tolbert and Zucker, 1999) relating to fuel types or reliable car manufacturers also seemed to influence MA utilization in the Delivery Company. Remarkably, these institutions affected the process as explicit choices regarding the investment criteria or considered options. The process lacked genuine questioning and reflection regarding these assumptions. For MA information to be effective during technological transitions, managers must find a way to position the decision making in a wider context. One such way to do this would be to build a greater understanding of the business context (Hall, 2010). This study also encourages decision makers to reflect on their organizations' collective ways of reasoning and following existing norms and routines. In practice, this could mean questioning underlying assumptions and beliefs on perceived value and profitability (see Hall, 2010; Miller, 2001 on how accounting facilitates managerial work).

Third, *different managers appreciate different scope, content, and timing of MA information* regarding the decision (c). Different ways of reasoning affect how managers see the desired decision outcome. Thus, extending the actor-based features of decision making could enable an increased awareness of the cognition and preferences of the different actors with respect to the MA

analyses. At the same time, the MA analyses could be developed to be more user friendly in some contexts, where this has been identified as a major limitation.

The case study shows that communication regarding MA information may involve technical, financial, or sustainability figures. The parties involved may hold different perceptions and may value certain factors over others. Quite typically, technical figures (such as cost impacts) and personal values (an individual's commitment to sustainability) are intertwined in the observed communication and cannot be easily separated. MA information can serve as a communication platform to open a dialog on different ways of reasoning and whether to include or exclude certain individual and strategic viewpoints (see Laine *et al.*, 2016a). This suggestion is in line with the observation that individual and collective knowledge may be expanded through dialog and negotiation (Cuncliffe, 2004; Gherardi and Nicolini, 2001; Hall, 2010).

Fourth, the *process structure can ignore the needed managerial viewpoints* (d). Although an established analytical procedure can help structure a complex decision-making context (Arbnor & Bjerke, 2008), it can exclude certain actors' viewpoints. Individual managers' unique information sources might not fit or are not included in the decision-making process—a limitation also identified in the case study.

For example, the current decision criteria and process structure in the Delivery Company ignored the sustainability target of 40% of the vehicles being alternative fuel vehicles in the future. This target was a responsibility of the Head of Sustainability, who was keen on including this consideration to the process structure. The case findings highlight the need for building links between individual managers' viewpoints and the process to establish the criteria to be included in the decision-making process. In this case, a few managers wished to include sustainability factors in the initial investment decision-making process, whereas others believed that it was natural to consider such factors when optimizing vehicle operations.

Not all possible managerial viewpoints can be heard and included at each process stage to ensure a functioning decision-making process. Communication and dialog are required to form a collective understanding of the case (Isaacs, 1993; 2001). A shared understanding of the external and internal conditions of the case can help outline the desired decision-making process (Gerdin & Greve, 2004). The process can be updated to involve the necessary parties that share responsibilities for each process stage. As suggested by Laine *et al.* (2016b), social processes of sense-making could help managers identify and interpret the business impacts of complex decisions. The results of the present study confirm this observation and further suggest that such sense-making could take place in different phases of the decision-making procedures, depending on the particular decision-making situation involved and its interfaces to the wider organization. Importantly, such sense-making could either enable consensus with respect to the decision, or result in critical perspectives that could question or significantly alter the present decision-making process.

In sum, the case study identified limitations that were largely related to the insufficient actor-based features in the decision making. Communication and reflection are required for effective MA information utilization in a particular case, as described by Nørreklit *et al.* (2010) among others. Figure 3 conveys the idea that MA information can either support or contradict pre-assumptions regarding expected financial impacts. In this vein, reflection is required to bring up

the particular viewpoints that may significantly affect the interpretation of MA facts regarding such impacts (b, c). However, the case study suggests that extending MA analyses may be also largely beneficial to overcome the limitations of the MA information utilization. In the case study, some managerial actors brought up the need for additional MA tools and MA information to help influence other actors and encourage reflection on the assumptions embedded in the existing decision-making process.

Altogether, reflections on the current analytical and actor-based features of decision making and the related limitations in MA utilization could help managers use MA information more effectively. In the long term the reflections could fulfill the idea of accounting information facilitating and enabling managerial work at different levels, as examined and called for in recent MA studies (Hall, 2010; Miller, 2001; Jordan and Messner, 2012).

6. Conclusion

This study investigated the practical limitations for MA information utilization in decision making. In particular, the study explored limitations stemming from the analytical decision-making process structure and the involvement of several managerial actors. The study contributes to the understanding of supportive MA information utilization for decision making. It also holds implications for developing better functioning MA utilization in practice, thus reinforcing the need to support managerial work through MA information (Hall, 2010).

The case study identified the following limitations hindering the effective use of MA information, largely related to insufficient actor-based features in the decision-making:

1) Managers can lack expertise in the use of MA tools.
2) Managerial interaction can lack reflection on taken-for-granted assumptions.
3) Different managers can desire different scope, content, and timing of MA information.
4) The process structure can ignore the needed managerial viewpoints.

The findings suggest that the utilization of MA information in typical analytical decision-making procedures may justify routine decisions without a broader reflection or dialog. This analytical way of use may deter organizations from recognizing potentially valuable solutions outside the scope of their routine decisions, thus decreasing the actual impact of MA information (Wouters and Verdaasdonk, 2002). In addition to the limitations stemming from analytical procedures, also insufficiently exercised actor-based elements can hinder the utilization of MA information. Managers have different organizational roles, which affect how they see the desired decision outcome. Different personal intentions and organizational roles set different managerial needs for MA information in the process. In their roles, different managers need or desire different scope, content, and timing of economic information regarding the decision. They may also have limited expertise in MA tools, which limits the integration of certain managerial viewpoints.

Although in the case study, many limitations stemmed from the insufficient actor-based orientation, introducing new MA analyses and extending the validity of analytical approaches may

also help overcome some of the limitations. The case study findings reinforce existing results on designing useful MA information (Wouters and Verdaasdonk, 2002) with MA information utilized in a facilitating manner (Miller, 2001), as well as the importance of attaining an increased understanding of the business context in financial terms (Hall, 2010). More specifically, this study highlights the following avenues through which the existing limitations of effective MA information utilization can be overcome, combining analytical and actor-based features of decision making in a reflective manner:

1) Integrate different actors' viewpoints with MA information already in the decision-making process structure.
2) Find ways to introduce MA information on unconventional decision alternatives.
3) Enable reflection on relevant actors' values, roles, and responsibilities during the execution of decision making.

As a managerial implication, the findings of this case study highlight the need for reflection on the limitations of existing investment decision-making practices. The following questions could guide such reflection: What are the pre-assumptions that guide our investment decisions? Which viewpoints would bring up unconventional, yet potentially valuable, investment alternatives? Developing MA that supports investment decision-making processes is an unceasing process that requires continuous reflection on the industry, the business itself, and the financial impacts of the decisions made. The researchers supported this development work at the Delivery Company by organizing a group meeting that offered managers a discussion forum to reflect on their different viewpoints and decision-making principles.

Finally, ample scope for further research remains. The findings of this study are limited to one empirical context in one industry. The authors believe that building on current and forthcoming cases on MA information utilization would provide an extended understanding of the antecedents and impacts of effective, reflective MA information utilization for decision making.

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