Turun yliopisto
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GREEN SUPPLY CHAIN MANAGEMENT PRACTICES AND FIRM PERFORMANCE: EVIDENCE FROM FINLAND

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TURUN YLIOPISTON JULKAISUJA – ANNALES UNIVERSITATIS TURKUENSIS
Sarja - ser. E osa - tom. 4 | Oeconomica | Turku 2016

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The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

ISBN 978-951-29-6536-6 (PRINT)
ISBN 978-951-29-6537-3 (PDF)
ISSN 2343-3159 (Painettu/Print)
ISSN 2343-3167 (Verkkojulkaisu/Online)
Painosalama Oy - Turku, Finland 2016

ABSTRACT

Green supply chain management practices and firm performance: evidence from Finland

In order to address the increasing stakeholder requirements for environmentally sustainable products and processes, firms often need the participation of their supply chain partners. Green supply chain management has emerged as a set of managerial practices that integrate environmental issues into supply chain management. If implemented successfully, green supply chain management can be a way to achieve competitive advantage while enhancing the environmental sustainability of the firm. The overall purpose of this dissertation is to contribute to the discussion on green supply chain management practices from the perspective of their drivers and performance implications.

The theoretical background arises from the literature on competitive strategy, firm performance and green supply chain management. The research questions are addressed by analysing firm-level data from manufacturing, trading and logistics firms operating in Finland. The empirical data comes from two consecutive Finland State of Logistics surveys in 2012 and 2014, combined with financial reporting data from external databases. The data is analysed with multiple statistical methods.

First, the thesis contributes to the discussion of the drivers of GSCM practices. To enhance the understanding of the relationship between competitive strategy and GSCM practices, a conceptual tool to describe generic competitive strategy approaches was developed. The findings suggest that firms pursuing marketing differentiation are more likely to be able to compete by having only small environmental effects and by adopting a more advanced form of external green supply chain management, such as a combination of strong environmental collaboration and the increased environmental monitoring of suppliers.

Furthermore, customer requirements for environmental sustainability are found to be an important driver in the implementation of internal GSCM practices. Firms can respond to this customer pressure by passing environmental requirements on to their suppliers, either through environmental collaboration or environmental monitoring.

Second, this thesis adds value to the existing literature on the effects of green supply chain management practices on firm performance. The thesis provides support for the idea that there is a positive relationship between GSCM practices and firm performance and enhances the understanding of how different types of GSCM practices are related to 1) financial, 2) operational and 3) environmental performance in manufacturing and logistics. The empirical results suggest that while internal GSCM practices have the strongest effect on environmental

performance, environmental collaboration with customers seems to be the most effective way to improve financial performance. In terms of operational performance, the findings were more mixed, suggesting that the operational performance of firms is more likely to be affected by firm characteristics than by the choices they make regarding their environmental collaboration. This thesis is also one of the first attempts to empirically analyse the relationship between GSCM practices and performance among logistics service providers.

The findings also have managerial relevance. Management, especially in manufacturing and logistics industries, may benefit by gaining knowledge about which types of GSCM practice could provide the largest benefits in terms of different performance dimensions. This thesis also has implications for policy-makers and regulators regarding how to promote environmentally friendly activities among 1) manufacturing; 2) trading; and 3) logistics firms.

Keywords: Green supply chain management; Performance; Competitive strategy; Environmental monitoring; Environmental collaboration

TIIVISTELMÄ

Vihreä toimitusketjun johtaminen ja yrityksen suorituskyky: tuloksia suomalaisesta yritysaineistosta

Yritykset tarvitsevat usein toimitusketjukumppaneitaan vastatakseen eri sidosryhmien kasvaneisiin vaatimuksiin ottaa huomioon tuotteiden ja toimintojen ympäristövaikutukset. Vihreällä toimitusketjun johtamisella pyritään huomioimaan ympäristönäkökulma toimitusketjun kaikissa vaiheissa tuotteen tai palvelun suunnittelusta aina elinkaaren loppuun. Vihreä toimitusketjun johtaminen on osa laajempaa kestävän kehityksen viitekehystä, jossa tarkastellaan ympäristön lisäksi taloudellista ja sosiaalista ulottuvuutta. Yrityksen on mahdollista lisätä sekä ympäristöystävällisyyttään että kilpailuetuaan vihreällä toimitusketjun johtamisella. Tämän tutkimuksen tarkoituksena on osallistua keskusteluun vihreän toimitusketjun johtamisen syistä ja yrityksen suorituskykyyn liittyvistä seurauksista.

Väitöskirja pohjaa kilpailustrategia-, suorituskyky- ja vihreän toimitusketjun johtamisen kirjallisuuteen. Tutkimuskysymyksiä tarkastellaan analysoimalla yritystason empiiristä aineistoa Suomessa toimivista valmistavan teollisuuden, kaupan ja logistiikan alan yrityksistä. Aineistolähteinä käytetään kahden kansallisen Logistiikkaselvityksen aineistoa vuosilta 2012 ja 2014, johon yhdistetään tilinpäätösaineistoa ulkoisista tietokannoista. Aineiston analyysiin käytetään monimuuttujamenetelmiä.

Väitöskirjan ensimmäinen kontribuutio liittyy vihreän toimitusketjun johtamisen syitä käsittelevään kirjallisuuteen. Tutkimus lisää ymmärrystä yrityksen kilpailustrategian ja vihreän toimitusketjun johtamisen käytäntöjen välisestä yhteydestä kehittämällä työkalun yleisten kilpailustrategioiden kuvaamiseen. Tulosten perusteella näyttäisi siltä, että markkinointidifferointia kilpailustrategianaan käyttävät yritykset kilpailevat todennäköisemmin pienillä ympäristövaikutuksilla ja käyttävät muita yrityksiä todennäköisemmin monimutkaisempia vihreän toimitusketjun johtamisen käytäntöjä, kuten laajaa ympäristöyhteistyötä ja -valvontaa toimittajasuhteissaan.

Tutkimuksen tulokset osoittavat myös, että asiakkaan ympäristövaatimukset ovat merkittävä vaikutin yritysten sisäisessä toiminnassa. Yritykset voivat vastata tähän asiakkailta tulevaan paineeseen siirtämällä vaatimukset omille toimittajilleen joko ympäristöyhteistyön tai -valvonnan keinoin.

Väitöskirjan toinen pääkontribuutio on lisätä tietoa vihreän toimitusketjun johtamisen yhteydestä yrityksen suorituskykyyn. Tutkimuksessa tarkastellaan, miten erilaiset vihreän toimitusketjun johtamisen käytännöt vaikuttavat valmistavan teollisuuden ja logistiikkayritysten 1) taloudelliseen, 2) operationaaliseen ja 3) ympäristösuorituskykyyn. Tutkimuksen tulokset tukevat näkemystä, että

vihreän toimitusketjun johtamisen käytäntöjen ja suorituskyvyn välillä on positiivinen yhteys. Tulokset osoittavat, että yrityksen ympäristösuorituskykyyn voidaan vaikuttaa eniten yrityksen sisäisillä toimilla, kun taas taloudellinen suorituskyky on eniten yhteydessä asiakkaiden kanssa tapahtuvaan ympäristöyhteistyöhön. Operationaaliseen suorituskykyyn, kuten logistiikkakustannuksiin, palvelutasoon ja käyttöpääoman tehokkuuteen, liittyvät tulokset olivat ristiriitaisempia, ja aineiston perusteella vaikuttaisikin siltä, että operationaaliseen suorituskykyyn vaikuttavat ennemmin yrityksen erityispiirteet kuin sen tekemät vihreään toimitusketjuun liittyvät päätökset. Väitöskirja on myös yksi ensimmäisistä tutkimuksista, jossa tarkastellaan vihreän toimitusketjun johtamisen ja suorituskyvyn välistä yhteyttä logistiikkapalveluntarjoajien näkökulmasta.

Erityisesti valmistavan teollisuuden ja logistiikan alalla toimivien yritysten johto voi hyötyä väitöstyössä saaduista tuloksista erilaisten vihreän toimitusketjun johtamisen käytäntöjen yhteyksistä taloudelliseen, operationaaliseen ja ympäristö-suorituskykyyn. Myös päättäjät ja viranomaiset voivat käyttää saatua tietoa edistämään ympäristöystävällistä toimintaa teollisuuden, kaupan ja logistiikan alalla.

Avainsanat: Vihreä toimitusketju; suorituskyky; kilpailustrategia, ympäristövalvonta; ympäristöyhteistyö

ACKNOWLEDGEMENTS

Every once in while my mother likes to cite my primary school teacher. She had once said that she would not be surprised if she saw a book written by me one day. Although I suspect that she meant a book of fairy tales rather than a doctoral dissertation, the two have something in common: they are about telling a story. Although fairy tales tend to be a work of imagination, while an academic study definitely should not be. The key is to pick a subject you are enthusiastic about and try to engage your readers so that after reading the text they will have something to think about. I hope that I have succeeded in that.

I would not have been able to make it without the wonderful people who have helped me in this dissertation process. I wish to express my deepest gratitude to them.

First of all, I cannot thank my supervisors Professor Juuso Töyli and Professor Lauri Ojala enough. You are the best supervisors I can think of. My heartfelt thanks to you, Juuso, for your time and effort, and guidance on issues ranging from how to build an academic career to the basics of off-piste skiing. I truly admire your extensive knowhow in statistical analysis methods. I hope that during this process I have managed to master a fraction of them. Thank you, Lauri, for employing me as a research assistant in 2010, which was the start of the path that led to this moment. I am very thankful for the resources that I needed to accomplish my research and the time you dedicated to help me improve the manuscripts. *Pieni stilisointi* ("small editing") is greatly appreciated.

I wish to express my gratitude to my pre-examiners, Professor Robert D. Klassen (Western University) and Professor Joseph Sarkis (Worcester Polytechnic Institute). I am privileged that two of the top scholars within the field were able to dedicate time to my thesis. Thank you for your thorough and constructive feedback that helped me in improving the dissertation. I am also thankful to Docent Pietro Evangelista (Research Institute on Innovation and Services for Development) for agreeing to act as the opponent of this thesis.

I have been privileged to work with fantastic colleagues in the Operations and Supply Chain Management unit: Dr. Tomi Solakivi, Professor Harri Lorentz, M.Sc. Tuomas Kiiski, M.Sc. Vesa Kilpi, and Dr. Jarmo Malmsten. In particular, I have enjoyed our lunch discussions – typically ending up in a heated debate or laughing our heads off. Thank you, Tomi, for co-authoring papers, sharing your expertise and having a drink with me all over the world during our work trips. Thank you Harri, for setting an example of how a hard-working scholar should behave and also for sharing your insights on academic life. Thank you Tuomas and Vesa for the peer support, and thank you to Jarmo for our fruitful discussions on junior sports.

I want to thank Turku School of Economics and the University of Turku Graduate School (UTUGS) for providing me with full-time funding that has made it possible to focus on my research. The financing of this doctoral research project has also been kindly provided by Oskar Öflundin säätiö, Turun Kauppaopetussäätiö – Stiftelsen för Handelsutbildning i Åbo, TOP-säätiö and Turun kauppakorkeakouluseura (the Turku School of Economics Association). Please accept my sincere thanks for your generous support.

Importantly, I would like to thank my friends who have helped me in difficult times, shared unforgettable moments and had fun with me. Special thanks go to Mikko, Laura, Iida and Jukka who have been truly loyal friends and who have made me forget all about work. Thank you for all the adventures, long discussions, drinks, bad karaoke and everything in between. Over the years, I have also been privileged to play floorball with a bunch of talented, fun and smart ladies. You have been my second family. My warmest thanks go to Luumu, Jasu and Emppu for long dinners, mysterious WhatsApp messages and for being able to call you friends outside the floorball rink.

Finally, I want to give my most loving thanks to the people closest to me. Juuso, thank you for your love and patience. I wasn't at my best during the most stressful moments of the thesis process, but your pragmatic approach: "let's get you some food and then we'll think about it" did the trick every time. I look forward to all the adventures ahead of us.

Sunna, on the day you were born, Dad asked me if I wanted a little sister or a little brother. A little sister was indeed what I wanted, and I am fortunate to have you in my life ever since. I admire your determination and your no-nonsense attitude. Keep up the good work.

I owe my greatest thank you to my parents, Sirpa and Pasi. I can confidently say that I have the best parents imaginable. Thank you for not questioning my choices in life, even though it included 21 years of continuous study from elementary school to this doctoral defence. I have probably never managed to explain what I have actually been working with but I hope I am able to shed some light on that in my lectio praecursoria. Thank you for your support throughout my life, both spiritual and financial. Special thanks to Mum: We made a deal last autumn. I could not be happier that you kept you promise although I was not able to keep mine in the agreed schedule. You are my idol.

Turku, 1 July 2016

Sini Laari

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PART I: INTRODUCTION

1 INTRODUCTION

1.1 Background of the study

The expanding global economy has brought prosperity but also environmental degradation (World Bank 2012), such as climate change, ozone layer depletion, loss of biodiversity, pollution, degradation and the depletion of air, water, minerals and land (United Nations Environment Programme 2012; World Bank 2012). These issues have become important to firms because their stakeholders, such as regulatory authorities, customers, competitors, non-governmental organisations and employees, are increasingly demanding that firms address environmental and social sustainability in business operations (Carter & Easton 2011). Firms wishing to minimise their environmental impacts might discover that their ability to do so is dependent on their ability to manage increasingly complex supplier relationships (Darnall et al. 2008). Supply chain management (SCM) plans and controls business processes from raw material suppliers and end-customer and links together partners in a supply chain (Harrison & van Hoek 2008), which provides an excellent starting point for improving sustainability (Linton et al. 2007).

This research addresses the economic and environmental dimensions of sustainability, particularly in the context of green supply chain management (GSCM). According to Linton et al. (2007), the focus of environmental management has shifted from firm level to supply chain level (Linton et al. 2007). As a result, GSCM has emerged as a way to combine elements of environmental management and supply chain management (Zhu et al. 2008; Yang et al. 2013). The whole life cycle of a product is taken into account, from product design to end-of-life management (Srivastava 2007).

Firms tend to adopt GSCM practices due to external factors, which are mostly linked to stakeholder pressure and internal factors stemming from business-led strategic processes (Testa & Iraldo 2010). On the positive side, an improved corporate image, increased efficiency and innovation leadership have been mentioned as driving managers to adopt green supply chain management (Testa & Iraldo 2010). In a recent survey by McKinsey (2014) 43 per cent of respondents said that their company seeks to align sustainability with their overall business goals. Previous studies argue that properly designed environmental management in the supply chain can create competitive advantage and result in performance improvements (Vachon & Klassen 2008; Shi et al. 2012).

On the negative side, the risks associated with environmental non-compliance also drive GSCM practices. Risks can be exogenous, e.g. industry environment, supplier location and national institutional context, or endogenous, e.g. managerial decisions, firm size and other firm specific issues (Roehrich et al. 2014). Closs et al. (2011) even suggest that "a sustainable supply chain reflects the firm's ability to plan for, mitigate, detect, respond to, and recover from potential global risks". Risks can be either direct or indirect or have major, e.g. profit and firm value, or minor, e.g. product quality and customer satisfaction, performance effects (Hofmann et al. 2014). For example, environmental incidents might intensify regulatory pressures (Reid & Toffel 2009), cause a significant loss in share price (Bansal & Clelland 2004), damage a firm's image and reputation and have customers boycott firms or cancel their orders (Hajmohammad & Vachon 2016). Increasing reliance on an outsourced supply base calls for the active management of supplier sustainability risks because buying firms cannot transfer the risk of unacceptable environmental practices onto suppliers (Foerstl et al. 2010).

Besides adopting less environmentally harmful practices in their daily internal operations, firms are increasingly extending their focus to external supply chain members (Zhu et al. 2013). In the global economy, firms are becoming more and more dependent on their suppliers to gain competitive advantages (Yeung et al. 2008) and firms might be held responsible not only for their own firm but also for the environmental and social performance of their suppliers (Seuring & Müller 2008). As a response to pressures from various stakeholders, firms have introduced supplier evaluation schemes that integrate environmental and social criteria (Seuring & Müller 2008) and require environmental audits or environmental certifications from suppliers (Vachon & Klassen 2006a; Lee et al. 2014).

GSCM practices have been developed as a practical means to pursue an environmentally focused strategy (Green et al. 2012a). They can be viewed from four different perspectives. The first perspective is related to risk. Cousins et al. (2004) argue that that the greater the level of perceived loss to the firm the greater the chance that the firm will react in some way to minimise the expectation of loss. However, Galeazzo and Klassen (2015) discovered that risk-averse managers facing uncertainty were more likely to make small adjustments to their internal environmental activities than large and radical changes. These firms follow basic actions to manage some of the risks and are likely to use more structured practices, such as information gathering and supplier assessments (Cousins et al. 2004). In contrast, some firms try to mitigate the risks by continuously searching for new market opportunities through innovation and new product development (Hsu et al. 2016). Thus, they are likely to undertake the most advanced types of environment-related supplier initiatives (Cousins et al. 2004). For example, a firm might decide to accept the risk related to their suppliers' environmental compliance and budget

for damage control, or they can actively engage in improving their suppliers' environmental performance (Hajmohammad & Vachon 2016).

The second perspective is the innovativeness of activities, ranging from incremental, reactive activities to proactively seeking competitive advantage through improved environmental performance and environmental innovations (Zhu & Sarkis 2004). Moving beyond "low hanging fruit" to more ambitious environmental goals requires significant investment, radical changes in operational practices and reconfiguring existing supply chains (Walley & Whitehead 1994; Wu & Pagell 2011).

A third perspective is related to the sharing of the performance benefits because firms might be tempted to maximise their own performance, which can lead to sub-optimal supply chain's performance. In collaboration, supply chain partners can access and leverage each other's resources and enjoy their associated benefits (Cao & Zhang 2011). However, collaboration is not an entirely unproblematic concept (Barratt 2004; Singh & Power 2009). The uneven distribution of benefits can discourage firms from endorsing environmental initiatives fully, leading to unrealised potential (Brockhaus et al. 2013). For example, Tachizawa and Wong (2015) argue that some of the GSCM management approaches might be counter-productive as they motivate suppliers to act opportunistically, such as hiding potential problems.

Finally, a fourth perspective is related to time. According to Slawinski and Bansal (2015), there are intertemporal tensions in business sustainability because firms can engage in activities that juxtapose short-term and long-term perspectives or in activities that polarise the short-term and long-term. Environmental actions often impose costs in the short-term while the benefits will accrue in the long-term. Hence, firms need to find out a way to balance competing priorities by weighing short-term and long-term effects when making decisions under uncertainty (Wu & Pagell 2011).

Although there is a growing body of literature supporting the view that "being green" pays off (e.g. King & Lenox 2001a; Rao & Holt 2005; De Giovanni & Esposito Vinzi 2012; Yang et al. 2013; Zhu et al. 2013), it is necessary to shed light on which type of GSCM practices are most effective in terms of performance. In particular, literature on the performance implications of the choice of initiating environmental collaboration or monitoring is still scant. The unclear performance outcomes of GSCM practices might be an obstacle for firms seeking to justify GSCM implementation (Zhu et al. 2012).

Although it seems that environmental sustainability is a source of competitive advantage for an increasing number of firms, the relationship between competitive strategy and GSCM remains unclear. According to Testa and Iraldo (2010), GSCM is able to support a firm's competitive strategy by improving an environmental reputation. Several researchers (e.g. Fisher 1997; Mason-Jones et al. 2000;

Christopher & Towill 2001; Qi et al. 2011) have stressed the importance of ensuring the fit between competitive strategy and supply chain strategy. Despite their popularity in management literature, generic competitive strategies, such as the cost leadership/differentiation framework by Porter (1980), are yet to be extended to green supply chain management. This calls for further research on the connection between competitive strategy and GSCM strategy.

1.2 Key concepts

Azevedo et al. (2011) defines GSCM practices as any action performed across the supply chain, either within the company or involving external partners, to eliminate or reduce any kind of negative environmental impact. Internal GSCM practices reflect a firm's decisions to act in environmentally friendly ways (Azevedo et al. 2011), whereas external GSCM practices typically require some level of cooperation with other stakeholders (Zhu et al. 2013). Internal GSCM practices include, for example, the use of environmentally friendly materials and equipment, environmental policies, environmental audits and cross-functional collaboration on environmental issues. In contrast, external GSCM practices require cooperation with supply chain partners, for example, in the form of training, information sharing and jointly setting environmental goals (e.g. Vachon & Klassen 2006a; 2008; Green et al. 2012a; Gimenez & Sierra 2013). Hence, GSCM practices are defined in this thesis as environmental collaboration and/or environmental monitoring within a firm and with suppliers and customers that is aimed at reducing negative environmental impacts.

In general, firms can use two distinctive but complementary categories of GSCM practices, environmental collaboration or environmental monitoring, or a combination of both, to improve the environmental performance of their suppliers (Vachon & Klassen 2006a; Lee 2015). The two approaches differ in several aspects, such as 1) nature of the relationship (collaboration vs. arm's length), 2) the nature of the incentives (cooperative vs. competitive) and 3) the sharing of benefits (evenly split vs. unevenly split) (Vachon & Klassen 2006a; Green et al. 2012a; Hoejmose et al. 2014). However, the number and scope of empirical studies that consider both the monitoring and the collaboration approaches is limited (Lee 2015). Table 1 illustrates the differences between environmental collaboration and environmental monitoring.

Table 1 Comparison of environmental monitoring and environmental collaboration

	Environmental monitoring	**Environmental collaboration**	Vachon & Klassen (2006; 2008); Green et al. (2012a)
Related concepts	Mandated supply chain sustainability	Collaborative supply chain sustainability	Brockhaus et al. (2013)
	Coercive GSCM	Cooperative GSCM	Hoejmose et al. (2014)
	Supplier assessment	Supplier collaboration	Gimenez & Sierra (2013)
Nature of the relationship	Arm's length transactions; evaluation and control	Collaboration, direct involvement	Vachon & Klassen (2006; 2008)
	Hands-off	Hands-on	Gimenez & Sierra (2013)
Nature of incentives	Competitive: reward is based on how well firms perform relative to others	Cooperative: reward is based on joint performance	Terpend & Krause (2015)
Sharing of benefits	Uneven	Even	Brockhaus et al. (2013)
Examples of activities	Evaluation of suppliers' environmental performance, choosing suppliers based on environmental criteria, gathering and processing supplier information	Mentoring and assisting suppliers, information and experience sharing, technical and financial assistance to achieve certifications	Vachon & Klassen (2006; 2008); Lee (2015)

Although performance is of interest for researchers in any area of management and essential for the survival and success of firms, the term has been surprisingly loosely defined and used in the literature (Richard et al. 2009). Lebas (1995) defines performance as the potential for the future successful implementation of actions in order to reach objectives and targets. According to Neely et al. (1995) performance is a function of efficiency (how well resources are utilised) and effectiveness (the extent to which goals are met).

Firm performance has been operationalised in a number of ways in previous studies. Traditionally performance has been viewed as financial performance defined by accounting (Lebas 1995). However, a number of authors have called for a wider supply chain perspective on performance measurement and management (e.g. Beamon 1999a; Gunasekaran et al. 2004). For example, operational metrics such as quality, time, cost and flexibility, and customer service have been suggested as dimensions of performance (Neely et al. 1995; Fawcett & Cooper 1998; Beamon 1999a). Recently, organisations have begun to face increased scrutiny from various stakeholders regarding their compliance with environmental and social responsibility (Shaw et al. 2010). In this study, firm

performance is considered to consist of the following three dimensions: 1) financial performance, 2) operational performance and 3) environmental performance.

1.3 Research questions and limitations

The overall research objective of this dissertation is to contribute to the discussion on green supply chain management practices from the perspective of their drivers and performance implications. To address the research objective, three research questions are formulated.

RQ1*: What is the role of competitive strategy and customer requirements in green supply chain management adoption?*

Current understanding of the drivers that encourage the implementation of GSCM practices is still limited (Chavez et al. 2014). This thesis examines the role of two factors affecting the adoption of GSCM practices, namely competitive strategy and customer requirements. The strategic motives behind GSCM implementation have been recognised in previous literature (e.g. Simpson et al. 2007; Testa & Iraldo 2010; Lee et al. 2014; Foerstl et al. 2015). A high involvement in GSCM is typically anticipated to bring about improvements in firm competitiveness, such as company image, profitability and innovative capabilities (Testa & Iraldo 2010). The competitive dimensions associated with environmental concerns and supply chain management are increasingly important to organisations (Azevedo et al. 2011).

Firms must respond to environmental requirements in a way that is consistent with their business strategy (Wu & Dunn 1995). While an existing body of research emphasises the importance of achieving a fit between competitive strategy and supply chain strategy (e.g. Fisher 1997; Mason-Jones et al. 2000; Cristopher & Towill 2001; Qi et al. 2011), the relationship between competitive strategy and GSCM strategies remains relatively uncovered. According to Kuik et al. (2011), the alignment between competitive strategy and sustainable SCM can increase the awareness of firms in managing intra- and inter-organisational activities.

Naturally, internal strategy-led considerations are not the only determinant of the development of GSCM practices, but firms also face a multitude of environmental pressures from external stakeholders (e.g. Walker et al. 2008; Testa & Iraldo 2010; Zhu et al. 2013; Chavez et al. 2014). Buyer-supplier relationships have been recognised as playing a significant role in transferring environmental requirements in a supply chain (e.g. Hall 2000; González et al. 2008; Lee et al. 2014). Yet there is little research that specifically explores the relationship between

customer requirements and GSCM, although customer-focused GSCM activities could be a critical competency for creating value in a supply chain (Chavez et al. 2014).

RQ2: *What are the connections between green supply chain management practices and firm performance in manufacturing?*

Given the inconclusive results of previous studies, it remains unclear if firms that more comprehensively adopt GSCM perform better (Rao & Holt 2005; Lai & Wong 2012; Green et al. 2012a; Zhu et al. 2013). According to Zhu et al. (2012), the lack of a clear relationship between GSCM practices and performance improvements is an obstacle for manufacturing firms seeking to justify GSCM implementation. Thus, more research is needed to illustrate which type of GSCM practices are most effective in terms of each performance dimension. Moreover, Green et al. (2012b) argue that there is a lack of empirical research that looks into GSCM from a holistic and integrated perspective that can be used as a foundation for both theory building and theory testing. The phenomenon must be viewed from the supply chain perspective, including upstream and downstream sides as well as the internal processes (Yu et al. 2014). Moreover, the distinction between monitoring or collaboration-based GSCM approaches has remained largely unexplored (Brockhaus et al. 2013; Hoejmose et al. 2014) and should thus be taken into account when examining performance implications.

RQ3: *What are the connections between environmental collaboration and firm performance in logistics services?*

Most of the previous research on GSCM has focused on the efforts of manufacturers and retailers (Lieb & Lieb 2010). Although a small number of previous studies has focused on logistics service providers (LSPs) and discussed issues – such as 1) the type of green practices adopted (Evangelista et al. 2010; Evangelista 2014; Martinsen & Huge-Brodin 2012), 2) the drivers affecting the adoption of environmental initiatives (Lin & Ho 2008; Evangelista 2014), 3) the interface between LSPs and shippers (Martinsen & Björklund 2012), and 4) the effect of GSCM on green performance and firm competitiveness in container shipping (Yang et al. 2013), empirical research on the performance outcomes of GSCM practices in the context of logistics service providers remains limited to relatively few studies (Perotti et al. 2012). Industries may exhibit dissimilar attitudes toward environmental issues (Lin & Ho 2008), therefore it is necessary to clarify whether the findings reported in other industries are applicable to the logistics sector.

A logistics service provider typically serves multiple customers and operates at geographically dispersed sites (Piecyk & Björklund 2015). Furthermore, their contracts are likely to vary in length and the service bundles included, leading to changing configurations in the logistics network (Lukassen & Wallenburg 2010). Piecyk and Björklund (2015) list a number of challenges logistics service providers face in their GSCM adoption, such as the complexity of network-wide actions, a need to offer tailored solutions to individual customers and to collaborate with other players in the supply chain while coping with low profit margins, which lead to limited resources being available to support sustainability initiatives. Busse (2010) discovered that the costs of innovation for LSPs were higher than for other service providers, and that LSPs were less innovative. This, in turn, might explain why LSPs tend to be at an early stage in the development of green logistics for practice (Isaksson & Huge-Brodin 2013). It is expected that the answers to RQ3 will provide a deeper understanding of what kinds of performance implications LSPs can expect from environmental collaboration.

An *a priori* model (Figure 1) is suggested in order to illustrate the relationships between GSCM practices, their drivers and their performance implications and the scope of this thesis. GSCM practices are examined with regard to activities within the firm and with suppliers and customers, thus excluding environmental activities with other stakeholders, such as research institutions or non-governmental organisations (NGOs).

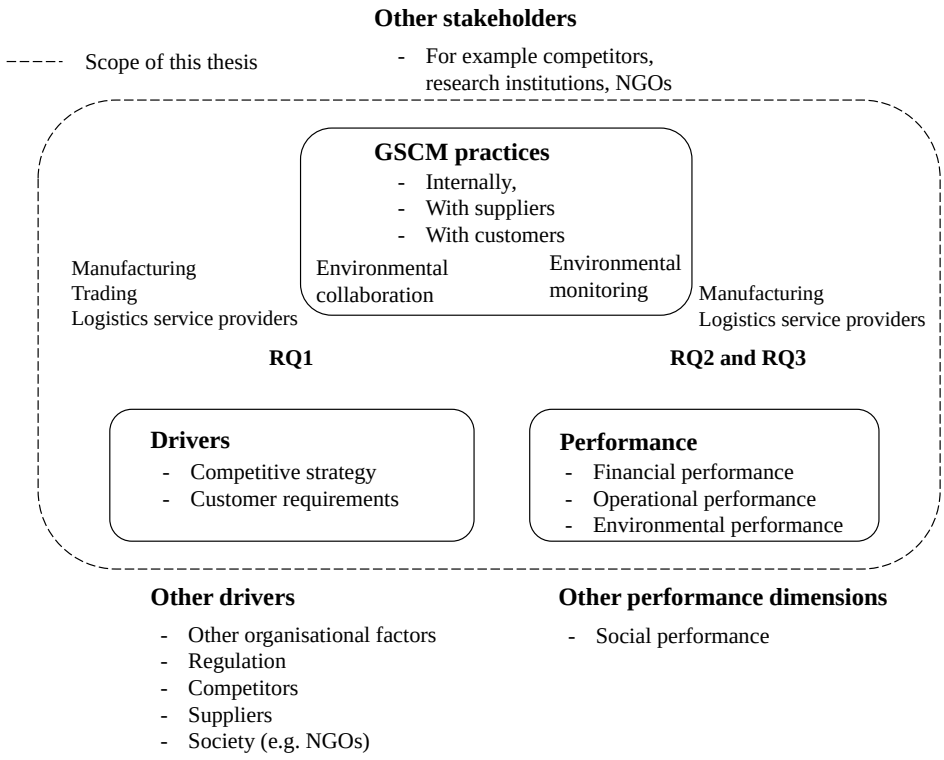

Figure 1 The scope and the a priori model of the thesis

The drivers of the GSCM practices examined in this thesis includes competitive strategy and customer requirements. Other drivers, such as regulation, competitors, suppliers and internal organisational factors, are therefore outside the scope of this study. The performance implications of GSCM practices are discussed in relation to financial, operational and environmental performance. Hence, the social dimension of performance is excluded.

1.4 Contribution

The green supply chain management field has been rapidly growing for at least 20 years but there still exists significant room for further development (Fahimnia et al. 2015). Thus, there is a substantial opportunity to extend GSCM from basic constructs to more nuanced relationships up and down the supply chain and to study their performance implications in a broader set of operating contexts.

Firstly, this dissertation discusses the role of 1) competitive strategy and 2) customer requirements at the level of GSCM adoption. The level of GSCM adoption refers here to the extent to which a firm is involved in GSCM practices.

This thesis refines generic competitive strategy approaches and applies them to the GSCM context of both logistics users and providers. Wu et al. (2014) call for research that helps managers to understand the distinctive needs of competitive strategy and GSCM strategy and to manage the relationships underlying these strategies. This thesis thus attempts to indicate the managerial implications regarding the design of a firm's GSCM practices to support a competitive strategy. It also sheds light on the different kinds of approaches customers use to increase the environmental compliance of their suppliers and attempts to understand their implications from both the customer's and the supplier's perspective.

Furthermore, this thesis contributes to the empirical testing of mainly firm-level and partly industry-level performance outcomes from GSCM practices. The thesis ultimately attempts to extend the theory in the light of the observed results. This research therefore empirically tests the impact of GSCM practices on the 1) financial, 2) operational and 3) environmental performance of firms operating in manufacturing and logistics. There has been a limited amount of research incorporating these three aspects of performance. In addition, the results have proved to be rather contradictory and need the further evaluation that is provided by this thesis.

Empirical research on the environmental activities of logistics service providers is scarce and there is virtually no research that has focused specifically on the environmental collaboration of logistics service providers although the complexity and highly competitive operating environment in the logistics sector might pose a challenge for GSCM adoption (Piecyk & Björklund 2015). This research is one of the first attempts to study the operational and financial performance of logistics service providers with regard to their environmental activities.

The results of this thesis can be used by managers and policy-makers to develop policies, strategies and activities to improve their current environmental practices. Managers may also benefit from knowledge about which type of GSCM practice appears to provide the largest benefits in terms of different performance dimensions. The findings also provide implications for policy-makers and regulators regarding how to promote environmentally friendly activities among 1) manufacturing, 2) trading and 3) logistics firms.

The empirical data for this thesis is derived from several sources. The main empirical data were collected as part of two consecutive Finland State of Logistics surveys in 2012 and 2014. The large-scale Finnish national logistics survey collects up to approximately 2,700 responses and provides an exceptionally wide sample for the empirical analysis of GSCM practices on several tiers of the supply chain, including manufacturing, trading and logistics.

Moreover, financial reporting data extracted from external databases is connected to firm-level survey data. While the majority of previous research uses either self-reported survey data or financial reports-based data, this thesis is able

to combine both sources, which brings novelty to the thesis. Several methods of analysis are used in the thesis articles, some of which are rather uncommon in GSCM research, e.g. generalised linear modelling.

1.5 Structure of the thesis

This dissertation consists of two parts: I) the introduction and II) the original research articles. The research articles include four individual papers that address GSCM practices from different perspectives: article I "Supply chain perspective on competitive strategies and green supply chain management strategies" by Laari, Töyli and Ojala (2016); article II "Firm performance and environmental collaboration in manufacturing" by Solakivi, Laari, Töyli and Ojala (2016); article III "Performance outcomes of environmental collaboration: evidence from Finnish logistics service providers" by Laari, Solakivi, Töyli and Ojala (2016); and article IV "Firm performance and customer-driven green supply chain management" by Laari, Töyli, Solakivi and Ojala (2016). The connections between the research questions and articles addressing them are shown in Table 2.

Table 2 Articles addressing each sub-research question

		Article I	Article II	Article III	Article IV
RQ1	What is the role of competitive strategy and customer requirements in GSCM adoption?	X			X
RQ2	What are the connections between GSCM practices and firm performance in manufacturing?		X		X
RQ3	What are the connections between environmental collaboration and firm performance in logistics services?			X	

X = contributes to the research question

The introductory part starts with Chapter 1 by introducing the background of the study and the research questions and by discussing the scope and limitations of the dissertation. Chapters 2, 3 and 4 present the theoretical framework behind the research questions. Chapter 2 discusses five generic competitive strategies: low cost leadership, marketing differentiation, operations differentiation, hybrid strategy and the stuck-in-the-middle strategy. Chapter 3 gives an overview of the financial, operational and environmental dimensions of firm performance.

The first two subchapters in Chapter 4 discuss the definitions of GSCM and GSCM practices. The third subchapter introduces the main theoretical lenses applied in this thesis to examine GSCM practices. The fourth subchapter describes

existing research on the effects of GSCM practices on firm performance, while the last subchapter provides a synthesis of the theories and performance implications.

In Chapter 5, the research approach, research process and methodology of this dissertation are discussed. The data collection and methods of analysis are reviewed and the study is evaluated in terms of reliability and validity. Chapter 6 describes the research constructs in detail. Chapter 7 summarises the results of the thesis articles in relation to the research questions of this dissertation. Finally, Chapter 8 outlines the theoretical and managerial contributions of this dissertation and discusses future research avenues.

2 COMPETITIVE STRATEGIES

Strategy is an integral part of any business plan. Porter (1980) describes competitive strategy as a formula for how a firm is going to compete, what its goals should be and what policies will be needed to achieve those goals. According to Porter (1987), a firm has two levels of strategy: company-wide corporate strategy and business unit or competitive strategy. While the former refers to the decision on what businesses a firm should be in and how its headquarters should organise the business units, the latter concerns how to create competitive advantage in each business the firm operates in. This thesis focuses on the business unit-level competitive strategy. However, given that the majority of the studied firms are rather small, it is likely that they have only one business unit and, consequently, one competitive strategy.

The relationship between the competitive strategy adopted by a firm and its performance has traditionally been a key concern in business strategy research (Parnell 2006). Generic strategy typologies represent a broad perspective on the strategy-performance relationship, focusing on the notion that firm performance is a function of strategic factors that are common across some rivals in a given industry (Parnell 2006). While the competitive strategy perspective views the firm as a bundle of activities aimed at adapting to an industry environment by seeking an attractive position in the market, the more recent perspectives, such as the resource-based view, see firms as a bundle of unique resources owned and controlled by the firm (Spanos & Lioukas 2001).

Much of previous research on competitive strategies can be traced to Porter's (1980) seminal work in which he argues a firm must make a choice between two generic strategies to achieve above-average performance: cost leadership or differentiation. Furthermore, Porter (1980) suggests a focus strategy, which aims at serving a particular customer group or a segment with either cost leadership or differentiation. Given that the majority of the firms analysed in this thesis are micro-sized or small- and medium-sized, it is more likely that they pursue a focus strategy with either cost leadership or differentiation to serve a narrower target market than trying to achieve low cost or differentiation for the whole industry. Thus, although the next sub-chapters will address the characteristics of the two main types of generic strategies, it should be noted that in the thesis setting they are pursued by firms as part of a focus strategy.

Porter (1980) argues that the simultaneous pursuit of cost leadership and differentiation is unlikely to produce sustainable competitive advantage and that a

firm would risk becoming "stuck-in-the-middle" without a coherent strategy. Consequently, a firm that is stuck in the middle will earn attractive profits only if the structure of the industry it is operating in is highly favourable or if its competitors are also stuck in the middle (Porter 1985). Nevertheless, several authors provide empirical evidence that cost leadership and differentiation might be compatible approaches and suggest the pursuit of hybrid strategies (e.g. Hill 1988; Wright et al. 1991; Beal & Yasai-Ardekani 2000; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010; Salavou 2015).

In addition, manufacturing strategy literature has identified a number of dimensions on which firms compete. These competitive priorities include cost, quality, flexibility and delivery among others (e.g. Skinner 1969; Stock et al. 1998; Ferdows & De Meyer 1990; Corbett & van Wassenhove 1993). Similarly, faster innovation cycles and having the ability to acquire and evolve new ways to solve process and product problems can be seen as a source of competitive advantage (Dyer 1996; Kaufman et al. 2000). Along with the traditional dimensions, some authors have suggested that environmental issues should be included as a competitive priority (e.g. Florida 1996; de Burgos Jiménez & Céspedes Lorente 2001; Jabbour et al. 2012; Longoni & Cagliano 2015). Given the growing responsibility of firms to reduce the environmental impacts of their activities, environmental management is an emerging and important competitive priority (Jabbour et al. 2012). A firm needs to pay explicit attention to it in order to prevent competitors from exploiting its weaknesses (de Burgos Jiménez & Céspedes Lorente 2001).

Competitive priorities can be seen as areas in which a firm chooses to excel in order to meet customer requirements (Stock et al. 1998). In line with Porter (1980), Skinner (1969) believes that strong trade-offs exist between competitive priorities and that firms need to focus on a single competitive priority (or, at most, just a few) in order to compete. The argument is based on the inconsistency of the skills and capabilities needed to excel at one competitive priority compared to the set of skills required for another competitive priority (Stock et al. 1998).

Ferdows and De Meyer (1990) rejected the traditional trade-off model and suggested that a firm does not need to choose one competitive priority at the expense of another because competitive priorities must be cumulative. Competitive priorities can be considered complementary, rather than mutually exclusive, given that an existing capability can facilitate the developing of other capabilities (Boyer & Lewis 2002). The idea of competitive priorities is closely related to generic competitive strategies. Cost as a competitive priority would correspond to cost leadership, while others, such as flexibility, quality and delivery, would correspond to differentiation (Stock et al. 1998; Shavarini et al. 2013).

Finally, it is important to draw a distinction between intended strategy and realised strategy. According to Mintzberg (1978), strategy is traditionally viewed as a statement of intent, a consciously formulated set of guidelines that determines decisions into the future. Realised strategy, in turn, is "a pattern in a stream of decisions", which emerges as a result of intentional and unintentional decisions. In this thesis competitive strategy is considered a realised strategy because it is operationalised through current sources of competitive advantage.

2.1 Cost leadership

Cost leaders achieve superior financial performance by having a significantly lower cost structure than their competitors (Beal & Yasai-Ardekani 2000). Firms pursuing cost leadership typically face fierce price competition from highly homogeneous products, which makes it difficult to provide personalised products, and those firms have to serve customers with strong bargaining power (Huo et al. 2014). Successful low cost leaders are usually positioned to exploit an attractive value proposition originating directly from their low cost emphasis. As a consequence, cost leadership can also be seen as another form of differentiation (Parnell 2006).

According to Porter (1980), cost leadership requires that the firm emphasises the aggressive construction of efficient-scale facilities, the vigorous pursuit of cost reductions from experience, tight cost and overhead control, the avoidance of marginal customer accounts and cost minimisation in areas such as R&D, service, sales force, and advertising. In order to achieve a low-cost advantage, a firm must have a low-cost mind-set, low-cost manufacturing and rapid distribution and replenishment, and the personnel need to be committed to pursuing that strategy (Malburg 2000; Akan et al. 2006; Allen & Helms 2006). According to Hill (1988), three sources of cost economies are relevant for establishing a low-cost position: economies due to learning effects, economies of scale and economies of scope. Akan et al. (2006), in turn, suggest mass production, mass distribution, economies of scale, technology, product design, input cost, the capacity utilisation of resources, and access to raw materials as ways to achieve low cost leadership. A firm must also be willing to discontinue any activities in which they do not have cost advantage and may also need to consider outsourcing activities to other organisations that have a cost advantage (Malburg 2000; Allen & Helms 2006).

2.2 Marketing differentiation

Firms pursuing a differentiation strategy can charge a premium price for their products based on product characteristics, delivery system, the quality of service, or the distribution channel (Allen & Helms 2006). The differentiation strategy attracts a sophisticated or knowledgeable consumer interested in a unique quality product or service (Akan et al. 2006). Given that there is not a comparable product, customers are less price-sensitive and willing to pay a higher price for these non-standardised products (Porter 1980; Allen & Helms 2006). Pursuing a differentiation strategy implies a trade-off with cost advantage and involves bearing higher costs in a number of functional areas in order to support differentiation through extensive research, product design, high quality materials and intensive customer support (Porter 1980; Helms et al. 1997). In this thesis differentiation is further divided into marketing differentiation and operations differentiation.

Marketing differentiation promotes uniqueness and point of difference through image, customer service, advertising, promotions, distribution and other marketing-related activities (Menguc et al. 2007). Marketing differentiators convince current or prospective customers that a company or its products are superior to competitors, although the differences may only be cosmetic (Beal & Yasai-Ardekani 2000). Hence, firms are able to achieve a competitive advantage over their competitors because of the perceived uniqueness of their products and services (Acquaah & Yasai-Ardekani 2008). Resulting customer loyalty and the need for a potential rival to overcome uniqueness creates entry barriers (Porter 1980). A key step in the successful execution of the differentiation strategy is to determine what makes the company different from competitors (Allen & Helms 2006).

2.3 Operations differentiation

Operations differentiation is based on different competitive priorities (Shavarini et al. 2013). A firm competing with operations differentiation would attempt to gain competitive advantage on the basis of the quality of its products or services (quality), its ability to make rapid design changes, the ability to launch new products quickly or to respond to changes in demand (flexibility), or the ability to deliver the product to the customer fast and on time (delivery) (Stock et al. 1998). Fawcett et al. (1997) argue that while cost and quality have become basic standards by which competitiveness is measured, delivery performance has become increasingly important as a viable differentiator. Furthermore, differentiation on

flexibility is becoming more pronounced as firms are increasingly dispersing their activities in different locations (Ndubisi et al. 2005).

Operations differentiation could also be considered to correspond to performance-oriented logistics in Persson's (1991) typology. In this segment the firm wants to ensure a certain level of performance or to create competitive advantage through superior logistics performance. Ketchen and Hult (2007) describe "best value supply chains" that strive to excel along multiple competitive priorities, such as speed, quality, cost and flexibility. Instead of focusing on a single priority they focus on total value added to the user.

2.4 Hybrid strategies

The "taxonomical" approach of competitive strategy advocated by Porter (1980) has been challenged by a number of authors defending the "dimensional" approach (e.g. Miller & Dess 1993; Pertusa-Ortega et al. 2009). Porter (1980) argues that cost leadership and differentiation are alternative and incompatible methods, given that the former strategy requires a large market share and scale economies, whereas the latter may require a small market share and therefore may translate into a lack of scale economies (Helms et al. 1997). In contrast, the dimensional approach views generic competitive strategies as dimensions of strategic positioning rather than two distinct and mutually exclusive strategies. As a consequence, firms fall somewhere along the continuum of the strategic dimensions of cost leadership and differentiation (Miller & Dess 1993; Pertusa-Ortega et al. 2009). Several authors suggest the pursuit of hybrid strategies by combining cost leadership and differentiation (e.g. Hill 1988; Spanos et al. 2004; Kim et al. 2004; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010; Claver-Cortés et al. 2012; Salavou 2015). Cost-based and differentiation-based competitive advantages are difficult to sustain, thus firms pursuing a hybrid strategy may be able to achieve a higher performance (Acquaah & Yasai-Ardekani 2008). Additionally, there is rarely a unique low cost position and firms have to pursue both cost leadership and differentiation strategies simultaneously (Hill 1988). Firms pursuing a differentiation strategy may also be able to achieve a low-cost position by emphasising efficiency in their value-creating activities, thereby further strengthening their competitive position vis-à-vis their competitors (Acquaah & Yasai-Ardekani 2008).

The advocates of hybrid strategies associate certain problems with pure strategies (cost leadership or differentiation) (Miller 1992; Beal & Yasai-Ardekani 2000; Leitner & Güldenberg 2010; Claver-Cortés et al. 2012; Salavou 2015):

- Pure strategies may leave serious gaps or weaknesses in product offerings and ignore important customer needs.

- Firms focusing on a pure strategy might be less responsive to market changes and be less agile and flexible in offering products that focus more on either costs or on a specific product feature.
- Pure strategies are easier to imitate, and firms following them may be at a disadvantage compared to those that combine them in a creative way because hybrid strategies can yield multiple sources of advantage over competitors, thus allowing a realisation of higher performance.

These three problems can be transformed into arguments for hybrid strategies: customer needs can be addressed better with a hybrid strategy because a hybrid strategy is more difficult to imitate and it might generate a more flexible and wider view (Claver-Cortés et al. 2012). Hybrid strategies are argued to offer many strategic options of "grey shades", irrespective of the sector the firm operates in (Salavou 2015). The adoption of a hybrid strategy may help a firm to obtain several sources of advantage, and thus enable higher performance levels and safety against competitors (Pertusa-Ortega et al. 2009). A number of previous studies have found empirical evidence that firms pursuing a hybrid strategy had equal or greater financial performance compared to firms focusing either on cost leadership or differentiation (e.g. Spanos et al. 2004; Kim et al. 2004; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010). Thus, the research on competitive strategy has shifted focus since Porter's (1980) work. While the research question used to be which one of the pure strategies led to higher firm performance, today the research revolves more around whether a pure competitive strategy or a hybrid competitive strategy leads to superior performance (Salavou 2015).

2.5 Stuck-in-the-middle strategies

According to Porter (1980), cost leadership and differentiation are mutually exclusive and a firm that is unwilling to make strategic choices might become "stuck-in-the-middle". The idea of stuck-in-the-middle refers to a lack of clarity in the strategy, which fails to place a distinct emphasis on either dimension (Pertusa-Ortega et al. 2009). Others see stuck-in-the-middle strategies as an underdeveloped form of hybrid strategy based on an intermediate position: it is below that of the other hybrid strategies but higher than that of "no strategy" alternatives (Spanos et al. 2004). Previously, research mixed hybrid strategies with stuck-in-the-middle strategies, but more recent studies refer to the former as competitive behaviour that emphasises more than one generic strategy, while the latter refers to the lack of distinctive emphasis on any particular strategy, i.e. an average emphasis on all generic strategies (Salavou 2015). Many previous studies have associated stuck-in-the-middle strategies with lower levels of performance (e.g. Porter 1980; Kim

et al. 2004; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010). However, Spanos et al. (2004) found that stuck-in-the-middle strategies, conceptualised as an underdeveloped version of a hybrid strategy, were more profitable than expected and yielded above-average performance. Hence, a stuck-in-the-middle strategy perceived as an average performance in all strategic dimensions might be a viable option for some firms.

2.6 Linkage to green supply chain management

Table 3 summarises the competitive strategies described earlier in this chapter. The typology of competitive strategy approaches can be used as conceptual tool to describe the options a firm has in terms of competitive strategy.

Although previous research recognises the relationship between business strategy (or competitive strategy) and supply chain practices (Cousins 2005), competitive strategy has received limited attention in previous studies on green supply chain management. Earlier research has, for example, developed generic competitive environmental strategies (Orsato 2006) and studied the integration environmental and social priorities in operations strategy (Longoni & Cagliano 2015). Hoejmose et al. (2013) focused on the social dimension of sustainability and found that competitive strategy had an effect on socially responsible supply chain management. Wu and Pagell (2011) conclude that environmental efforts have to make sense in terms of business.

Longoni and Cagliano (2015) argue that the strategy deployment regarding environmental and social sustainability is particularly difficult because of their complexity, their interrelations with traditional competitive priorities and the longer time period. Thus, firms face the challenge of balancing environmental issues and sound business practices in a dynamic, complex and uncertain environment (Wu & Pagell 2011). Although Testa and Iraldo (2010) suggest that the adoption of GSCM practices can be driven by diverse strategic motivations (such as reputation, efficiency or innovation), there is a need to increase the understanding of how firms integrate environmental priorities into their competitive strategy.

Table 3 Description of competitive strategies

Strategy	Description	Sources
Cost leadership	Superior financial performance achieved by having a lower cost structure than competitors. Cost leadership requires cost economies, tight cost and overhead control, avoidance of marginal customer accounts, and cost minimisation in areas such as R&D, service, sales force and advertising.	Porter 1980; Hill 1988; Beal & Yasai-Ardekani 2000; Allen & Helms 2006; Akan et al. 2006; Huo et al. 2014
Marketing differentiation	Marketing differentiation promotes uniqueness through image, customer service, advertising, promotions, distribution and other marketing-related activities to persuade a customer to pay a premium price.	Porter 1980; Beal & Yasai-Ardekani 2000; Menguc et al. 2007
Operations differentiation	Operations differentiation attempts to gain competitive advantage on the basis of the quality of its products or services (quality), ability to make rapid design changes, to launch new products quickly or to respond to changes in demand (flexibility), or ability to deliver the product to the customer fast and on time (delivery).	Fawcett et al. 1997; Stock et al. 1998; Shavarini et al. 2013
Hybrid	Hybrid strategies combine cost leadership and differentiation to obtain several sources of competitive advantage, and thus enable higher performance levels and protection from competitors.	Miller 1992; Acquaah & Yasai-Ardekani 2008; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010; Salavou 2015
Stuck-in-the-middle	Seen as lack of clarity in the strategy or as an underdeveloped form of a hybrid strategy based on an intermediate position	Porter 1980; Spanos et al. 2004; Pertusa-Ortega et al. 2009; Salavou 2015

3 FIRM PERFORMANCE

In this study firm performance is considered to consist of 1) financial performance, 2) operational performance and 3) environmental performance. These three dimensions are further elaborated on in this chapter.

3.1 Financial performance

Financial performance could be considered as performance measured by financial indicators to assess a firm's efficiency and effectiveness (Rajesh et al. 2011). Financial performance measures define the long-term objectives of a business unit (Kaplan & Norton 1996). Stock et al. (2000) argue that in comparison to operational performance measures, financial performance measures are more likely to reflect the assessment of a firm by factors outside of the firm's boundaries.

Accounting measures are the most common and readily available means of measuring organisational performance. However, it should be noted that they reflect mainly historical activity and can be limited in anticipating expectations about future performance (Richard et al. 2009). The financial reporting-based metrics of Return-On-Assets (ROA), Return-On-Investment (ROI), Return-On-Capital-Employed (ROCE), and Earnings Before Interest and Taxes percentage (EBIT-%) are used to analyse financial performance. Return-based measures can be perceived as measures of managerial efficiency in the use of available resources (Babic & Plazibat 1998) and they are widely used in previous literature. ROA reflects how effectively a firm utilises its assets in generating profits (Wagner et al. 2012). According to Kaplan and Norton (1996) ROCE can be linked to operational performance, such as process quality and on-time delivery. ROI has been argued to be a useful (and perhaps the best available) indicator of business performance (Jacobson 1987). EBIT-% is included to check if profitability behaves differently compared to asset-based measures (Töyli et al. 2008; Solakivi 2014). Stock price and market share data were excluded in this research, given that most firms in the chosen samples are not publicly listed.

In addition to the financial reports-based measures of performance, financial performance is measured as the managerial perceptions of four financial indicators in article IV: increase in turnover, profit, market share and ROA. Thus, they could be characterised as quasi-objective measures, i.e. they produce specific objective performance information by self-report techniques (Richard et al. 2009). Although

any self-reported, perceptual measure might be subject to bias, similar methods have been used by several other studies (e.g. Vickery et al. 2003; Flynn et al. 2010; De Giovanni & Esposito Vinzi 2012; Green et al. 2012a). Powell (1995) argues that subjective performance measures might be preferred to financial reporting data due to heterogeneous samples that have industry differences in capital structures and accounting conventions and firm differences in inventory valuation, depreciation and salaries.

3.2 Operational performance

3.2.1 Components of operational performance used in this thesis

Numerous terms are used to refer to how a firm performs in terms of its internal logistics/supply chain operations. The term "operational performance" is used in this thesis to describe the measurable aspects of the outcomes of an organisation's processes (Voss et al. 1997). According to Stock et al. (2000), operational performance reflects competencies in specific areas of manufacturing and logistics, including cost, delivery speed and reliability, quality, and flexibility. Zhu et al. (2008) include items such as delivery reliability, product quality, and inventory levels. The terms "logistics performance" or "supply chain performance" are also used to describe the operational aspect of firm performance. However, despite the wide use of the term supply chain performance, most studies do not use inter-organisational metrics to assess it (Fabbe-Costes & Jahre 2008). Chow et al. (1994) discuss logistics performance and suggest that its elements include widely used measures, such as cost efficiency, customer satisfaction, on-time delivery, flexibility as well as less used dimensions, such as social responsibility and working conditions and job security. Despite the different terms used, the dimensions included in the definitions do not seem to vary much.

As suggested by Solakivi (2014), operational performance in the context of manufacturing and trading is, in this thesis, considered to consist of 1) logistics costs, 2) customer service performance and 3) asset utilisation. The dimensions are further defined as follows: logistics costs are considered to include 1) transportation and packing costs, 2) warehousing costs, 3) inventory carrying costs, 4) logistics administration costs and 5) other logistics costs (e.g. Töyli et al. 2008; Engblom et al. 2012).

Customer service performance is defined here as perfect order fulfilment rate and order fulfilment cycle time, whereas asset utilisation comprises cash-to-cash cycle time and inventory days of supply (Lorentz et al. 2012). The definition follows Töyli et al. (2008), Lorentz et al. (2012) and Solakivi (2014), who use a

similar operationalisation. While Töyli et al. (2008) use the term "logistics performance", Lorentz et al. (2012) and Solakivi (2014) use the term "intra-firm supply chain performance" to highlight that the perspective is limited to how the properties of the inter-firm supply chain affect the performance of the focal firm.

Given that the above-mentioned definition of operational performance cannot be easily applied to logistics service providers, the operational performances of LSPs were examined in this thesis by using the five operational efficiency measures suggested by Johnston (2010): 1) empty mile percentage, 2) average transport performance, 3) average length of haul and 4) average load factor in domestic shipments and 5) average load factor international shipments. The dimensions of operational performance in both manufacturing and trading and logistics services are explained in greater detail below.

3.2.2 Logistics costs

Logistics costs are expenses that are incurred by performing logistics activities and by having the infrastructure, capacity or the readiness to perform logistics activities during a certain time period (Hälinen 2015). Logistics costs represent a significant proportion of business costs: depending on the method applied and the industry in question, the share of logistics costs as a percentage of company turnover is estimated to be at least 10 per cent in industrialised countries (Engblom et al. 2012). Petterson and Segerstedt (2013) note that although the terms logistics cost and supply chain cost are often used interchangeably, their scope is essentially different. While logistics costs typically include costs related to distribution and warehousing, supply chain costs involve all relevant costs in the supply chain of the company, such as manufacturing and installation costs.

Several classifications of logistics cost components exist but the disjointed definitions or research methodologies make them difficult to compare (Rantasila 2013). Lambert (1994) includes transportation, warehousing, inventory carrying, order processing and information costs but also production lot quantity costs and costs of lost sales. Gunasekaran et al. (2001) include, for example, cost of lost sales, the opportunity cost of warehousing, capital and storage and risk costs under inventory costs, thus combining elements of warehousing and inventory carrying costs. Inventory carrying costs vary according to the level of inventory changes and warehousing costs vary according to the number of warehousing facilities (Lambert 1994).

Enblom et al. (2012) conclude that transportation, warehousing, inventory carrying and administration cost components as proposed by Heskett et al. (1973) seem to be generally in use but their limits are defined in different ways. There are also a variety of other logistics cost components in the previous literature, such as

customs charges, risk and damage, and handling and packaging (Zeng & Rossetti 2003).

Logistics cost data used in thesis article II consist of the following components: 1) transportation and packing costs, 2) warehousing costs, 3) inventory carrying costs, 4) logistics administration costs and 5) other logistics costs. They were measured as self-reported, open-field responses as a share of a firm's turnover, which, according to Stewart (1995), is a robust basis for analysis. The estimate for the total logistics cost comprises the sum of the individual components.

3.2.3 Customer service performance

Customer satisfaction is of paramount importance for increasing competitiveness (Gunasekaran et al. 2004). Customer service can be seen as a combination of individual service dimensions, whose importance may differ from one industry to another (Vickery et al. 2003). Hence, firms should measure the level of their customer service as customers might turn to other supply chains if their customer service level is not acceptably high (Beamon 1999a). Following previous literature (Fawcett and Cooper 1998; Töyli et al. 2008; Lorentz et al. 2012), customer service performance is considered here to consist of the perfect order fulfilment rate and order cycle time. Perfect order fulfilment rate is defined as complete orders delivered to customers by requested date and time in perfect condition, including all documentation (Fawcett & Cooper 1998). Order cycle time measures the days required for completing a customer order, from the receipt of the customer's order to the delivery of the goods (Gunasekaran et al. 2001). Filling orders completely and correctly the first time decreases operating costs and increases customer satisfaction (Tracey et al. 1999), short order cycle time implies responsiveness (Gunasekaran et al. 2001) and rapid responses to orders reduces operating costs, enabling customers to enjoy the benefits of the product immediately (Tracey et al. 1999).

In addition to assessing customer service performance from the focal firm's point of view, an item measuring a supplier's perfect order fulfilment was also included in the Finland State of Logistics 2012 and 2014 questionnaires and this thesis (article II). A supplier's delivery accuracy saves time and effort for the customer (Ulaga 2003). Given the increasing complexity of global sourcing strategies, supplier delivery performance should be the primary focus of source activities (Gunasekaran et al. 2004; Chae 2009). Firms should be able to quantify supplier delivery performance in financial terms in order to avoid short- and long-term problems, related to problems with perceived and actual performance and capital budgeting (Guiffrida & Nagi 2006).

3.2.4 Asset utilisation

Asset utilisation is a key measure of firm and overall supply chain performance as viewed by the financial market (Stank et al. 2005). Some authors consider asset utilisation to be a measure of financial performance (e.g. Capon et al. 1990; Brewer & Speh 2000), while others take a supply chain perspective (e.g. Gunasekaran et al. 2004; Töyli et al. 2008). A firm's cash flow policies manage working capital (Kroes & Manikas 2014) and although financial flows are one of the key elements of supply chain management, they have attracted limited scholarly attention (Wuttke et al. 2013).

One commonly used metric for measuring working capital performance is the cash-to-cash cycle time (also known as the cash conversion cycle). Cash-to-cash cycle time is a composite measure for assessing how well a firm is managing its capital (Farris & Hutchison 2002; Hofmann & Kotzab 2010). Cash-to-cash cycle time is measured as inventory days of supply plus days of sales outstanding minus days of payables outstanding (Lancaster et al. 1998; Farris & Hutchison 2002). Hence, a firm's cash flow can be influenced in three ways: by changing: 1) the time from when goods are sold up to the point when the revenue is collected by the firm, 2) the firm's inventory levels and 3) the time that a firm takes to pay its vendors (Kroes & Manikas 2014).

The cash-to-cash metric is important from both accounting and supply chain management perspectives. In accounting it can be used to assess liquidity and organisational valuation, while in SCM it serves as a measurement that bridges across the inbound and outbound processes of the firm through internal operations (Farris & Hutchison 2002). By eliminating non-value adding time in the supply chain, a firm can achieve significant reductions in working capital (Christopher & Ryals 1999).

Research has only recently begun to demonstrate that planning, managing, and controlling financial flows along supply chains will have a positive impact on supply chain profitability (Wuttke et al. 2013). Although cash inflows and outflows are usually managed by a firm's financial department or financial manager, the operating activities that generate the cash flows are frequently controlled by others (Özbayarak & Akgün 2006; Kroes & Manikas 2014). Due to potential trade-offs between operational and financial decisions, there is a need to consider both aspects jointly (Protopappa-Sieke & Seifert 2010).

A cash-to-cash cycle is particularly linked with the management of stock and shop floor control policy, which drives the stock levels for raw materials, work-in-progress and finished goods (Özbayarak & Akgün 2006). While goods are held in inventory, cash is tied up (Kroes & Manikas 2014). Furthermore, late deliveries invite late payments (Özbayarak & Akgün 2006), which means that cash from sales outstanding is unavailable while a firm waits for a customer to pay (Kroes &

Manikas 2014). Finally, a firm can benefit from longer payment cycles in its purchasing and therefore get interest-free financing (Farris & Hutchison 2002). However, longer payment times might hurt the firm's relationships with its suppliers, force suppliers to lower their service levels or raise their prices and harm the overall supply chain (Hofmann et al. 2010; Kroes & Manikas 2014).

3.2.5 Operational efficiency of logistics service providers

While the previous subchapters focused on the operational performance of manufacturing and trading firms, the operational performance of LSPs was examined in this thesis by using five operational efficiency measures developed by Johnston (2010): empty-mile percentage, average load factor (%) in both domestic and international shipments, average transport performance per vehicle (km), and average length of haul (km). Johnston (2010) argues that these measures are used by motor carriers to manage day-to-day operations and performance improvements in these metrics can increase asset utilisation and eventually financial performance. However, traditional performance measures have been criticised for failing to capture differentiation in rates for commodities (Baker 1989).

Baker (1989) suggests that LSPs would attempt to either increase the total number of miles (or kilometres) covered by an operation, increase the number of trips made or increase the average miles (or kilometres) per trip to spread the fixed costs over the widest possible base. Average length of haul, in turn, is a useful measure to separate short-distance from long-distance shipments, and increases in the measure may imply expansions and service optimisations (Cotrell 2008). Monitoring load factors, on the other hand, is based on the assumption that in the logistics industry, where freight rates are calculated on weight, high load factors produce high revenues per tractor (Baker 1989).

Empty journeys are an inevitable consequence of the uni-directional movement of freight consignments and the difficulty of balancing freight flows in the opposite direction (McKinnon & Edwards 2012). Cotrell (2008) studied the USA's trucking industry and found that the empty miles factor was considered an "extremely important" measure for the industry as empty running can be considered a waste of resources. Consequently, better asset utilisation and less non-revenue generating time between shipments should result in lower operating costs (Johnston 2010).

3.3 Environmental performance

Darnall et al. (2008) argue that organisations cause both direct and indirect impacts on the natural environment. Direct environmental impacts originate from inputs from first-tier suppliers that increase waste during product storage, transportation, processing, use or disposal. Indirect environmental impacts are connected to an organisation's second tier suppliers' products, which produce the inputs used in the first tier supplier's production process. Defined in the ISO 14001 certificate, the environmental impact is

> *...any change in the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.* (Olsthoorn et al. 2001)

Environmental performance can be considered the ability to mitigate harmful effects on the natural environment. Judge and Douglas (1998) define environmental performance as

> *...a firm's effectiveness in meeting and exceeding society's expectations with respect to concerns for the natural environment.*

According to Zhu et al. (2008), environmental performance is the ability to reduce air emissions, waste water, solid wastes, the consumption of hazardous materials, the frequency of environmental accidents and to improve a firm's environmental situation. El Saadany et al. (2011), in turn, do not view environmental performance from the perspective of reducing harmful environmental effects but simply as measuring the amount of pollutants released into the air from industrial plants and hazardous substances transferred to and from other plants that end up affecting soil and water quality as landfill. Yang et al. (2013) use the term green performance to describe the measurement of the interaction between the business and the environment.

Many companies use environmental reports as a communication tool to describe the most important links between the company and the environment (Azzone et al. 1996). Environmental reports include numerous environmental tangible and intangible environmental performance metrics that have implications for strategic, tactical and operational management levels (Hervani et al. 2005). Despite the fact that a body of previous research has advocated measuring environmental performance on the supply chain level, an internal focus seems to be the most common practice (Björklund & Forslund 2013). Furthermore, managing and measuring environmental performance indicators can contribute to significant cost savings and productivity gains (Shaw et al. 2010). Thus, a firm's evolutionary

stage in environmental management will have a large influence on the types of metrics used (Hervani et al. 2005). Environmental performance indicators can be classified according to the ISO 14031 guidelines (Henri & Journeault 2008; Shaw et al. 2010):

- Management performance indicators provide information about management's efforts in influencing its environmental performance, e.g. environmental costs or budget, the percentage of environmental targets achieved and the time spent responding to environmental incidents.
- Operational performance indicators assess the environmental performance of an organisation's operations, e.g. raw materials used/unit produced and the average fuel consumption of the vehicle fleet.
- Environmental condition indicators show the local, regional, national or global conditions of the environment, e.g. the contaminant concentration in ground or surface water and the area of contaminated land rehabilitated.

Jasch (2000) maintains that environmental management performance indicators are useful in quantifying internal environmental management targets but fail to offer information on the environmental performance per se. Instead, environmental condition indicators describe the direct impacts on the environment, such as the effect of air emissions on regional air quality, or the effect of waste water close to an industrial facility. Finally, operational performance indicators comprise the basis of the internal and external communication of environmental data, such as for GRI or EMAS reporting.

Moreover, similar to other performance dimensions, environmental performance can be measured as absolute performance or relative performance (Ahi & Searcy 2013). Absolute environmental performance indicators show amounts without a particular reference point (Tyteca 1996), such as tons of waste. Relative indicators are scaled to other variables, such as production volumes or the number of employees (Jasch 2000).

This thesis (article IV) follows previous research (Zhu et al. 2008; De Giovanni & Esposito Vinzi (2012); Yang et al. 2013) and measures environmental performance as the reduction of CO_2 emissions, waste, energy consumption, water consumption and the consumption of hazardous materials. Furthermore, the respondents were asked to assess whether their firm has been a forerunner in environmental issues.

4 GREEN SUPPLY CHAIN MANAGEMENT

4.1 Defining green supply chain management

There is a growing need to integrate sustainability into the operations of organisations. The most adopted definition of sustainable development is that provided by the Brundtland Commission (World Commission on Environment and Development 1987):

> *Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

Sustainability is often operationalised using the concept of triple bottom line developed by Elkington (1997), which integrates economic, environmental and social sustainability. The triple bottom line suggests that firms need to engage in environmentally and socially responsible behaviour and that positive economic gains can be made in the process (Gimenez et al. 2012).

Given the growing concerns of various stakeholders, firms might be held responsible not only for their own but also for the sustainable performance of their suppliers (Seuring & Müller 2008). As a result, researchers and practitioners in supply chain management are increasingly taking the impacts and implications of sustainability into account (Gimenez et al. 2012). The integration of sustainability into SCM has led to the development of sustainable supply chain management (SSCM), broadly defined by Carter and Rogers (2008) as:

> *the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains.*

Pagell and Wu (2009) refer to SSCM as specific managerial actions that are taken to make the supply chain perform well on all elements of the triple bottom line with an end goal of creating a genuinely sustainable supply chain.

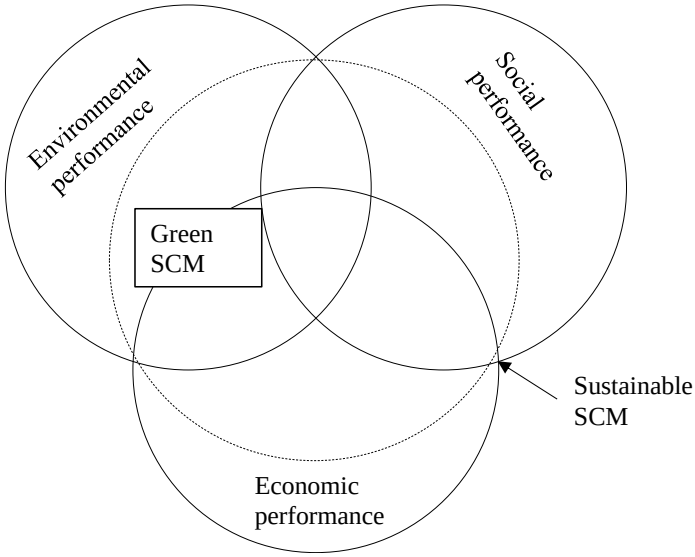

Figure 2 Illustration of sustainable and green supply chain management (Brockhaus et al. 2013)

Green supply chain management (GSCM) appears to be a more narrowly focused dimension of sustainable supply chain management, emphasising the environmental dimension of sustainability, while the social dimension is usually omitted. One of the most used definitions of GSCM is provided by Srivastava (2007) who describes GSCM as integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to consumers as well as the end-of-life management of the product after its useful life. Ahi and Searcy (2013) recently conducted an extensive literature review and found 22 unique definitions of GSCM. They found that, in general, the definitions addressed environmental and economic considerations while highlighting the role of coordination and flows. In addition, the definitions of GSCM range from the reactive monitoring of general environmental management programmes to more proactive practices and even environmental innovations (Zhu & Sarkis 2004).

4.2 Green supply chain management practices

Firms are adopting green supply chain management practices in response to stakeholder demands for environmentally sustainable products and processes (Green et al. 2012b). Green supply chain management has previously been classified into internal practices within the firm and external practices with supply chain partners (e.g. Rao & Holt 2005; De Giovanni & Esposito Vinzi 2012; Yang et al. 2013; Zhu

et al. 2013). Internal GSCM practices reflect a firm's decisions to act in an environmentally friendly way (Azevedo et al. 2011). External GSCM practices typically require some level of cooperation with other stakeholders, such as suppliers and customers (Zhu et al. 2013).

This thesis addresses internal GSCM practices and two types of external GSCM practices developed by Vachon and Klassen (2006a; 2008): environmental monitoring and environmental collaboration. These practices are examined in relation to suppliers and customers while other stakeholders, such as authorities, competitors and non-governmental organisations are excluded. These type of practices can also be referred to as governance mechanisms, i.e. practices used by firms to manage relationships with their suppliers (Gimenez & Sierra 2013). Environmental monitoring refers to activities using markets or arm's length transactions conducted by the buying organisation in order to select suppliers that have implemented environmental management systems, to inform suppliers of environmental requirements and to monitor the compliance of suppliers with environmental requirements.

Environmental collaboration, in turn, comprises the direct involvement of the buying organisation with its suppliers to jointly set and achieve environmental goals that result in the reduction of the environmental impact of coordinated activities (Vachon & Klassen 2006a; Green et al. 2012a). Given that each focal firm acts as a buyer to its suppliers and as a supplier to its customers, environmental collaboration and environmental monitoring can take place simultaneously both upstream and downstream in the supply chain (Vachon & Klassen 2008).

Hoejmose et al. (2014) use a similar type of distinction and divide GSCM into coercive and cooperative approaches, in which the former is concerned with requiring suppliers to behave in an environmentally responsible manner while the latter is more flexible and incentive-based. Brockhaus et al. (2013) classify the supply chain approaches toward sustainability into mandated and collaborative. The mandated approaches are usually initiated by buying firms and extended to upstream members using formal methods of communication. The benefits of the initiative might be disproportionately split. The collaborative approach, in turn, aims at gaining competitive advantage for the whole supply chain over a long period of time (Brockhaus et al. 2013). Gimenez and Sierra (2013) divide the governance mechanisms into "hands-on" and "hands-off" approaches. The former implies direct management and significant investments in time, personnel, and resources, while the latter is indirect and based on standards.

The choice of an appropriate governance mechanism has attracted some scholarly attention. The interviewees in the study by Brochaus et al. (2013) agreed that the collaborative approach would be more beneficial compared with the more mandated approach to sustainability. Collaboration builds trust and suggests

commitment to the relationship of the buyer and the supplier; in consequence, suppliers are more inclined to invest in development initiatives, such as GSCM adoption (Caniëls et al. 2013). However, other studies advocate the use of both types of GSCM practices. Large and Gimenez Thomsen (2011) found support for the idea that both green collaboration and green assessment had a direct positive impact on environmental performance. Green et al. (2012a) argue that environmental collaboration is a necessary precursor to environmental monitoring. Furthermore, supplier evaluation and monitoring is needed to determine which suppliers and what needs should be developed in closer collaboration according to Reuter et al. (2010) and Gimenez & Sierra (2013). Supplier-related GSCM practices have also been termed "environmental purchasing" or "green purchasing" in the previous literature (e.g. Zhu et al. 2008; Green et al. 2012b; Zhu et al. 2013).

Given the different characteristics of environmental collaboration and environmental monitoring, it is necessary to consider both aspects in GSCM research and in this thesis. The next section introduces four theories that are widely used in GSCM research, followed by a discussion on the effects of GSCM practices on firm performance.

4.3 Theoretical lenses applied to green supply chain management

Green supply chain management has been examined using numerous organisational theories (Sarkis et al. 2011). The institutional theory, transaction cost economics, the resource-based view and resource dependence theory are considered the most appropriate for this thesis – in order to take both the internal and external drivers of GSCM practices into account.

4.3.1 Institutional theory

Institutional theory posits that external pressures strongly affect organisational decision making (Di Maggio & Powell 1983; Scott 1998). Institutional theory is relevant to the adoption of GSCM practices as firms operate in a way that meets social and legal expectations (Tate et al. 2011). Pressures from stakeholders such as governments, customers, competitors, communities and environmental interest groups, and industry associations are likely to dictate environmentally responsible behaviour (Delmas & Toffel 2004). The pressures for environmental sustainability vary along the supply chain (Hall 2000). Large, high-profile firms are under considerable pressure from external stakeholders to improve their environmental

performance, whereas smaller suppliers or suppliers far upstream from the final consumer have fewer apparent incentives (Hall 2000; Lee et al. 2014).

Within institutional theory, there are three types of institutional mechanisms affecting managerial decisions: coercive, normative and mimetic pressures (Di Maggio & Powell 1983). Coercive pressure is exerted by the other organisations upon which the focal firm is dependent or by cultural expectations within society (Di Maggio & Powell 1983). Coercive pressures often come in two forms: industry-level pressures dictate what kind of conduct is expected from a particular industry while firm-level pressures are directly exerted on individual firms (Hoejmose et al. 2014). Mimetic pressures derive from uncertainty. Technological or environmental uncertainty or the lack of clear objectives might result in firms copying and imitating their successful competitors (Di Maggio & Powell 1983; Hoejmose 2014). Normative pressures cause firms to conform to expectations in order to be perceived as having legitimate organisational activities (Sarkis et al. 2011). Normative pressures include industry standards, best practices and conventional wisdom (Milstein et al. 2002).

Coercive pressures, such as regulations and regulatory enforcement, have been argued to be the main reasons for adopting environmental practices (Jennings & Zandbergen 1995). Failure to comply with these regulations may result in the loss of earnings, a damaged reputation and even the loss of the license to operate (Bansal 2005). In addition to industry-level coercive pressures, firms might face direct institutional pressure from customers (Vachon & Klassen 2006a; Hoejmose 2014). In response to downstream demands, firms tend to pass environmental requirements to their upstream suppliers through coercive mechanisms (Hoejmose et al. 2014; Lee et al. 2014). Lee et al. (2014) developed the term "green bullwhip effect" to describe the phenomenon where demands for better environmental performance are amplified when moved upstream through successive tiers. Greening a supply chain is a potentially effective mechanism to improve a firm's record on corporate social responsibility, to abate reputational risks, to reduce wastes and to increase the flexibility to respond to new environmental regulations (Simpson et al. 2007).

Less regulated contexts support the emergence of green supply chains designed with the objective of providing innovation and differentiation, resulting in GSCM initiatives diffusing through normative or mimetic pressures (Carbone & Moatti 2011). Increasing the environmental awareness of consumers forms a core normative pressure for manufacturers to implement GSCM (Sarkis et al. 2011). Recent literature also indicates that shippers' demands for environmentally friendly logistics services are also increasing, especially in developed economies (Martinsen & Björklund 2012; Wolf & Seuring 2010). For example, about a third of shippers participating in the Logistics Performance Index 2014 survey were

concerned about sustainability and the environmental footprint of their international supply chain when shipping to OECD countries (Arvis et al. 2014).

In addition, peer pressure, for example, from professional networks and industry associations has a positive impact on GSCM adoption (Tate et al. 2011). Normative or mimetic isomorphism can occur if a few leading firms wish to derive first-mover advantages from GSCM implementation (Carbone & Moatti 2011). Suppliers and other members of the supply chain sharing similar characteristics or locations become aware of environmental practices and use this information to evaluate and compete with other supply chain members (Tate et al. 2011).

4.3.2 Transaction cost economics

Transaction cost economics (TCE) explores how much effort and cost is required for two entities to complete an economic exchange or transaction (Williamson 1981; Sarkis 2011). Transaction costs can be divided into the costs arising from establishing contact with the new trade partner (searching costs), costs from negotiating a new contract with the partner (bargaining costs) and costs related to monitoring the partner's fulfilment of the contract (control costs) (Skjoett-Larsen et al. 2003).

Regarding environmental practices, information costs are associated with learning about new technologies, ideas, competitive landscapes, and even determining the costs of acquiring competency in a given arena (Tate et al. 2011). Bargaining costs accumulate primarily due to the time and effort involved in bargaining and developing an agreement (Tate et al. 2011). Time spent on bargaining activity reduces the time available for primary functions (Pearce 1997). Finally, transaction costs are incurred when monitoring the sustainability performance of suppliers (Carter & Rogers 2008). It should also be noted that the supplier might not be willing to invest in deepening the relationship if the transaction costs for meeting a particular buyer’s environmental requirements are considered to be too high (Tate et al. 2011).

The theory of TCE explains which transactions should be performed internally by the firm, which activities should be done outside of the firm through market mechanisms and why (Tate et al. 2011). The traditional make-or-buy decision can be extended to environmental issues. For example, firms might consider outsourcing some environmentally damaging processes in order to reduce liability, clean-up or image costs, or to gain environmental expertise (Sarkis et al. 2011). Firms with environmental specialties can have competencies and skills in areas such as environmental restoration, the transportation of hazardous materials and environmental product design, while the outsourcing firm can concentrate on core competencies instead of devoting time to developing additional skills (Zsidisin &

Siferd 2001). However, this type of outsourcing might result in increasing monitoring and control costs (Sarkis et al. 2011).

An organisation can internalise activities in the supply chain related to the environment or externalise them without committing significant amounts of their own resources in order to improve environmental performance outside its operations. The GSCM practices suggested by Vachon and Klassen (2006a) can also be examined from the TCE perspective. Thus, environmental monitoring corresponds to the externalisation dimension of the TCE framework and environmental collaboration to the internalisation dimension. While there might be substantial initial investment involved in a buyer–supplier relationship, collaboration helps firms reduce the costs of opportunism and monitoring (that are intrinsic to market transactions) through the development of process integration and mutual trust (Cao & Zhang 2011).

4.3.3 Resource-based view

The resource-based view (RBV) was developed by Wernerfelt (1984) who perceived a firm as a broader set of resources compared to the traditional view which accounts only for categories such as labour, capital and land. However, the potential importance of resources was understood much earlier. In the 1930s, economists, such as Edward Chamberlin and Joan Robinson highlighted firm heterogeneity (Fahy 2000). The idea was later developed by Edith Penrose (1959) who argued that the internal resources of a firm have a profound impact on the growth of the firm. A resource is "anything which could be thought of as a strength or weakness of a given firm". The resources a firm possesses can provide a source of competitive advantage (Barney 1991).

The extension of the RBV to the natural-resource-based view (NRBV) is widely used in explaining why firms adopt GSCM. The NRBV posits that strategy and competitive advantage can be created from capabilities facilitating environmentally sustainable economic activities (Hart 1995). Hart argues that for a resource to be valuable, rare, inimitable and non-substitutable, it must possess three characteristics: it must be causally ambiguous, socially complex and firm-specific.

However, the requirement for firm-specificity has been challenged. The relational view posits that organisational capabilities can be developed beyond organisational boundaries by combining resources existing in different supply chain members (Dyer & Singh 1998). These resources are causally ambiguous and socially complex and thus difficult for competitors to imitate (Shi et al. 2012). The relational view has been combined with the NRBV (e.g. Vachon & Klassen 2008; Shi et al. 2012) to argue that environmental management in the supply chain can

create competitive advantage. For example, environmental collaboration can lead to the development of knowledge-sharing routines and the development of the capability to integrate external resources (Vachon & Klassen 2008). Thus, the RBV is often used to explain more strategic motivations of GSCM adoption, such as why firms operating within the same context (market or industry) pursue different GSCM strategies despite experiencing similar institutional pressures (Testa & Iraldo 2010).

The development of resources and capabilities can be exemplified through improvements in a variety of performance metrics (Sarkis et al. 2011). Previous research has shown that GSCM adoption has improved, for example:

- quality, delivery and flexibility performance (Vachon & Klassen 2008)
- cost performance (Chavez et al. 2014)
- environmental performance (e.g. Rao & Holt 2005; De Giovanni & Esposito Vinzi 2012; Zhu et al. 2013), and
- financial performance (King & Lenox 2001a; Rao & Holt 2005; De Giovanni & Esposito Vinzi 2012; Zhu et al. 2013; Yang et al. 2013).

Furthermore, the resulting improvement in image and reputation can be considered a significant resource (Sarkis et al. 2011). However, Shi et al. (2012) point out that it is still unclear how the specific types of GSCM practices translate into a firm's strategic resources, which will eventually lead to competitive advantage and performance improvement.

4.3.4 Resource dependence theory

The resource dependence theory (RDT) suggests that firms rely on others to provide critical resources, components or capabilities provided by others (Pfeffer & Salancik 1978; Awaysheh & Klassen 2010). The dependence of one party provides the basis for the power of the other (Emerson 1962). Thus, firms with strong bargaining power can exercise control over weaker parties (Crook & Combs 2007; Nyaga et al. 2013). The diffusion of environmental practices in the supply chain can be explained with reference to the power development aspect of the RDT (Sarkis et al. 2011). Depending on their ability to control resources and potential substitutes, firms have several options for securing access to environmental resources (Hollos et al. 2012). The buying firm's ability to motivate suppliers to commit to environmental partnerships is usually based on the supplier's dependence of the buyer (Min & Galle 2001).

Large, dominant buyers are more likely to require environmentally friendly practices be adopted by their smaller suppliers (Hall 2000; Min & Galle 2001 Sarkis et al. 2011). The party with the dominant market power can influence the

environmental policies and strategies of other supply chain members and dictate supplier participation in green supply chain activities, even though these might not be perceived as directly beneficial by suppliers (Caniëls et al. 2013). Brockhaus et al. (2013) found that their case companies had a tendency towards efforts initiated by the dominant firms and then forced onto the weaker upstream members rather than the development of long-term competitive advantage for the supply chain as a whole. However, the suppliers are likely to comply but only to reactively fulfil minimum requirements (Caniëls et al. 2013). Although this approach might not be good in the long run, organisations might be unwilling to increase their dependence on other firms (Ulrich & Barney 1984; Brockhaus et al. 2013).

The RDT also suggests that firms lacking the required resources are likely to develop relationships with others to acquire those resources (Sarkis et al. 2011). Due to their lack of capital and know-how, smaller firms try to comply with the environmental requirements of their larger partners in order to secure their continued access to resources in the supply chain (González et al. 2008). Given that manufacturers have augmented their collaborative efforts with selected first-tier suppliers in order to address market demands, many suppliers have a strong justification to invest in and signal proactivity in sustainability-related practices in order to be selected for collaborative projects (Foerstl et al. 2015).

Incentives in buyer-supplier relationships can be grouped into competitive incentives, i.e. suppliers are awarded present and future business based on their performance relative to other suppliers – typically in an arm's length relationship; and cooperative incentives, i.e. a sharing of the benefits of increased performance within a dyadic buyer–supplier relationship based on their joint performance (Terpend & Krause 2015). Hence, environmental monitoring can be considered to consist mainly of competitive incentives while environmental collaboration involves mainly cooperative incentives.

4.4 Connections between green supply chain management practices and performance

4.4.1 GSCM and financial performance

An increasing number of studies have addressed the relationship between environmental sustainability and firm performance. Yet the findings from these studies have been inconsistent, giving practitioners no clear answers as to what actions would be beneficial to pursue (Golicic & Smith 2013). On the one hand, the implementation of GSCM practices is anticipated to result in environmental performance improvements in a firm. However, there is a concern that such

practices might not translate into improvements in financial performance, such as profitability or market share (Green et al. 2012b). For example, first-mover advantages can stem from GSCM implementation (Carbone & Moatti 2011). Developing skills in the early use of technologies and finding innovative solutions to environmental challenges can yield cost advantage over major competitors (Vachon & Klassen 2008). Nevertheless, developing radical environmental innovations requires significant resources and can increase costs, especially in the short-term (Devinney 2009; Wu & Pagell 2011).

On the other hand, GSCM is a way to minimise the risk of potential losses resulting from poor environmental performance by the focal firm or by firms in the same industry. Barnett and King (2008) point out that negative events, such as chemical spills, can have a profound effect on the whole industry. They demonstrated that firms can voluntarily come together with industry self-regulation to prevent harmful spillover effects, such as reputational risks, which could, in turn, damage the financial performance of the firms. The threat of new legislation or regulations and activist campaigns targeted at firms in the same industry can stimulate other firms to act proactively to avoid being targeted (Reid & Toffel 2009).

The results of the previous studies tend to support the positive relationship between GSCM practices and financial and/or economic performance (e.g. King & Lenox 2001a; Rao & Holt 2005; Zhu et al. 2008; Azevedo et al. 2011; Green et al. 2012b). Although the great majority of previous research acknowledges the positive effect of GSCM on financial performance, there is a small number of studies with contradictory results. For example, Cordeiro and Sarkis (1997) found a negative connection between environmental pro-activism and earnings-per-share performance forecasts, and Wang & Sarkis (2013) found a negative relationship between environmental SCM programmes and financial performance.

Hence, while an increasing number of studies have examined the relationship between GSCM and performance, the field could benefit from an examination of more nuanced relationships and a larger set of performance metrics. While some studies (e.g. Markley & Davis 2007; Wang & Sarkis 2013) examine financial performance using traditional measures compiled from financial statements, such as ROA, ROI, ROCE, and EBIT-%), many articles focus on economic performance and use perception-based indicators, such as opinions on the development of market share and cost savings (e.g. King & Lenox 2001a; Rao & Holt 2005; De Giovanni & Esposito Vinzi 2012; Zhu et al. 2013; Yang et al. 2013).

Internal GSCM practices, such as top management support, environmental management systems and certifications, have been recognized as comprehensive mechanisms for achieving superior performance (Zhu & Sarkis 2004; Yu et al. 2014). Building on the natural resource-based view, Shi et al. (2012) argue that intra-organisational environmental practices develop over time in organisations

and create tacit knowledge and efficient management routines that are causally ambiguous to the competitors and, consequently, improve organisational performance. An improved corporate image resulting from GSCM implementation could help firms to replace competitors who fail to address environmental issues (Klassen & McLaughlin 1996). Some of the Italian third-party LSPs studied by Perotti et al. (2012) indicated that the non-adoption of internal environmental management practices was a source of disadvantage.

Shi et al. (2012) propose that inter-organisational environmental practices create socially complex resources that prevent competition by being difficult to imitate and hence can be a source of competitive advantage. External environmental collaboration with supply chain partners implies that a firm is capable of effectively integrating internal and external knowledge, skills and technology (Yang et al. 2013).

Environmental collaboration with customers helps a firm to identify and fulfil customer needs, whereas environmental collaboration with suppliers enables quick responses to customer requirements. Hollos et al. (2012) highlight that a supplier's efforts to improve sustainability need to be combined with a buying firm's internal efforts in order to achieve superior performance. Environmental purchasing can improve a firm's economic position by reducing disposal and liability costs, conserving resources and improving public image (Carter et al. 2000). GSCM with customers maximises profits through reduced business waste and environmental costs and increases customer satisfaction (Azevedo et al. 2011). It can facilitate inter-organisational learning (Vachon & Klassen 2008) and support efficiency and synergy among business partners (Yang et al. 2013), which can translate into better performance (Rao & Holt 2005). Improved customer satisfaction and corporate image can bring financial benefits (Zhu et al. 2013). By adding more value to product or service offerings, firms can secure a larger market share and more revenue compared to their competitors (Hong et al. 2009).

4.4.2 GSCM and operational performance

Despite the increasing number of studies focusing on GSCM, empirical research on the effects of GSCM practices on operational performance is still limited (Zhu et al. 2013; Yu et al. 2014). Furthermore, only a limited number of studies have taken into account the multiple dimensions of GSCM (internal, upstream and downstream) in relation to operational performance (Yu et al. 2014). GSCM is frequently associated with quality improvements and efficiency (e.g. Porter & van der Linde 1995; Rao & Holt 2005; Vachon & Klassen 2008). The meta-analysis conducted by Golicic and Smith (2013) observed that nearly all environmental supply chain practices influenced operational efficiency and effectiveness.

Internal GSCM practices, such as environmental management systems and green logistics management, have been found to improve operational performance measures, such as quality, costs, on-time delivery, capacity utilisation and position in the marketplace, resulting in better products and equipment selection decisions, shortened lead time, reduced waste in production and improved chances for selling products in the international markets (Sroufe 2003; Lai and Wong 2012; Zhu et al. 2013). Environmental improvements can reduce downtime due to more careful monitoring and maintenance (Porter & van der Linde 1995), which might lower the needs for working capital (Christopher and Ryals 1999).

There are also contradictory results. González-Benito and González-Benito (2005) observed that implementing environmental practices related to internal production processes has a negative effect. They conclude that these practices, which are control-oriented rather than preventive, may not be optimal in terms of costs or time. Perotti et al. (2012) studied the green practices of Italian LSPs and reported only a minor effect on operational performance.

With regard to external GSCM practices with suppliers and customers, the majority of the previous studies appear to anticipate performance improvements. Improvements in the ability to coordinate operations across different supply chain members to respond to changes in customer requirements are seen as contributing to higher customer satisfaction (Gunasekaran et al. 2008). For example, working with customers on eco-design increases customer satisfaction as it increases conformance with product specifications and reduces the rejection rate (Vachon & Klassen 2008; Azevedo et al. 2011).

According to Chavez et al. (2014), manufacturers that implement customer-centric GSCM [1] can reduce costs and improve quality, delivery and flexibility. Vachon and Klassen (2008), in turn, observed that environmental collaboration with suppliers contributed to a broader manufacturing performance improvement, such as quality, delivery and flexibility, whereas environmental collaboration with customers was found to offer a narrower set of benefits.

The involvement of suppliers in greening the supply chain is essential for achieving benefits, such as cost reductions and environmental innovations (Yu et al. 2014). Suppliers must therefore help the buying firm change inbound logistics processes to reduce waste, e.g. packaging, which consequently can lead to operational advantages, such as cost reductions and ease of assembly (Walton et al. 1998). Azevedo et al. (2011) suggest that environmental collaboration with suppliers produces the same benefits as non-green supplier collaboration due to an increased level of integration. GSCM with suppliers is linked to operational performance through lower production costs, fast and reliable deliveries and an

[1] e.g. achieving environmental goals collectively with customers and working together with customers to reduce the environmental effects of operations activities

improved ability to respond to unforeseen events (Vachon & Klassen 2008; Yu et al. 2014).

4.4.3 GSCM and environmental performance

GSCM activities are generally connected with specific targets, investments and effects on economic and environmental performance (Zhu & Sarkis 2004). Extending the traditional supply chain into environmental issues enables the consideration of the total immediate and eventual environmental impacts of products and processes (Beamon 1999b).

Internal GSCM practices have been found to reduce the negative environmental impacts of business operations (e.g. Zhu & Sarkis 2004; De Giovanni & Esposito Vinzi 2012; Yang et al. 2013). Furthermore, GSCM helps to improve environmental performance, minimise waste and achieve cost savings through synergy among business partners (Rao and Holt 2005). The environmental impact of a product is the result of interrelated decisions made at different stages in the supply chain (Roy & Whelan 1992; Albino et al. 2012). Testa and Iraldo (2010) mention the use of raw materials, the generation of waste by consumer goods and their packaging and the transportation of those goods as examples of environmental aspects that cannot be fully addressed without the participation of several firms in the supply chain. Given that firms are not directly involved in all these stages, collaboration between various supply chain members is an essential tool for reducing the products' environmental impact and enhancing a firm's environmental performance. Thus, firms are increasingly adopting environmental monitoring and collaboration practices to ensure that the supplied materials and equipment are environmentally friendly and produced using environmentally sustainable processes (Rao & Holt 2005; Green et al. 2012a).

While a lack of coordination regarding external practices can weaken environmental performance (Zhu et al. 2012), collaboration between the buyer and the supplier to achieve environmental management goals is potentially an effective way for a customer to introduce environmental performance requirements, environmental innovation activity and environmentally sound process technologies into the supply chain (Simpson & Power 2005). Gimenez and Sierra (2013) state that the higher the level of implementation of environmental monitoring and collaboration, the higher the environmental performance.

Although the majority of previous research indicates that external GSCM practices contribute to environmental performance gains (see for example Testa & Iraldo 2010; Green et al. 2012; Albino et al. 2012; Zhu et al. 2013), contradictory results have been reported. For example, Zailani et al. (2012) did not find environmental purchasing had a positive effect on environmental performance.

They think that one reason for this finding could be that by purchasing environmentally friendly materials the direct benefit goes to the suppliers rather than the buying firm indirectly.

All in all, as suggested by Green et al. (2012a), it is expected that firms pursue environmental collaboration and monitoring at the supply chain level with suppliers and customers in order to enhance environmental performance. Consequently, firms implementing green strategies should primarily focus on improving their environmental performance – an increase in economic performance should be the secondary target (De Giovanni 2012).

4.5 Synthesis

The four theories described in section 4.3 are summarised in Table 4. In previous literature, institutional theory and resource dependence theory appear to be typically used to investigate the role of the external drivers, such as authorities, competitors or customers, in the adoption of GSCM practices. Transaction cost economics and the RBV seem to be applied to explain that firms can expect performance improvements from GSCM adoption due to reduced transaction costs, associated environmental requirements or increased competitive advantages that stem from GSCM-related resources within the firm and its supply chain partners.

Table 4 Summary of organisational theories applied in this thesis in relation to GSCM practices

Theory and its relevance to the GSCM context	**Sources**
Institutional theory	
External stakeholders strongly affect GSCM adoption. Coercive, mimetic and normative pressures cause firms to conform to environmental expectations.	Di Maggio & Powell (1983); Jennings & Zandbergen (1995); Delmas & Toffel (2004); Carbone & Moatti (2011); Sarkis et al. (2011); Hoejmose et al. (2014)
Transaction cost economics	
Transaction costs incur for finding, negotiating and monitoring environmentally sustainable supplier relationships. An organisation can internalise (environmental collaboration) or externalise (environmental monitoring) activities in the supply chain related to the environment.	Williamson (1981); Vachon & Klassen (2006); Tate et al. (2011); Sarkis et al. (2011)
Resource-based view	
Valuable, rare, imperfectly imitable and non-substitutable resources of a firm can create competitive advantage. GSCM can create competitive advantages by combining resources existing in different supply chain members.	Wernerfelt (1984); Barney (1991); Hart (1995); Dyer & Singh (1998); Vachon & Klassen (2008;) Sarkis et al. (2011); Shi et al. (2012)
Resource dependence theory	
Firms are dependent on others to provide critical resources, components or capabilities. Power asymmetry in the supply chain can explain the diffusion of GSCM practices. The party with dominant market power can influence the environmental policies and strategies of other supply chain members.	Pfeffer & Salancik (1978); Ulrich & Barney (1984); Gonzalez et al. (2008); Caniëls et al. (2011); Sarkis et al. (2011); Hollos et al. (2012); Brockhaus et al. (2013); Nyaga et al. (2013); Terpend & Krause (2015)

Section 4.4 discussed the connections between GSCM practices and firm performance in the light of findings in the existing literature. Table 5 summarises these examples, which have also been used to build the hypotheses in the thesis articles II, III and IV.

Table 5 Examples of the connection between GSCM practices and dimensions of firm performance

GSCM practice	Financial performance	Operational performance	Environmental performance
Internal GSCM practices	Create tacit knowledge (Shi et al. 2012), improve corporate image (Klassen & McLaughlin 1996)	Improve quality, costs, on-time delivery, capacity utilisation and position in the marketplace (Sroufe 2003; Lai and Wong 2012; Zhu et al. 2013), reduce downtime (Porter & van der Linde 1995)	Improve environmental performance (Zhu & Sarkis 2004; De Giovanni & Esposito Vinzi 2012; Yang et al. 2013)
Environmental monitoring by customers	Increases customer satisfaction (Azevedo et al. 2011), improves corporate image (Klassen & McLaughlin 1996)	Increases conformance to product specifications and reduces the rejection rate (Vachon & Klassen 2008; Azevedo et al. 2011)	Encourages firms to reduce products' environmental impacts (raw material use, packaging etc.) (Testa & Iraldo 2010)
Environmental monitoring of suppliers	Reduces disposal and liability costs and improves public image (Carter et al. 2000).	Lowers production cost, increases speed and reliability of deliveries and improves the ability to respond to unforeseen events (Vachon & Klassen 2008; Yu et al. 2014)	Reduces products' environmental impacts (raw material use, packaging, etc.) (Testa & Iraldo 2010)
Environmental collaboration with customers	Helps to identify customer needs, facilitates inter-organisational learning (Vachon & Klassen 2008), supports efficiency and synergy (Yang et al. 2013)	Increases conformance to product specifications and reduces the rejection rate (Vachon & Klassen 2008; Azevedo et al. 2011)	Reduces waste (Testa & Iraldo 2010), develops environmental innovations (Simpson & Power 2005)
Environmental collaboration with suppliers	Enables quick response to customer requirements, supports efficiency and synergy (Yang et al. 2013)	Lowers production costs, increases speed and reliability of deliveries and ability to respond to unforeseen events (Vachon & Klassen 2008; Yu et al. 2014), helps to change inbound logistics processes to reduce waste (Walton et al. 1998)	Reduces products' environmental impacts (raw material use, packaging, etc.) (Testa & Iraldo 2010), develops environmental innovations (Simpson & Power 2005)

5 RESEARCH METHODOLOGY

5.1 Research approach

Research methods are grounded in the philosophical traditions of a discipline and originate from its prevailing paradigms (Golicic & Davis 2012). A paradigm can be viewed as a set of basic beliefs that deals with ultimates or first principles (Guba & Lincoln 1994). A paradigm contains the elements of ontology, epistemology and methodology (Guba & Lincoln 1994; Frankel et al. 2005). Ontology is the way a reality is conceived and perceived and addresses the question of whether objective reality exists or not (Frankel et al. 2005; Hallebone & Priest 2009). Epistemology refers to the way knowledge is to be generated, represented, understood and used and addresses the question of what is the relationship between the researcher and what can be known (Guba & Lincoln 1994; Frankel et al. 2005; Hallebone & Priest 2009). Ontological and epistemological assumptions guide methodological decisions, which deal with how we gain knowledge of the world (Frankel et al. 2005).

According to Crotty (1998), there are three main epistemological stances and their variants: objectivism, constructionism and subjectivism. In the objectivist view, reality exists independent of social actors (Bryman 2004) and objective truth can be discovered (Crotty 1998). Constructionism rejects this view. Meaning is not discovered but constructed by social actors (Crotty 1998; Bryman 2004). In subjectivism, meaning is imposed on the object by the subject and thus does not come out of an interplay between the subject and the object (Crotty 1998).

Epistemology underpins the theoretical perspective. According to Crotty (1998), Bryman (2004) and Saunders et al. (2007), there are several theoretical perspectives, such as positivism, interpretivism and realism, which are used to provide a context for the research process. This research follows the positivist approach maintaining that science can be conducted in an objective way (Bryman 2004). In positivism, existing theory is used to develop hypotheses that will be tested and confirmed, in whole or part, or refuted. This will lead to the further development of theory that can be tested by future research (Saunders et al. 2007).

Furthermore, it is essential to consider the relationship between theory and research. There are three main research approaches that may result in the acquisition of new knowledge: induction, deduction and abduction. Inductive reasoning is a theory building process starting with specific empirical cases or a collection of observations, and seeking to establish generalisations about the

phenomenon under investigation, i.e. from facts to theory (Hyde 2000; Spens & Kovács 2006). However, even in theory building, a priori assumptions, frameworks or a perceived problem provide the foundation for the study (Flynn et al. 1990). Deductive reasoning is a theory testing process that commences with established theory, develops a priori hypotheses and tests them empirically to see whether the theory applies to specific instances (Hyde 2000; Saunders et al. 2007; Kovacs & Spens 2006). Similar to induction, abductive reasoning starts with a real-life observation, followed by an iterative process of "theory matching" in order to find a new matching framework or to extend the theory used prior to this observation and finally suggest a new theory (Kovács & Spens 2005).

According to Saunders et al. (2007), there are several important characteristics of the deductive approach: (1) a search to explain causal relationships between variables; (2) use of controls to allow the testing of hypotheses; (3) highly structured methodology to facilitate replication; (4) the operationalisation of concepts in a way that enables facts to be measured quantitatively; (5) reductionism, meaning that problems are reduced to the simplest possible elements; and (6) generalisation by selecting a sufficiently large sample size. The inductive approach, on the contrary, emphasises a more flexible structure to enable changes as the research progresses and is less concerned with the need to generalise (Saunders et al. 2007).

Positivism entails elements of both the deductive and inductive approach (Bryman 2004). A mainly deductive approach is applied in thesis articles II, III and IV. In article I, mainly inductive reasoning is adopted.

In terms of methodology, positivism is often associated with quantitative methods (Crotty 1998). Croom (2009) outlines the typical structured process of the quantitative approach: first, concepts are examined and tested through observable, tangible and clearly defined variables. Second, controlled measurement, using laid down procedures and protocols are used to test causality between variables. Creswell (2009) argues that surveys and experiments are appropriate strategies of enquiry for the quantitative approach. The main practices in this approach include identifying variables to study and examining them by use of questions or hypotheses, collecting numerical information, using unbiased approaches and employing statistical procedures (Creswell 2009).

Survey research is a suitable method when the empirical evidence concerns questions like "how variables are related", "where the relations hold" and "to what extent a given relation is present" (Croom 2009). There are two main types of survey research: exploratory and explanatory (Malhotra & Grover 1998). Exploratory survey research takes place during the early stages of research into a phenomenon (Forza 2002). It aims at becoming more familiar with the topic and attempts to identify and describe the variability in different phenomena (Malhotra & Grover 1998). Thus, it can help to identify the concepts to be measured in

relation to the phenomenon under study, how to best measure them and how to discover new facets of the phenomenon (Forza 2002).

Explanatory survey research examines and explains causal relationships between variables (Malhotra & Grover 1998; Saunders et al. 2007). It takes place when knowledge of the phenomenon has been expressed in a theoretical form using well-defined concepts, models and propositions (Forza 2002).

Given that one of the main objectives of this thesis is to test causal relationships between green supply chain management practices and firm performance using well-defined concepts and models, the approach used in this thesis is mainly explanatory survey research.

5.2 Research process

The research process, eventually leading to the completion of doctoral studies, started in 2010, when the author was employed as a research assistant in the Operations and SCM research group to help in preparing the Finland State of Logistics 2010 survey. Two years later the Ministry of Transport and Communications Finland and the Finnish Transport Agency commissioned Finland State of Logistics 2012. The research group decided to include items regarding environmental collaboration in the questionnaire in order to address the growing interest in environmental issues. At the time, as the author was interested in environmental issues in supply chains, it was decided that the Master's thesis would consist of developing a research framework to study the connection between environmental collaboration and firm performance and use Finland State of Logistics 2012 data as an example of a potential data source. While working on the Master's Thesis, the author became confident that the topic could be further elaborated on in future research.

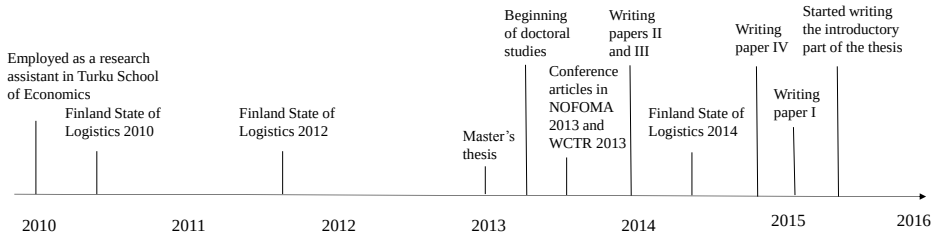

Figure 3 The research process and thesis articles in chronological order

After graduating in spring 2013, the author was accepted as a doctoral student by Turku School of Economics. Preliminary ideas that were later developed in the thesis articles were presented and published in the NOFOMA (Nordic Logistics

Research Network) 2013 conference in Gothenburg and the WCTR (World Conference on Transport Research) 2013 conference in Rio de Janeiro in summer 2013. Later that year, the writing of articles II "Firm performance and environmental collaboration in manufacturing" and III "Performance outcomes of environmental collaboration: evidence from Finnish logistics service providers" commenced. Article III continues from the analysis of article II by expanding from manufacturing firms to logistics service providers. The findings of articles II and III influenced the research questions addressed in article IV as it was decided to address GSCM on a broader level in the next articles. The data and material for articles I "and IV "Firm performance and customer-driven green supply chain management" were collected as part of Finland State of Logistics 2014.

The author was able to revise questions related to environmental practices to also include items on environmental monitoring. Items related to internal GSCM practices were modified as internal environmental collaboration was found to be a slightly challenging construct in terms of small and medium-sized firms. In addition, new items on environmental and financial performance were developed. It was considered that perception-based metrics would enable the using of structural equation modelling techniques in data analysis.

5.3 Data collection

The empirical data used in this thesis was obtained from two sources: (1) two consecutive Finland State of Logistics (FSoL) surveys in 2012 and 2014, and (2) from financial reporting data extracted from external databases. The data sources used in each thesis article are summarised in Table 6.

Since 1990, the Finnish Ministry of Transport and Communications has commissioned research institutions to examine the current state and future outlook of logistics in Finland. The five latest Finland State of Logistics surveys were conducted by Turku School of Economics in 2006, 2009, 2010, 2012 and 2014. The 2014 survey was commissioned by the Finnish Transport Agency, an authority subordinate to the Ministry of Transport and Communications.

Data from Finland State of Logistics 2012 (Solakivi et al. 2012) and Finland State of Logistics 2014 (Solakivi et al. 2014) are used in this thesis. The unit of analysis is a firm.

The data for FSoL surveys were collected from a web-based survey. The surveys were targeted at three main industries: manufacturing, trading and logistics service providers operating in Finland. In addition, the questionnaire includes separate sections for consultants and academics within the logistics/SCM field. The sample frame in both surveys includes all-non student members of the Finnish Association of Purchasing and Logistics (LOGY), members of the Finnish

Transport and Logistics Association (SKAL) and members of the Federation of Finnish Enterprises (Suomen Yrittäjät, SY) active in the industries covered in the survey. While the members of LOGY and SY include manufacturing, trading and logistics firms, the SKAL members are mainly logistics service providers. Furthermore, the respondent frame for the 2012 survey included members of the Finnish Service Sector Employers (PALTA) active in the logistics industry.

Table 6 Summary of used empirical data sources and analysis methods

Article	Approach	Data source(s)	Sample	Analysis methods
I	Survey	FSoL 2014 (survey) **	N = 382 firms (128 manufacturing, 110 trading, 144 logistics)	Cluster analysis, analysis of variance, cross-tabulations
II	Survey + financial reports	FSoL 2012 (survey) *, Orbis database (financial reporting data)	N = 135 manufacturing firms	Descriptive analysis, confirmatory factor analysis, generalised linear modelling
III	Survey + financial reports	FSoL 2012 (survey) *, Voitto+ database (financial reporting data)	N = 311 logistics service providers	Confirmatory factor analysis, hierarchical multiple regression analysis, generalised linear modelling
IV	Survey	FSoL 2014 (survey) **	N = 119 manufacturing firms	Partial least squares structural equation modelling

* total N in 2012 = 2732 responses
** total N in 2014 = 1731 responses
FSoL = Finland State of Logistics

An invitation to take part in the FSoL 2012 survey was emailed to a total of 38,834 people. The total number of responses was 2,732 and the response rate 7.0 per cent. In the FSoL 2014 survey, the invitation was emailed to 29,196 people. The total number of responses was 1,731 and the response rate 5.9 per cent. However, the response rate for medium- and large-sized firms is relatively high, and the surveys cover a large proportion of the main industries – if measured as a share of turnover. Wagner and Kemmerling (2010) analysed 229 survey studies in the field of logistics, including the respective response rates. They conclude that there is a significant negative relationship between the response rate and the number of questionnaires sent out. Compared to their findings, the response rates of the FSoL 2012 and 2014 surveys can be considered to be well in line with other surveys on a similar scale (Figure 4).

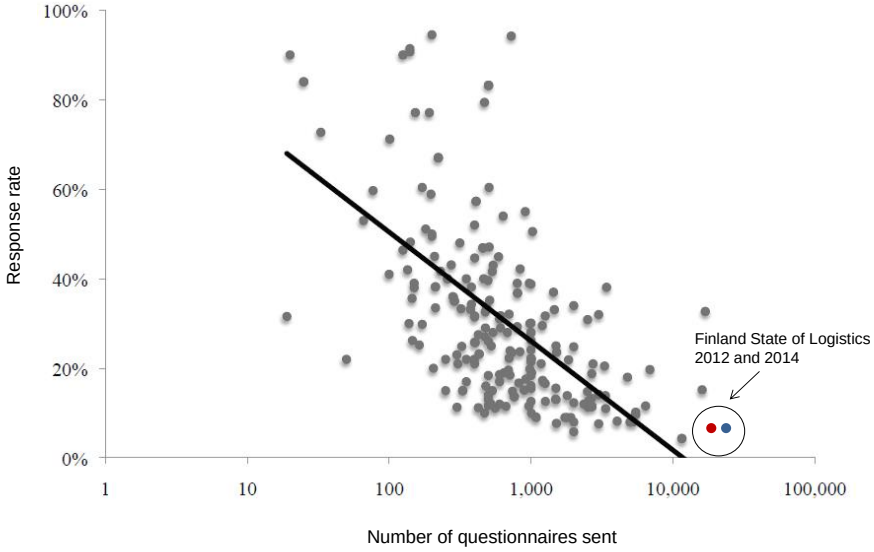

Figure 4 Finland State of Logistics 2012 and 2014 surveys: response rates (%) and number of questionnaires sent out compared to other studies in logistics research (adapted from Wagner & Kemmerling 2010)

Members of the SY and SKAL are typically self-employed entrepreneurs or micro-sized companies, which contributed significantly to the low response rate. In contrast, the majority of LOGY member firms are medium-sized and large firms operating in Finland. If more than one response was received from the same company, the most complete one, i.e. the one with lowest number of empty questions, was chosen. If the number of complete responses was identical, the questionnaire received first was chosen.

In addition to survey data, data from financial reporting was used in this thesis. Survey respondents were identified and assigned a business identity code based on their contact information. The business identity code was used to link the responses to financial reporting data from the corresponding years. The financial data used in connection with article II were extracted from the Orbis database of Bureau van Dijk, covering nearly 150 million companies worldwide (Bureau van Dijk 2015). The financial data used in connection with article III were extracted from the Voitto+ database by Suomen Asiakastieto. Voitto+ includes financial reporting from around 150,000 Finnish companies (Suomen Asiakastieto 2015).

5.4 Data analysis methods

5.4.1 Methods analysing sample and population distributions

Independent samples t-test and Mann-Whitney U test were used to test the non-response bias. The respondents of the first and last response wave in the survey are compared to see whether the two group's perceptions differ (Armstrong & Overton 1977). The t-test can be applied to normal distributions whereas the Mann-Whitney U-test is nonparametric and can thus be used to estimate non-normally distributed variables. Both tests are used to determine whether to accept or reject the null hypothesis of equality between the means of two groups.

The t-value can be calculated as

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{s_{\bar{X}_1 - \bar{X}_2}} \quad (1)$$

where $\bar{X}$ is the observed value of the sample mean; μ is the hypothesised value of the population mean; and $s_{\bar{X}}$ is the estimated standard error of the mean. When the t-value is calculated it is compared to the critical t-value from the Student's t-distribution to determine the p-value (Welkowitz et al. 2011).

The Mann-Whitney U-test is a nonparametric alternative to the independent samples t-test in situations where the t-test can yield inaccurate results. The analysis is made on the ranking order of data to test the null hypothesis of the two samples coming from identical distributions (Rosenthal 2011). The test is based on a test statistic U, which can be converted to a corresponding z-score to determine statistical significance (Field 2013).

Pearson's Chi-Square test of independence evaluates the probability that an association between two categorical variables is due to chance (Rosenthal 2011). The Chi-square test compares the observed frequencies with the frequencies expected by chance according to a particular distribution across all the categories of one variable or all the combinations of categories of two variables (Cramer & Howitt 2004). The value of a Chi-square can be calculated as

$$X^2 = \sum \frac{(f_o - f_e)^2}{f_e} \quad (2)$$

where f_0 is the observed cell count and f_e is the expected cell count. Observed cell counts are the number of cases that occur in a given category. Expected cell counts are the number of cases that should have occurred in a given category if the null hypothesis of no group difference was true (Hanneman et al. 2013). The

greater the value of a chi-square is, the more likely it is that the two variables are related and not independent (Cramer & Howitt 2004).

5.4.2 Cluster analysis

Cluster analysis is a group of statistical procedures specifically designed to discover classifications within complex datasets (Gore 2000). Cluster analysis groups objects based on the characteristics they possess (Hair et al. 2010). The objective of cluster analysis is to classify objects into clusters such that objects within one cluster exhibit high internal (within-cluster) homogeneity and high external (between-cluster) heterogeneity (Gore 2000; Hair et al. 2010).

To conduct a cluster analysis, a researcher first needs to determine how to measure similarity. Two individuals are close when their dissimilarity or distance is small or their similarity is large (Everitt et al. 2011). Interobject similarity can be measured in a number of ways, but correlational measures, distance measures and association measures dominate the applications of cluster analysis. Distance measures, such as Euclidean distance, squared Euclidean distance, Manhattan distance or Mahalanobis distance are most commonly used (Hair et al. 2010).

Hierarchical clustering techniques can be divided into agglomerative methods proceeded by a series of successive fusions of *n* individuals into groups, and divisive methods that successively separate the *n* individuals into finer groupings. Agglomerative methods are probably more widely used (Everitt et al. 2011). Since the agglomerative cluster method proceeds until only one cluster remains, it is up to the researcher to determine the number of clusters in the final solution (Gore 2000). Therefore, researchers commonly use a stopping rule that suggests two or more cluster solutions which can be compared to make the final decision. A typical example uses an agglomeration coefficient to determine where a large increase in heterogeneity between clusters at each successive step occurs. There are numerous agglomerative algorithms used to define similarity between multiple member clusters in the clustering process, such as single linkage, complete linkage, average linkage, centroid method and Ward's method. (Hair et al. 2010).

Contrary to hierarchical methods, non-hierarchical clustering techniques assign objects into a predefined number of clusters. The first task is to identify the cluster seeds; they are identified either by the researcher or in a random process. The next step is to assign each observation to one of the cluster seeds based on similarity (Hair et al. 2010). A combination of both hierarchical and non-hierarchical clustering methods is recommended: a hierarchical approach can be used to identify a preliminary set of cluster solutions as a basis for determining the appropriate number of clusters, whereas non-hierarchical procedures can be used to refine the results and to validate the final cluster solution (Hair et al. 2010).

Following Hair et al. (2010), both hierarchical agglomerative and non-hierarchical cluster analysis methods were used in thesis article I to identify similarities in GSCM strategies. First, hierarchical cluster analysis was used to determine the candidate number of clusters. Ward's method with squared Euclidean distance was used as a clustering algorithm because of its tendency to generate clusters that are homogenous and relatively equal in size (Hair et al. 2010). Ward's method is based on forming the cluster that results in the smallest increase in the sum of the squares during each step (Gore 2000). Coefficient changes in the agglomeration schedule were used to determine the candidate number of clusters, which were then tested with K-means cluster analysis. Finally, ANOVA and Post Hoc tests were conducted to examine whether statistically significant differences exist between the clusters.

5.4.3 Confirmatory factor analysis

Factor analysis is a technique whose main purpose is to define the underlying structures (factors) among the variables in the analysis (Hair et al. 2010). Hypothetical constructs are studied by using a variety of observable proxies or indicators of them that can be directly measured (Raykov & Marcoulides 2006). In practice, the researcher collects data on observed variables and applies factor analysis techniques to either *explore* which observed variables relate to factors or to *confirm* that a particular subset of factors defines each construct or a factor (Schumacker & Lomax 2010). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) are philosophically quite different methods. In EFA, the factors are derived from statistical results, not from theory. In EFA, an analysis is conducted to explore how many factors there are, whether the factors are correlated and which observed variables best measure each factor (Schumacker & Lomax 2010). CFA is used to test how well the a priori theoretical specification of the factors matches the actual data (Hair et al. 2010). In CFA, the researcher must specify the number of factors existing for a set of variables, which factors are correlated and which factor each variable will load onto before the results can be computed (Hair et al. 2010; Schumacker & Lomax 2010).

CFA allows the researcher to perform an exact test of the measurement theory by specifying the relationships between the constructs and the observed variables (Hair et al. 2010). CFA follows the basic sequence of five steps: model specification, model identification, model estimation, model testing and model modification (Schumacker & Lomax 2010). Model specification includes determining every relationship and parameter in the theoretical model that is of interest (Schumacker & Lomax 2010). Model identification deals with whether enough information exists to identify a solution (Hair et al. 2010). Next, the

parameters of the specified factor model are estimated using different procedures, such as maximum likelihood, generalised least squares or unweighted least squares. The fit of the model is estimated in order to check whether the specified model is supported by the sample data. If the fit is not good, the model is typically modified to achieve a better fit (Schumacker & Lomax 2010). The results of the factor analysis can be used to create a new set of variables that incorporate the character and nature of the original variables in a smaller number of new variables, for example, by using factor scores or summated scales (Hair et al. 2010).

CFA is used in articles II and III to test the measurement theory and to reduce the number of research variables by grouping individual items into research constructs.

5.4.4 Hierarchical multiple regression

Hierarchical multiple regression, also called block or nested regression, is a way of computing basic ordinary least squares (OLS) regression in stages (Garson 2014). It is used to determine what proportion of the variance in a given variable is explained by other variables when these variables are entered into the regression analysis in a certain order, and whether these proportions are significantly greater than would be expected by chance (Cramer 2003). Thus, in hierarchical multiple regression, richer models (models with more regressors) are compared to simpler models. The change in R^2 from model 1 (a simpler model with q regressors) to model 2 (a richer model with $q + r$ regressors) is tested to examine whether the model with $q + r$ regressors has a larger population squared multiple correlation coefficient than the model with only q regressors. (Kelley & Bolin 2013.)

Hierarchical multiple regression resembles stepwise regression but the researcher, not the computer, determines the order of entry of the variables by entering them in successive blocks (Garson 2014). The order of entry of the regressors is theoretically driven (Kelley & Bolin 2013). Hierarchical multiple regression enables controlling for the effects of covariates or testing the effects of certain predictors without the influence of others.

Hierarchical multiple regression is used in thesis article III. A set of control variables are entered in the first block and the predictor variables are entered in the subsequent blocks.

5.4.5 Generalised linear modelling

Generalised linear models (GLMs) are generalisations of the classical linear regression that allow modelling with non-normal distributions (Dunteman & Ho 2006). A generalised linear model comprises three components (Fox 2008):

1: A random component specifying the conditional distribution of the response variable, Y_i. The distribution is typically assumed from the exponential family, such as the Gaussian (normal), binomial, Poisson, gamma, or the inverse-Gaussian families of distributions.

2: A linear predictor which is a linear function of regressors:

$$\eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_k X_{ik} \quad (3)$$

3: A link function $g(\cdot)$, which transforms the expectation of the response variable, $\mu_i = E(Y_i)$, to the linear predictor:

$$g(\eta_i) = \eta_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_k X_{ik} \quad (4)$$

Logistics costs in article II and load factors in article III were found to be non-normally distributed. Potential distribution candidates (gamma, beta and normal distribution) were compared using Schwarz's Information Criteria, which led to choosing the beta-distribution for all logistics cost components and load factors in domestic and international shipments. Following Solakivi (2014), generalised linear modelling was thus used in the analysis. A logarithmic link function of $g(\mu) = ln(\mu)$ was used in connection with the beta-distributed variables. Given that GLM does not allow the assessing of the goodness of fit of a model with R^2, individual coefficients were used to analyse the significance of the model.

5.4.6 Partial least squares structural equation modelling

Research hypotheses in article IV are estimated by using partial least squares (PLS) structural equation modelling. Structural equation modelling (SEM) is a multivariate technique that enables the researcher to simultaneously investigate a series of interrelated dependence relationships among the measured variables and unobservable latent constructs as well as between several latent constructs (Hair et al. 2010). There are two types of SEM. Covariance-based SEM (CB-SEM) estimates relationships between multiple variables by determining how well a proposed theoretical model can estimate the covariance matrix for the sample data. PLS-SEM, in turn, explains variance in the dependent variables when examining the model (Hair et al. 2014). Rather than using the maximum likelihood estimation

generally applied in CB-SEM, PLS is based on a series of ordinary least squares regressions (Hair et al. 2014) and focuses on endogenous target constructs in the model and aims at maximising their explained variance (Hair et al. 2012). PLS is a prediction-oriented method that is appropriate for small sample sizes, complex models, data that do not follow multivariate normality and specifying formative constructs (Peng & Lai 2012; Hair et al. 2014). PLS is enjoying increasing popularity across various disciplines, such as operations management (Peng & Lai 2012), strategic management, information systems, marketing and consumer behaviour (Henseler et al. 2009).

The PLS path models are formally defined by two sets of linear equations: the inner model (structural model) and the outer model (measurement model). The inner model specifies the relationships between unobserved or latent variables, while the outer model specifies the relationships between a latent variable and its observed or manifest variables (Henseler et al. 2009). The inner model, i.e. the structural model, for relationships between the latent variables can be written as:

$$\xi_j = \beta_{0j} + \sum_{q:\xi_q \to \xi_j} \beta_{qj} \xi_q + \zeta_j \quad (5)$$

where ξ_j (j=1,…,J) is the generic endogenous latent variable, β_{qj} is the generic path coefficient interrelating the q-th exogenous latent variable to the j-th endogenous one, and ζ_j is the error in the inner relation, i.e. the disturbance term in the prediction of the j-th endogenous latent variable from its explanatory latent variables (Esposito Vinzi et al. 2010).

PLS modelling contains two different kind of outer models: reflective and formative measurement models (Henseler et al. 2009). Reflective models are models where the latent variable causes the observed variables, whereas in the formative models the causality is assumed to be in the opposite direction (Bollen 1989).

The reflective model used in thesis article IV has causal relationships from the latent variable to the manifest variables in its block. Each manifest variable reflects the corresponding latent variable and plays the role of endogenous variable in the block specific measurement model. Indicators linked to the same latent variable should covary and each block is assumed to be homogenous and unidimensional. (Esposito Vinzi et al. 2010.) In a reflective model each manifest variable is related to the corresponding latent variable by a regression model:

$$x_{pq} = \lambda_{p0} + \lambda_{pq} \xi_q + \varepsilon_{pq} \quad (6)$$

,where λ_{pq} is the loading associated to the p-th manifest variable in the q-th block and the error term ε_{pq} represents the imprecision in the measurement process. Standardized loadings are often preferred for interpretation purposes as they

represent correlations between each manifest variable and the corresponding latent variable (Esposito Vinzi et al. 2010).

An assumption behind this mode is that error ε_{pq} has a zero mean and is uncorrelated with the latent variable of the same block:

$$E(x_{pq}|\xi_q) = \lambda_{p0} + \lambda_{pq}\xi_q. \quad (7)$$

This predictor specification assures desirable estimation properties in classical Ordinary Least Squares (OLS) modelling (Esposito Vinzi et al. 2010).

The PLS algorithm is essentially a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations. Henseler et al. (2009; 2012) describe the first stage of the PLS path modelling algorithm consisting of the following four steps:

In step 1 the outer proxies of the latent variables, are calculated as weighted sums of their respective indicators. The weights are either pre-determined or estimated. As an initial iteration any non-trivial linear combination of the indicators can be used as a latent variable's outer proxy. Later iterations use the weights obtained from the previous iterations.

In step 2 the inner weights are calculated for each latent variable in order to reflect how strongly the other latent variables are connected to it in order to maximise the final R^2 value estimations of the endogenous latent variables. The path weighting scheme suggested by Lohmöller (1989) is used in this thesis.

In step 3 the inner proxies of the latent variables are computed as linear combinations of their adjacent latent variables' outer proxies (obtained in step 1) using the inner weights determined in step 2.

In step 4 the outer weights are calculated as covariances between the inner proxy of each latent variable and its indicators.

The four steps are repeated until the change in outer weights between two iterations is sufficiently low and drops below a predefined limit. In this analysis a threshold value of 10^{-6} was used. Upon the algorithm's convergence after step 4, the final outer weights are used to compute the final latent variable scores in step 2, which are further used to run OLS regressions to determine estimates for the relationships in the structural model.

5.5 Reliability and validity of the research

This thesis uses cross-sectional survey design, which raises the question of whether the concurrent measurement of variables can be used to infer causality. Also, the financial-reporting data used in this thesis is limited to a single time period. To mitigate the problem, Shah and Goldstein (2006) suggest describing the theory that

is tested and its expected results as clearly as possible prior to conducting the analysis.

Furthermore, transforming theoretical concepts into observable and measurable variables is a challenge in survey research (Forza 2002). In this thesis, the measurement scales that were used have been taken or modified from existing operationalisations to mitigate the problem. However, for example, GSCM and performance are multifaceted constructs. For practical reasons, the limited number of questionnaire items cannot cover every aspect of the construct.

Another issue related to the survey method emerges due to measuring people's perceptions. For example, internal GSCM practices are measured by asking respondents to state whether they agree or disagree (on a 5-point Likert scale) with statements such as "*We have increased the usage of environmentally friendly raw materials and components*" or "*We utilise green marketing for our products and/or services*". As a result, the starting point of each firm cannot be assessed with the present survey data. Some firms might have a more reactive GSCM strategy and they have increased the use of environmentally friendly raw materials incrementally, whereas more proactive firms might try to develop environmentally innovative products and processes to gain competitive advantages from their GSCM practices.

In this thesis, a multitude of procedures were followed in order to ensure reliability and validity. First, in the data collection for articles II and III, the survey responses were combined with the financial data from the Orbis or Voitto+ database based on the business identity codes in order to counteract the potential impact of common method bias arising from using a single source.

Second, a set of procedural remedies suggested by Podsakoff et al. (2003) were applied in the questionnaire. To avert the possible consistency motive, the dependent and independent variables were separated and placed in different phases of the survey. In articles II and III different scales were used for independent (Likert scale) and dependent variables (open field). To avoid the social desirability bias, respondents could choose if they wanted to give their email address and the name of the company or remain anonymous.

Third, the response rates of FSoL surveys 2012 and 2014, 7.0 and 5.9 respectively, may raise the question of the potential for non-response bias. To address it, early and late respondents were compared (Armstrong & Overton 1977) using independent samples t-test or Mann-Whitney U-test. Although the results do not reject the possibility of non-response bias, they suggest that non-response may not be a problem to the extent that the late respondents are similar to non-respondents.

Fourth, the goodness of measures was also analysed in terms of validity and reliability. Validity is concerned with whether the right concept is being measured, whereas reliability is concerned with stability and consistency in measurement

(Forza 2002). Internal consistency is often used to assess the reliability of measures. In articles II, III and IV internal consistency is assessed within CFA, using composite reliability and/or Cronbach's alphas. The reliability measures exceed the commonly used threshold of 0.70 (Nunnally and Bernstein 1994). In article IV, which used PLS-SEM, indicator reliability was also assessed by checking if the indicator's outer loadings were higher than 0.708 (Hair et al. 2014).

Construct validity consists of numerous sub-dimensions, such as content validity, substantive validity, unidimensionality, convergent validity, discriminant validity and predictive validity. Content validity refers to the extent to which the construct is represented by the items, while substantive validity refers to the theoretical linkage between the construct and the items. Testing them is mostly subjective (Garver & Mentzer 1999). In this thesis, content and substantive validity were addressed by using previous studies on scale development and by discussing the individual items in the research group.

The unidimensionality of the constructs was examined within the CFA using overall measurement fit and components of the measurement fit (Garver & mentzer 1999). Overall measurement fit was assessed using cut-off criteria for model fit indices, such as the goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), comparative fit index (CFI), normed fit index (NFI), incremental fit index (IFI), and the root mean square error of approximation (RMSEA) (Hu & Bentler 1999). The components of the measurement model were evaluated by examining standardised residuals, modification indices and standardised parameter estimates (Garver & Mentzer 1999).

Convergent validity concentrates on whether the individual items that measure the same construct converge (Forza 2002). In this thesis convergent validity was evaluated by calculating the average variance extracted (AVE) values to see if the cut-off value of 0.50 was exceeded (Hu & Bentler).

Discriminant validity, in turn, focuses on whether the items of the measures actually measure the correct construct and not a different construct (Forza 2002). In articles II and III pairwise X^2 difference tests were conducted to assess the discriminant validity (Anderson & Gerbing 1988), first by fixing the correlation between the latent variables at 1.0, and then by freeing the correlation. In article IV discriminant validity was tested by examining the cross-loadings of the indicators to ensure that an indicator's outer loading on the associated construct was greater than its loadings on other constructs. Furthermore, the Fornell-Larcker criterion was used to confirm that the square root of each construct's AVE exceeded its highest correlation with any other construct (Hair et al. 2014).

Finally, the research constructs were examined using correlation matrices to check predictive validity. In addition, the structural equation model can be used to evaluate the direct and indirect relationships among the latent variables (Garver & Mentzer 1999).

6 RESEARCH CONSTRUCTS

The thesis articles employ a multitude of constructs with various measurement scales. These are presented in detail in this chapter.

6.1 Financial performance

Financial performance was measured both as objective, financial reporting-based data, and subjective, survey-based data. The measures that were used are listed in Table 7. Following previous work by Töyli et al. (2008) and Solakivi et al. (2011) Return on Assets (ROA) and Earnings Before Interest and Taxes percentage (EBIT-%) were used to measure financial performance in thesis articles II and III. In addition, Return on Capital Employed (ROCE) was used in article II while Return on Investment (ROI) was used in article III. Financial performance measures in these two articles were obtained from external databases: Orbis (article II) and Voitto+ (article III). These two databases also contain official financial reporting data from firms that are not publicly listed.

Table 7 Measures of financial performance used in the thesis articles

Construct	Data source	Thesis article	From
Financial-reporting based measures; %			
Return on Assets	Orbis, Voitto+	II, III	Capon et al. (1990); Töyli et al. (2008); Solakivi et al. (2011)
Return on Capital Employed	Orbis	II	
Return on Investment	Voitto+	III	
Earnings Before Interest and Taxes	Orbis, Voitto+	II, III	
*Perception-based measures; 5-point Likert scale **			
Out turnover has increased	Survey	IV	Flynn et al. (2010); Green et al. (2012a); De Giovanni & Esposito Vinzi (2012)
Our profit has increased	Survey	IV	
Our market share has increased	Survey	IV	
Our Return on Assets has increased	Survey	IV	
Our Return on Assets has increased	Survey	IV	

Data source: Finland State of Logistics survey, Orbis, Voitto+
* Measured as change in the past 2 years

Furthermore, perception-based measures of financial performance measured on a Likert scale were used in article IV. The respondents were asked to evaluate statements regarding the change in a set of financial performance indicators in the past two years. For each item, the respondents were asked to assess the item considering the economic situation in order to take the uncertainty of the global economic situation into account. Perception-based financial performance measures are widely used in the literature (e.g. Vickery et al. 2003; Flynn et al. 2010; Green et al. 2012a; De Giovanni & Esposito Vinzi 2012) and they have been found to correlate with objective measures (Richard et al. 2009).

6.2 Operational performance

The operational performance of manufacturing firms is considered to consist of logistics costs, customer service performance and asset utilisation. The operational performance of manufacturing firms was analysed in thesis article II. In article II the term "intra-firm supply chain performance" is used instead of operational performance in order to emphasise how the properties of the inter-firm supply chain affect performance in the focal firm (Lorentz et al. 2012).

The metrics used to measure the operational performance of manufacturing and LSPs are illustrated in Table 8.

Logistics costs were further divided into five components following multiple sources (Heskett et al. 1973; Töyli et al. 2008; Solakivi et al. 2011; Engblom et al. 2012):

1) transportation and packing costs
2) warehousing costs
3) inventory carrying costs
4) logistics administration costs
5) other logistics costs.

The logistics cost data was obtained as self-reported, open field survey responses as a share of a firm's turnover. Open response fields enabled the respondents to assess each logistics cost component to an accuracy of one decimal.

Following the examples in previous literature (Fawcett and Cooper 1998; Töyli et al. 2008; Lorentz et al. 2012), customer service performance was measured as the perfect order fulfilment rate (% of all orders) and order cycle time (days).

As suggested by Töyli et al. (2008), Lorentz et al. (2012) and Solakivi (2014), asset utilisation was operationalised as cash-to-cash cycle time. Cash-to-cash cycle time was measured as inventory days of supply plus days of sales outstanding minus days of payables outstanding (Lancaster et al. 1998; Farris & Hutchison 2002).

Table 8 Measures of operational performance used in the thesis articles

	Construct	Measured as	Thesis article	From
Manufacturing	*Logistics costs*			
	Transportation and packing costs	% of firm turnover	II	Heskett et al. (1973); Töyli et al. (2008); Solakivi et al. (2011); Engblom et al. (2012)
	Warehousing costs	% of firm turnover	II	
	Inventory carrying costs	% of firm turnover	II	
	Logistics administration costs	% of firm turnover	II	
	Other logistics costs	% of firm turnover	II	
	Total logistics costs	% of firm turnover	II	
	Customer service performance			
	Perfect order fulfilment	% of all orders	II	Fawcett & Cooper (1998); Töyli et al. (2008)
	Order fulfilment cycle time	Days	II	
	Asset utilisation			
	Inventory days of supply	Days	II	Farris & Hutchison (2002), Töyli et al. (2008), Solakivi et al. (2011)
	Days of sales outstanding	Days	II	
	Days of payables outstanding	Days	II	
Logistics	*Operational efficiency of LSPs*			
	Transport performance	km/vehicle in a year	III	Johnston (2010)
	Empty miles	% of transport performance	III	
	Average length of haul	km	III	
	Average load factor (domestic)	%	III	
	Average load factor (international)	%	III	

Data source: Finland State of Logistics 2012 survey

In addition, the operational performances of the LSPs were analysed in thesis article III using five operational efficiency measures by Johnston (2010): empty-mile percentage, average load factor (%) in both domestic and international shipments, average transport performance per vehicle (km), and average length of haul (km) (Table 8).

6.3 Environmental performance

The construct measuring environmental performance (article IV) is based on previous work by Zhu et al. (2008), De Giovanni & Esposito Vinzi (2012) and Yang et al. (2013). The respondents were asked to evaluate statements about the relative change in their environmental performance in the past two years. The statements related to the reduction of CO2 emissions, waste, energy consumption, water consumption and the consumption of hazardous materials. Moreover, the respondents were asked to evaluate whether their firm has been a forerunner in environmental issues. Each item was measured on a 5-point Likert scale. The measures used are listed in Table 9.

Table 9 Measures of environmental performance used in thesis article IV

Items	From
Environmental performance; 5-point Likert scale	
Carbon dioxide emissions considering the volume of production have decreased.	Modified from Zhu et al. (2008); De Giovanni & Esposito Vinzi (2012); Yang et al. (2013)
Waste considering the volume of production has decreased.	
Energy consumption considering the volume of production has decreased.	
Consumption for hazardous materials considering the volume of production has decreased.	
Compared to our competitors, we have been a forerunner in environmental issues.	

Data source: Finland State of Logistics 2014 survey

6.4 Competitive strategies

The scale for competitive priorities was developed using previous work by Ward and Duray (2000), Beal and Yasai-Ardekani (2000) and Krajewski et al. (2010). Moreover, two single items measuring the importance of small environmental impacts and efficient SCM were added. The final scale consists of 13 items measuring differentiation, price and cost, the operational areas of competitive priorities, namely flexibility, quality, speed (e.g. Skinner 1969; Stock et al. 1998), and SCM and environmental impacts. The respondents were asked to assess which of the items are currently sources of advantage for their firm in relation to their competitors. Each item was designed for response using a five-point Likert scale in which 1 corresponds to "strongly disagree" and 5 to "strongly agree. Hence, the scale measures realised strategy, i.e. actual performance in these competitive priorities rather than strategic intent or emphasis placed (Mintzberg 1978; Zhao et al. 2006).

Competitive priorities were further divided into the five broader categories described in Chapter 2: cost leadership, marketing differentiation, operations differentiation, hybrid strategy, and stuck-in-the-middle. A summary of the operationalisation can be found in Table 10.

Table 10 Measurement items and the operationalisation of competitive strategies

Construct	Measurement items *	Source
Cost leadership	A lower price level = 5; and/or Lower costs of operations = 5	
Marketing differentiation	Stronger brand = 5; and/or More succesful marketing communication = 5 and/or;	
Operations differentiation	Better supply chain management = 5; and/or Better ability to customize products and services = 5; and/or More effective capacity utilization = 5; and/or Superior quality of our products or sevices = 5; and/or Speedier operations = 5	Modified from Ward & Duray (2000); Beal & Yasai-Ardekani (2000); Krajewski et al. (2010)
Hybrid strategy	Cost leadership and marketing differentiation or operations differentiation	
Stuck-in-the-middle	All measurement items <5	

Measured as 5-point Likert scale in comparison to competitors: 1 = strongly disagree, 5 = strongly agree
Data source: Finland State of Logistics 2014 survey

Cost leadership includes firms that have given the value of 5 to low price and/or low cost but reach a medium or low score in other dimensions. Marketing differentiation includes firms that have given the value of 5 to strong brand and/or successful marketing while scoring a medium or a low value in other dimensions. Operations differentiation refers to firms that give a high value to at least one high operational capability (quality, speed, capacity utilisation, SCM) but do not reach a high score in cost leadership or marketing differentiation. Hybrid strategy includes firms combining cost leadership with differentiation. Differentiation can be classified either into marketing differentiation characterised by strong brand and marketing, or operations differentiation, such as quality, flexibility or speed (Hill 1988; Stock et al. 1998; Beal & Yasai-Ardekani 2000). Finally, a firm that does not obtain a high score in any competitive priority is considered to be stuck-in-the-middle.

6.5 Green supply chain management practices

Green supply chain management practices are measured using either scales focusing on environmental collaboration or scales that measure GSCM practices on a more general level, including items on both environmental collaboration and environmental monitoring. Articles II and III analyse the effect of environmental collaboration on firm performance. Given that Vachon and Klassen's (2008) original scales did not measure internal environmental collaboration and the need

to include all dimensions of collaboration as suggested by Flynn et al. (2010), a new set of items measuring internal environmental collaboration was constructed based on Vachon and Klassen's (2008) scales. The respondents were asked to consider their activities in the past two years. Each type of environmental collaboration was assessed on five questionnaire items using a five-point Likert scale in which 1 corresponds to "strongly disagree" and 5 to "strongly agree". Constructs related to environmental collaboration were included in the Finland State of Logistics 2012 questionnaire and are illustrated in Table 11.

The construct measuring environmental collaboration with suppliers was excluded in article III focusing on LSPs. Given the small size of the majority of respondents within the logistics sector and thus their limited abilities to collaborate with their suppliers, the items measuring environmental collaboration with suppliers were considered unsuitable for analysis. As a consequence, article II focuses on manufacturing firms and includes all three dimensions of environmental collaboration, while article III focuses on LSPs and includes internal and customer collaboration.

Table 11 Items for measuring environmental collaboration in articles II and III

Construct	Thesis article	From
Internal environmental collaboration; 5-point Likert scale	II, III	
We have set environmental goals for ourselves	II, III	
There is a mutual understanding of responsibilities regarding environmental performance	II, III	Modified from Vachon & Klassen (2006; 2008)
We have worked together to reduce the environmental impact of our activities	II, III	
We have conducted joint planning to anticipate and solve environment-related problems	II, III	
We have worked together to reduce the environmental impact of our products	II, III	
Environmental collaboration with suppliers; 5-point Likert scale		
We've worked together to achieve environmental goals collectively with our key suppliers	II	
There is a mutual understanding of responsibilities regarding environmental performance	II	
We have worked together to reduce environmental impact of our activities	II	Vachon & Klassen (2006; 2008)
We have conducted joint planning to anticipate and solve environmental-related problems	II	
We have worked together to reduce environmental impact of our products	II	
Environmental collaboration with customers; 5-point Likert scale		
We've worked together to achieve environmental goals collectively with our key customers	II, III	
There is a mutual understanding of responsibilities regarding environmental performance	II, III	
We have worked together to reduce the environmental impact of our activities	II, III	Vachon & Klassen (2006; 2008)
We have conducted joint planning to anticipate and solve environment-related problems	II, III	
We have worked together to reduce the environmental impact of our products	II, III	

Data source: Finland State of Logistics 2012 survey

The items measuring internal environmental collaboration were found to be less applicable to micro-sized firms. Hence, the questionnaire items on internal GSCM activities were made more general, following Zhu et al. (2008) and Yang et al. (2013) (Table 12). Furthermore, it was deemed necessary to understand whether the use of a collaborative approach or a monitoring-based approach to GSCM yielded different performance outcomes.

Table 12 Items for measuring internal GSCM practices in articles I and IV

Construct	Thesis article	From
Internal GSCM; 5-point Likert scale		
We have increased the usage of environmentally friendly raw materials and components.	IV	Modified from Zhu et al. (2008); Yang et al. (2013)
We have designed our products and/or services so that their materials can be recycled.	IV	
Being environmentally conscious is an integral part of our corporate culture.	IV	
We plan the deliveries of the company to minimize the environmental impacts.	IV	
We utilise green marketing for our products and/or services.	IV	
We conduct internal environmental audits to ensure that products and/or services meet the environmental goals.	IV	
We do cross-functional cooperation for mitigating environmental impacts.	IV	

Data source: Finland State of Logistics 2014 survey

Table 13 Items for measuring external GSCM practices in articles I and IV

Construct	Thesis article	From
(Environmental collaboration with suppliers)		Modified from Vachon & Klassen (2006); Zhu et al. (2008); De Giovanni & Esposito Vinzi (2012)
We have worked together with our suppliers to take environmental issues into account in product design .	I; IV	
We have developed our deliveries to be more environmentally friendly with our suppliers.	I; IV	
Our company and our suppliers have a clear mutual understanding of responsibilities in environmental issues.	I; IV	
(Environmental monitoring of suppliers)	I; IV	
We have used environmental impacts as an essential criterion in supplier selection.	I; IV	
We have asked our suppliers for information on their environmental compliance.	I; IV	
We have demanded our suppliers to ensure the environmentally friendly practices of second-tier suppliers.	I; IV	
We have demanded our suppliers to implement an environmental management system (eg. ISO 14000, EMAS)	I; IV	
GSCM with customers; 5-point Likert scale		
(Environmental collaboration with customers)		
We have worked together with our customers to take environmental issues into account in product design	I; IV	
We have developed our deliveries to be more environmentally friendly with our customers.	I; IV	
Our company and our customers have a clear mutual understanding of responsibilities in environmental issues.	I; IV	
(Environmental monitoring by customers)	I; IV	
Our customers have used environmental impacts as an essential criterion in supplier selection.	I; IV	
Our customers have asked us for information on our environmental compliance.	I; IV	
Our customers have demanded us to ensure the environmentally friendly practices of our suppliers.	I; IV	
Our customers have demanded us to implement an environmental management system (eg. ISO 14000, EMAS)	I; IV	

Data source: Finland State of Logistics 2014 survey

Using previous work (Vachon & Klassen 2006a; Zhu et al. 2008; De Giovanni & Esposito Vinzi 2012), seven measurement items for evaluating GSCM activities with suppliers and seven measurement items for GSCM activities with customers were introduced in the Finland State of Logistics 2014 survey. The respondents were asked to consider their activities in the past two years. The two sets of items for external GSCM are identical apart from the one focusing on suppliers and another on customers. Of those seven measures, three concentrate on environmental collaboration and the remaining four on environmental monitoring. The items measuring external GSCM practices are presented in Table 13.

6.6 Control variables

A number of control variables were used in the thesis articles to account for firm characteristics. A summary of them is presented in Table 14.

Firm size was measured as turnover and used as a control variable in several articles. Previous research argues that firm size is likely to play an important role in environmental activities (Pagell & Wu 2009). Larger firms are under greater scrutiny but they typically have more resources to tackle environmental issues (Stanwick & Stanwick 1998). Small firms have less power over their suppliers and less knowledge to share with their major customers, which could translate into a decrease in collaborative activities with them (Vachon & Klassen 2006b).

In articles I, II and IV micro-sized firms were omitted from the analysis using the turnover criterion in the European Commission's definition; i.e. firms with a turnover of less than two million euros. In article II manufacturing firms were divided between small and medium-sized firms (turnover 2-50 million euros) and large firms (turnover > 50 million euros). In article III LSPs were divided into two groups: micro-sized firms (turnover < 2 million euros) and small-to-large-sized firms (turnover ≥ 2 million euros).

Table 14 Control variables used in the thesis articles

Construct	Operationalisation	Thesis article	From
Firm size; categorical	Micro-sized firms omitted	I, II, IV	European Commission (2005)
	0 = Turnover 2-50 million; 1 = Turnover > 50 million	II	
	0 = Turnover 0-2 million; 1 = Turnover > 2 million	III	
Manufacturing strategy ; categorical	0 = Push; 1 = Pull	II	Lorentz et al. (2012), Solakivi et al. (2015)
Industry orientation; categorical	0 = Technology industry; 1 = Other industries	II	Solakivi et al. (2015)
Value added; categorical	0 = Low (below Finnish median); 1 = High (above Finnish median)	II	Solakivi et al. (2015)
Single largest customer's share; %	the single largest customer's share of turnover (%)	III	Vachon & Klassen (2006)
Part of the value chain mainly served; categorical	0 = Manufacturing; 1 = Trading	III	Gonzalez-Benito & Gonzalez-Benito (2006)
Tier in the supply chain; categorical	M1 = manufacturing of raw materials and components ; M2 = manufacturing of end products; W = Wholesale; R = Retail, L = Logistics service provider	I	NACE 2002 industry classification

Manufacturing strategy was used as a control variable in article II given that the location of the decoupling point between push and pull strategies has the potential to make production more sustainable (Nieuwenhuis and Katsivou 2015). In the Finland State of Logistics surveys the respondents were asked to describe their main manufacturing strategy by using a categorical variable with five categories: Make to Stock, Make to Order, Assembly to Order, Engineer to Order and Capacity Selling. Following Lorentz et al. (2012) the firms were further divided into firms employing mainly push (Make to Order) or pull strategies (other categories).

Moreover, in article II firms were divided according to their industry orientation and value added. Industry orientation refers to whether or not the firm belongs to the Finnish "technology industries" interest group (manufacturers of electronics, machinery and basic metals), while value added is based on whether the average value-added percentage was above or below that of Finnish manufacturing (Solakivi 2015). Firms operating in high value-added industries may be more

profitable and thus have more resources to use in GSCM. Firms belonging to the technology industries are typically more export oriented than other industries (Solakivi et al. 2015), which might have an effect on their GSCM practices.

In article III focusing on the environmental collaboration of LSPs, the single largest customer's turnover share (%) was used as a control variable. Vachon and Klassen (2006) suggest that customer base concentration has an effect on the adoption of GSCM practices because the supplier's dependence on the customer is likely to affect their willingness to participate in environmental initiatives (Min & Galle 2001; Sarkis et al. 2011). In addition, the LSPs were divided into two groups based on the part of the value chain the company mainly serves: manufacturing or trading. Proximity to the final customer has been argued to increase environmental proactivity (Gonzalez-Benito & Gonzalez-Benito 2006). Brockhaus et al. (2013) reported that mandated sustainability projects were typically initiated by large retailers. Given that firms have a tendency to transfer environmental requirements to their suppliers (Lee et al. 2014), this might translate into environmental requirements for LSPs.

In article I the manufacturing and trading firms were divided into different tiers of the supply chain based on the industry they operate in, using the industry classification NACE 2002 as reference. The retail (R) and wholesale (W) tiers of the value chain were considered to consist of firms that were classified as firms operating in retail and wholesale trade respectively. The manufacturing industries were divided into the manufacturing of raw materials and components (M1) and the manufacturing of end products (M2) based on the latest input–output tables of manufacturing in Finnish national accounts (Statistics Finland 2015). The industries in which the majority (over 50%) of the outputs were distributed within the same industry were deemed to belong to the M1 tier of the supply chain, while the industries where the majority (less than 50%) of the outputs were distributed outside the industry were considered to belong to the M2 tier of the supply chain. The LSPs were divided into the corresponding four groups, serving each tier in the manufacturing-trading supply chain.

7 SUMMARY OF THE RESULTS

The purpose of this chapter is to present the empirical results of the four research articles in relation to the research questions. Articles I and IV relate to the first research question: *What is the role of competitive strategy and customer requirements in green supply chain management adoption?* Articles II and IV address the second research questions: *What are the connections between GSCM practices and firm performance in manufacturing?* The third research question: *What are the connections between environmental collaboration and firm performance in logistics services*? is addressed in article III. Whereas articles II and III particularly focus on environmental collaboration, article IV examines GSCM practices from a broader perspective, including both environmental collaboration and environmental monitoring.

Article II analyses a sample of 135 manufacturing firms from the Finland State of Logistics 2012 survey while article IV tests a sample of 119 manufacturing firms from the Finland State of Logistics 2014 survey. In articles II and III firm performance is considered to consist of financial performance, measured financial reporting data, and operational (or intra-firm supply chain) performance. Article IV, in turn, examines financial and environmental performance using perception-based measures.

Operational performance outcomes are studied in the context of manufacturing (article II) and LSPs (III). As was the case regarding the financial performance elaborated on above, article II examines environmental collaboration within the firm and with suppliers and customers, while article III considers only customer-side environmental collaboration to be relevant for the studied sample of LSPs. In article II the term "intra-firm supply chain performance" is used to describe the operational performance of manufacturing firms.

7.1 Role of competitive strategy in GSCM adoption

The role of competitive strategy in GSCM adoption (RQ1) is addressed in article I. A total of 128 manufacturing, 110 trading and 144 logistics firms operating in Finland were divided into five categories based on their competitive priorities: cost leadership, marketing differentiation, operations differentiation, hybrid strategy, and stuck-in-the-middle. Marketing differentiation and operations differentiation

were found to be the most pursued competitive strategies in manufacturing and trading. LSPs tended to prefer operations differentiation to other strategic options.

Among all respondents, a group of environmentally proactive firms, i.e. firms who considered small environmental impacts to be an important or a very important source of competitive advantage (4 or 5 in the Likert scale), were identified. This led to a subsample of 39 manufacturing, 34 trading firms and 44 LSPs. The analysis reveals that these firms are more likely to be marketing differentiators, which confirms that pursuing a better market image seems to be the most effective driver of GSCM practices (Testa & Iraldo 2010). Moreover, the results suggest that environmental proactivity is very rarely the only source of competitive advantage and it is typically combined with marketing, superior quality and capacity utilisation. These firms seem to be similar to the "environment first" firms in Wu and Pagell's (2011) classification of the environmental postures of firms and the "eco-branding" firms in Orsato's (2006) classification. In this category the environmental attributes of the products are also quality attributes, and the firms are therefore able to charge a premium price for the green product offering.

Using cluster analysis, four groups of manufacturing and trading firms and fourgroups of LSPs were formed based on their GSCM approach towards suppliers (manufacturing and trading) and customers (LSPs). In manufacturing and trading, firms were separated into four groups based on their approach to ensuring their suppliers' environmental sustainability:

- Cluster 1: low collaboration and low monitoring of suppliers
- Cluster 2: average collaboration and average monitoring of suppliers
- Cluster 3: average collaboration and high monitoring of suppliers, and
- Cluster 4: high collaboration and high monitoring of suppliers

Correspondingly, based on their customers' main method of encouraging environmentally friendly behaviour, the LSPs were divided into four clusters:

- Cluster 1: low collaboration and low monitoring by customers
- Cluster 2: average collaboration and average monitoring by customers
- Cluster 3: high collaboration and average monitoring by customers, and
- Cluster 4: high collaboration and high monitoring by customers

The GSCM strategy clusters are illustrated in Figure 5. While previous research indicates that firms prefer a coercive approach in extending sustainability initiatives to their supply chain partners (Brockhaus et al. 2013), the majority of the analysed firms seem to favour the low or average environmental monitoring of

suppliers or they combine high environmental monitoring with high environmental collaboration.

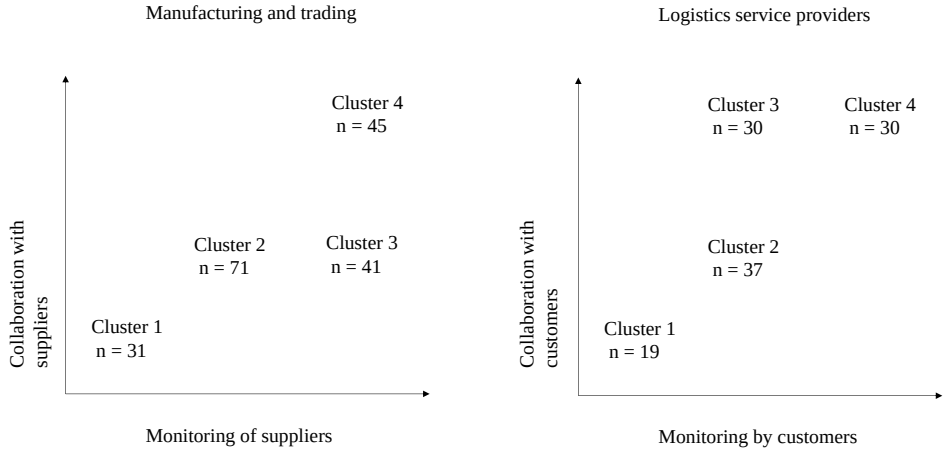

Figure 5 GSCM strategy clusters in manufacturing and trading and logistics services

The clusters were then analysed in connection to the identified competitive strategy approaches, revealing interesting insights. In trading, the operations differentiation strategy was found to be connected with lower levels of environmental collaboration and monitoring of suppliers. In manufacturing, operations differentiators tended to pursue high monitoring and average collaboration. Firms pursuing cost leadership/hybrid strategies and marketing differentiation were more likely to combine high environmental collaboration with high environmental monitoring. The differences might reflect the level of perceived supplier risk as suggested by Cousins et al. (2004) and Hajmohammad and Vachon (2016). They recommend a collaboration-based approach to mitigate the risks if potential losses are high. For example, 45 % of the manufacturing and trading firms in the upper right quadrant pursuing high environmental collaboration and monitoring are marketing differentiators, whereas 57 % of the firms in the left lower quarter are operations differentiators. Furthermore, the results highlight that the vast majority of the firms in Cluster 4 also compete by having small environmental effects.

Despite the lack of statistically significant values, the results from the LSPs appear to be in line with those of manufacturing and trading, given that environmentally proactive LSPs seem to be more likely to form more collaborative relationships with their customers.

The results of article I suggest that a competitive strategy is associated with GSCM practices. A firm is more likely to choose a more complex approach in

GSCM if environmental sustainability is included in the competitive strategy. As an illustration, 55 % of manufacturing and trading firms pursuing a high collaboration and the high monitoring of suppliers (Cluster 4) report that they compete by having only a small environmental effect. The corresponding percentage in the low collaboration and low monitoring group (Cluster 1) is 20. The finding supports previous research by establishing that through the adoption of environmental sustainability as a strategic imperative and with the aid of appropriate management support, firms can proceed with more advanced forms of GSCM, such as environmental collaboration (e.g. Zhu et al. 2008; Green et al. 2012a).

7.2 Role of customer requirements in GSCM adoption

The role of customer requirements in GSCM adoption is addressed in article IV. In the article, partial least squares (PLS) structural equation modelling is used to test a sample of 119 Finnish manufacturing firms. The results of the PLS reveal that the structural path from environmental monitoring by a focal firm's customers to internal GSCM is statistically significant. Thus, the results of the article imply that customers are an important driver for the process of implementing internal GSCM practices, contrary to the majority of previous studies suggesting that internal GSCM practices precede all external activities (e.g. Rao and Holt 2005; De Giovanni and Esposito Vinzi 2012; Shi et al. 2012; Green et al. 2012a; Zhu et al. 2013; Yang et al. 2013). This is in line with previous suggestions by Walker et al. (2008), Thun and Müller (2010) and Chavez et al. (2014), who all argue that customer pressure prompts the implementation of GSCM practices.

As suggested by Gimenez and Sierra (2013), the study also indicates that the environmental monitoring of suppliers acts as an enabler of more collaborative relationships. The results highlight that pre-existing governance mechanisms, such as environmental monitoring, promote the use of more advanced stages of GSCM practices, such as environmental collaboration (Paulraj et al. 2014; Gavronski et al. 2011).

To summarise the findings related to RQ1, the results of articles I and IV reveal that firms pursuing marketing differentiation as a competitive strategy are more likely to compete by having small environmental effects and by adopting a more advanced form of external green supply chain management, such as a combination of high environmental collaboration and a high environmental monitoring of suppliers. The findings support the notion that customer requirements for environmental sustainability play a significant role in making internal operations greener. Furthermore, manufacturing firms can respond to customer pressure by transferring environmental requirements upstream in the supply chain, either by

collaborating or monitoring their suppliers' environmental performance. In line with previous studies (Gimenez & Sierra 2013; Terpend & Krause 2015), environmental collaboration with suppliers can be facilitated if the firm is already monitoring their suppliers' environmental compliance.

7.3 Connections between GSCM practices and performance in manufacturing

7.3.1 GSCM and financial performance

Above all, the results of this dissertation underline that the type of GSCM practice plays a significant role in determining what kind of performance outcomes can be expected. The findings are summarised in Table 15 and explained below in detail.

In terms of financial performance in manufacturing, external GSCM practices seem to be the key. Using financial reporting data on ROCE, ROA and EBIT percentage, article II indicates that environmental collaboration with suppliers is positively linked to EBIT-% whereas environmental collaboration with customers is positively associated with ROA. Contrary to expectations, a negative connection between internal environmental collaboration and ROCE emerged, i.e. a higher level of internal environmental collaboration reduces ROCE.

The analysis that was conducted by using perception-based indicators in article IV supports these findings. Only environmental collaboration with customers was found to be directly related to financial performance, measured as perception-based indicators. In contrast, neither internal GSCM practices nor environmental collaboration with suppliers directly resulted in financial performance improvements. Internal GSCM practices are indirectly connected to financial performance through environmental collaboration with customers. The findings support Hollos et al. (2012) who argue that sustainable supplier collaboration only improves the sustainability of the buying firm while other aspects contribute to economic performance.

Table 15 Summary of the connections between GSCM practices and performance

GSCM practice	Financial performance		Operational performance		Environmental performance		Article
	Manufacturing	Logistics	Manufacturing	Logistics	Manufacturing	Logistics	
Internal GSCM	ns	N/A	N/A	N/A	+	N/A	IV
Environmental collaboration	ROCE (-)	ROI (-)	Supplier delivery time (+) Inventory days of supply (+) Days of payables outstanding (+) Cash-to-cah (+)	ns	N/A	N/A	II, III
External GSCM							
Environmental monitoring							
of suppliers	ns	N/A	N/A	N/A	+	N/A	IV
by customers	N/A	N/A	N/A	N/A	N/A	N/A	IV
Environmental collaboration							
with suppliers	EBIT-% (+)	N/A	Inventory carrying costs (-) Supplier delivery accuracy (+) Days of sales outstanding (+)	ns	ns	N/A	II, III, IV
with customers	+ ROA (+)	EBIT-% (+) ROI (+) ROA (+)	Inventory carrying costs (+) Administration costs (+) Other logistics costs (+) Total logistics costs (+) Inventory days of supply (-)	Average load factor in domestic shipments (+)	ns	ns	II, III, IV

N/A = not applicable
ns = non-significant relationship(s)

7.3.2 GSCM and operational performance

In terms of logistics costs, no statistically significant connections with internal environmental collaboration were found with any of the individual components or total costs. The outcomes of external environmental collaboration were dependent on whether the activities focus on suppliers or customers. Environmental collaboration with customers increased inventory carrying costs, logistics administration costs, other logistics costs and total logistics costs. Although Solakivi et al. (2015) found that external supply chain collaboration decreased logistics costs, it seems that when the environmental element is added to collaboration, the logistics costs tend to increase.

In contrast, the results revealed that environmental collaboration with suppliers was associated with lower inventory carrying costs. One reason could be that environmental sustainability is considered an additional cost and that the members in the supply chain try to reduce the negative financial effects by passing the additional costs upstream in the supply chain to the next tiers. It might also be possible that environmental collaboration with suppliers has improved delivery and flexibility, as suggested by Vachon and Klassen (2008), which in turn could lower the inventory carrying costs.

The results of article II indicate that internal environmental collaboration is linked to supplier delivery time in manufacturing. However, the coefficient was positive, meaning that increased internal environmental collaboration is associated with longer supplier delivery time, which could be seen as a negative outcome from a firm's perspective. One reason might be that firms try to achieve internal environmental goals by preferring slower and less polluting transport modes or the consolidation of shipments (McKinnon & Edwards 2012), which in turn increases the delivery time.

Regarding asset utilisation, internal environmental collaboration was found to be connected to more inventory days of supply, more days of payables outstanding and longer cash-to-cash cycle time. From a firm's perspective, expanding the days of payables outstanding could be considered a positive outcome, whereas the other impacts can be considered negative.

The findings concerning the external environmental collaboration of manufacturing firms seem to be mixed. As expected, increased environmental collaboration with suppliers is connected to higher supplier delivery accuracy. However, environmental collaboration with suppliers also increased days of sales outstanding. Environmental collaboration with customers, in turn, decreased inventory days of supply. The decrease in inventory days of supply might be due to the better information sharing that is associated with closer collaboration.

In addition, control variables used in the analyses had several statistically significant relationships with operational performance measures. The membership in technology industries has a connection with all measures of customer service performance and asset utilisation. Given that these firms are typically more export-oriented, it seems that they need to pay particular attention to customer service levels and asset utilisation in order to compete with foreign firms.

7.3.3 GSCM and environmental performance

The connections between GSCM practices and environmental performance in manufacturing firms are outlined in article IV. As described by several previous articles (e.g. Zhu and Sarkis 2004, De Giovanni and Esposito Vinzi 2012; Yang et al. 2013) environmental performance is positively affected by internal GSCM practices. In addition, the environmental monitoring of suppliers is also found to enhance environmental performance, although to a smaller extent. By monitoring suppliers' environmental compliance, firms are able to obtain a greener product or service, as suggested by Green et al. (2012a) and Gimenez and Sierra (2013).

Interestingly, the more collaborative approaches with customers or suppliers were not connected to environmental performance improvements. This finding conflicts with Preuss (2005), who recommends that firms move from confrontational arm's length relationships to a collaborative relationship in order to benefit fully from environmental management. Article IV concludes that one possible reason for this might be that suppliers need to exceed a certain threshold in environmental performance, but that activities beyond that level have only a marginal impact on environmental performance. Another reason could be that environmental monitoring results in immediate performance gains while performance improvements gained from environmental collaboration are achieved over a longer period of time.

7.4 Connections between environmental collaboration and performance in logistics services

7.4.1 Environmental collaboration and financial performance

The analysis of 311 LSPs providing road transport services provides further support for the conclusions reached regarding manufacturing. Article III studies internal environmental collaboration and external environmental collaboration with customers compared to the financial and operational performance of LSPs. It

was decided to exclude supplier-side collaboration given that the majority of the respondents are micro- or small-sized, and hence their abilities to collaborate with suppliers, such as vehicle manufacturers and fuel companies, is marginal. Consequently, the results on the connections of external environmental collaboration only apply to the customer-side of the supply chain.

The analysis reveals that internal environmental collaboration has a significant negative connection with ROI. Although the finding related to this negative association between internal environmental collaboration and financial performance is somewhat surprising, it is in line with Zhu et al. (2013) who conclude that internal green practices and economic performance are negatively connected. In previous literature, LSPs have been found to be at an early stage of GSCM implementation (Isaksson & Huge-Brodin 2013), which results in significant start-up investment despite benefits not yet being achieved (Wu & Pagell 2011; Zhu et al. 2013).

External environmental collaboration with customers, in turn, was found to have a significant positive connection with EBIT-%, ROI and ROA of LSPs. ROI has the strongest linkage to environmental customer collaboration. It can thus be concluded that environmental collaboration with customers seems to be the most effective way to improve financial performance. The current results imply that the financial performance of a company can be improved while also reducing effects on the natural environment if the right type of GSCM is chosen. Internal environmental collaboration alone is not enough to improve financial performance but both manufacturing firms and LSPs need to extend their focus beyond organisational boundaries and to their customers.

7.4.2 Environmental collaboration and operational performance

The environmental collaboration of logistics service providers was assessed in relation to operational efficiency in article III. The results seem to be in line with those of manufacturing, implying that operational performance is only marginally connected to environmental collaboration. Furthermore, only average load factors in domestic shipments were found to be associated with internal environmental collaboration and external environmental collaboration with customers. Furthermore, it should be noted that the model containing both internal and external environmental collaboration was found less suitable than the model containing only control variables.

With the results on financial performance implying that external environmental collaboration with customers improves EBIT-%, ROI and ROA, it seems that the profitability of a company might be improved through better vehicle utilisation (McKinnon & Edwards 2012). The lack of statistically significant relationships

between environmental collaboration and other operational performance measures supports the notion put forward by Perotti et al. (2012) concluding that green supply chain practices had only a low impact on the operational performance of Italian LSPs.

In logistics services, larger firms were found to have a higher transport performance per vehicle and longer average hauls. Furthermore, firms that mainly serve manufacturing generally had a higher load factor in domestic shipments and a higher average transport performance per vehicle than firms that mainly serve trading. The single largest customer share of turnover was found to have significant linkages with most of the operational measures, which indicates that having one or a few large customers enables LSPs to better utilise vehicle capacity.

Overall, the findings of this thesis imply that the operational performance of firms is more closely linked to firm characteristics than the choices they make regarding their environmental collaboration, which supports previous studies on traditional supply chain collaboration (e.g. Solakivi et al. 2015).

8 CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

While Chapter 7 summarises the empirical results in relation to the research questions, the findings are further elaborated on in this concluding chapter. First, the theoretical contributions to current research streams are discussed. Next, the managerial implications are provided in order to highlight the practical relevance of this dissertation. A summary of the methodological contributions then follows. Lastly, the boundary conditions and suggestions for future research are outlined in the final section of this concluding chapter.

8.1 Theoretical contribution

Halldorsson et al. (2015) posit that the potential of supply chain management research lies in explaining interfirm dynamics: how to adapt, integrate and reconfigure resources across firm boundaries. In order to respond to changes in the market, environmental firms should integrate internal and external resources using organisational processes (Teece et al. 1997). Interfirm dynamics in the context of green supply chain management are the focus of this thesis. Yu et al. (2014) call for research on green supply chain management on the totality of a supply chain from internal practices to upstream and downstream-focused activities. Thus, this research examines GSCM practices within a company and with suppliers and customers. Furthermore, one of the main contributions of this thesis is that GSCM practices are analysed in several industries. While articles II and IV focus on manufacturing, article III extends the focus to logistics service providers and article I analyses firms in manufacturing, trading and logistics.

This thesis relates to literature streams on competitive strategy, green supply chain management and performance. The contributions are summarised in Table 16 and discussed below.

First, this thesis contributes to the discussion of the drivers of GSCM practices. As outlined in the introduction, very little is known about the connection between competitive strategy and GSCM strategy. Although most companies are expected to behave in an environmentally responsible way, only a limited number of firms in each industry can transform environmental investments into sources of competitive advantage (Orsato 2006). Following the resource-based view, Hitt (2011) argues that resources should be deployed in ways that match the strategies

implemented by a firm. From the perspective of GSCM, it is essential to understand which types of practices support each competitive strategy.

Table 16 Contribution to different research streams

Research stream	**Main contributions of this thesis**
Competitive strategy	• Develops a conceptual tool to describe competitive strategy approaches • Studies the relationship between competitive strategy and GSCM
Green supply chain management	• Examines GSCM practices within the firm and with suppliers and customers in several industries • Argues that the distinction between environmental collaboration and environmental monitoring needs to be taken into account • Develops a taxonomy of external GSCM strategies based on the extent of environmental collaboration and environmental monitoring • Highlights the role of customer requirements as a driver of internal GSCM practices
Performance	• Shows how different types of GSCM practices are related to each dimension of firm performance • Is one of the first attempts to empirically analyse the relationship between GSCM practices and performance among logistics service providers

The exploratory results obtained in article I indicate that environmental proactivity is typically combined with capabilities facilitating marketing differentiation. This adds to the configuration theory research stream, proposing that there exists an ideal set of organisational characteristics for each context (Vorhies & Morgan 2003). Brand and high perceived quality are pivotal for marketing differentiators (Beal & Yasai-Ardekani 2000; Menguc et al. 2007), and GSCM is a way to improve them. The results are in line with the study by Hoejmose et al. (2013) on the impact of competitive strategy on socially responsible supply chain management (SR-SCM), implying that firms pursuing differentiation strategy are more engaged in SR-SCM. The thesis thus agrees with previous literature arguing that sustainable supply chain management is not at the core of every firm's business strategy (van de Ven and Jeurissen 2005; Hoejmose et al. 2013), which should be taken into account when planning GSCM practices.

Although integrating lean and green practices simultaneously to minimise waste and non-value adding activities together with environmental impacts has received growing interest (e.g. King & Lenox 2001b; Mollenkopf et al. 2010; Yang et al. 2011), it seems that *small environmental effects are considered to be a source of*

differentiation rather than a way to increase efficiency and to reduce costs in order to compete with price, supporting the findings of Maas et al. (2014), Reyes-Rodrígues et al. (2014), and Longoni and Cagliano (2015). Thus, firms might see GSCM practices as a way to charge premium prices for their green product or service offerings, as suggested by Orsato (2006) and Wu & Pagell (2011).

Article I also compares identified GSCM strategy clusters to competitive strategies. Operations differentiation strategy was found to be connected with lower levels of environmental collaboration and the monitoring of suppliers, whereas cost leadership/hybrid strategies and marketing differentiation were linked with high environmental collaboration with high environmental monitoring. The results also reveal that a substantial number of the firms pursuing the "high collaboration and high monitoring" approach compete by having small environmental effects. Complementing existing literature (e.g. Zhu et al. 2008; Green et al. 2012a), the findings of the present study indicate that *a firm is more likely to choose a more complex approach in GSCM if environmental sustainability is integrated into its competitive strategy.* The results can also be linked to literature on traditional supply chain collaboration. Cousins (2005) found that firms pursuing a differentiation strategy have a more long-term view of the business and use more complex collaborative approaches to manage their supply.

The findings could also imply that marketing differentiators, in particular, perceive the potential losses from environmental incidents as high. Given that marketing differentiators compete with brand and reputation, environmental non-compliance has the potential to have diverse effects on them. Cousins et al. (2004) propose that managers perceiving high losses from environmental inaction are likely to choose the most advanced environmental initiatives towards suppliers. Environmental monitoring and environmental collaboration are practices that aim at reducing environmental risks (Hajmohammad & Vachon 2016). A combination of these practices could be described as advanced, given that it requires mutual goals, the significant dedication of resources, and formal and informal knowledge sharing.

The thesis also gives new insights into existing theories on the role of customers in GSCM adoption. Although a number of previous research papers have highlighted the role of customer pressure in diffusing environmental sustainability in the supply chain (Walker et al. 2008; Thun & Müller 2010; Chavez et al. 2014), only a small amount of studies take customer requirements into account as an antecedent of internal and upstream GSCM practices. Institutional theory suggests that social norms, such as the requirements of customers, are a major source of normative pressure for implementing GSCM (Zhu et al. 2013). Customers can also be considered to be a source of coercive pressure, if, in line with the resource-dependence theory, power is located in the downstream of the supply chain (Sarkis et al. 2011, Brockhaus et al. 2013; Chavez et al. 2014; Lee et al. 2014; Foerstl et

al. 2015). Hajmohammad and Vachon (2016) point out that environmental monitoring and collaboration can be employed only if a firm has a reasonable amount of power over their suppliers. The power can be leveraged to pass environmental requirements to upstream suppliers through GSCM practices (Vachon & Klassen 2006a; Brockhaus et al. 2013; Hoejmose et al. 2014; Lee et al. 2014). Building on these notions, article IV highlights that *GSCM with customers, in particular environmental monitoring by customers, precedes internal GSCM practices*, contrary to the predominant view, which assumes that internal GSCM practices is an antecedent of all external activities (Rao and Holt 2005; De Giovanni and Esposito Vinzi 2012; Shi et al. 2012; Green et al. 2012a; Zhu et al. 2013; Yang et al. 2013). The strong positive connection between environmental monitoring by customers and internal GSCM practices highlights the need to respond to changes in customer requirements, as suggested by Green et al. (2012a).

The costs of the initial and on-going transactions determine whether or not to form an alliance with the supplier (Hitt 2011). From this perspective, a firm would benefit from finding an optimal mix of environmental monitoring and collaboration to minimise the costs of transaction (Tate et al. 2011; Sarkis et al. 2011). The present findings contribute to this discussion by providing empirical support that *environmental monitoring is an enabler of environmental collaboration.* The relationship of these mechanisms has been studied by only a small amount of studies in the sustainability context (e.g. Foerstl et al. 2010; Gavronski et al. 2011; Gimenez and Sierra 2013; Paulraj et al. 2014). The findings imply that the more advanced stages of GSCM practices, such as environmental collaboration, are facilitated by existing governance mechanisms. The thesis agrees with Paulraj et al. (2014) in suggesting that the environmental monitoring of suppliers can act as an integrating force that deepens trust and collaboration between supply chain members. The results highlight the need to take the distinctive characteristics of environmental collaboration and monitoring-based approaches into account when investigating GSCM practices.

Halldorsson et al. (2015) argue that a combination of the resource-based view and supply chain management is able to offer an inter-organisational view on competitiveness. Prior literature argues that GSCM practices can create valuable, rare, unimitable and non-substitutable resources (Hart 1995; Hollos et al. 2012). Hence, this thesis considers GSCM practices as resources and sets out to investigate how these specific types of resources influence firm performance. Specifically, this thesis adds value to the existing literature on the relationships between GSCM practices and financial, operational and environmental performance. Companies will need to balance competing priorities and to decide how many resources they want to invest in GSCM practices to achieve their desired outcomes (Wu & Pagell 2011).

This thesis concludes that *firms must be able to adapt their GSCM practices to respond to stakeholder demands and to combine their internal GSCM resources with those of suppliers and customers.* Overall, the results support the notion put forward in the resource-based view and its extensions (Hart 1995; Vachon & Klassen 2008; Shi et al. 2012): competitive advantage and performance improvements can be achieved by combining GSCM related resources with external partners. However, in line with the dynamic capabilities view, the resources need to fit changing situations (Vanpoucke et al. 2014). The appropriate selection of supply chain partners helps firms to identify and exploit relational capabilities to address current and evolving environmental challenges through the exchange of distinctive assets, knowledge, resources, and capabilities (Paulraj 2011). Articles II, III and IV support the previous findings by King and Lenox (2001), Rao and Holt (2005), De Giovanni and Esposito Vinzi (2012), Yang et al. (2013), and Zhu et al. (2013) that *there is a positive relationship between GSCM practices and firm performance.* Thus, it enhances our understanding of how different types of GSCM practices are related to each dimension of firm performance.

The analysis of manufacturing firms in articles II and III provides several interesting insights into the performance outcomes of GSCM practices. As anticipated by previous research (De Giovanni & Esposito Vinzi 2012; Zhu et al. 2013), article IV reveals that internal GSCM practices have the strongest effect on environmental performance. With regard to external GSCM practices, the findings of the current study contrast with those of Gimenez and Sierra (2013), as collaborative GSCM practices do not seem to be necessary to improve environmental performance. Instead, *the environmental monitoring of suppliers is the most effective external practice in terms of environmental performance*.

In terms of operational performance, the analysis in article II resulted in mixed findings. While Vachon and Klassen (2008), Yu et al. (2014) and Chavez et al. (2014) found that GSCM practices were linked to flexibility, delivery, quality and cost, the results of article II revealed both positive and negative connections. The majority of the statistically significant results could be considered undesirable from a firm's perspective. However, the results of Vachon and Klassen (2008), Yu et al. (2014) and Chavez et al. (2014) are based on samples of large North American and Chinese manufacturers, whereas the present sample includes smaller Finnish firms. The reason for the contradictory results might be that the small Finnish firms do not have similar resources to commit to environmental collaboration and hence the improvements in operational performance are also more limited. In line with previous studies on general supply chain collaboration (Solakivi et al. 2015), the results seem to imply that *the operational performance of firms is more likely to be related to the characteristics of a firm than whether or not the firms collaborate on environmental issues.*

Using the financial reporting data of manufacturing firms, article II found a positive connection between environmental collaboration with suppliers and EBIT-%, and environmental collaboration with customers and ROA. Contrary to the expectations, a negative connection between internal environmental collaboration and ROCE emerged. Article IV confirms the findings using perception-based indicators: environmental collaboration with customers was the only GSCM practice that was directly related to financial performance. Thus, it can be concluded that GSCM practices within the firm and with suppliers, particularly the environmental monitoring of suppliers, can improve a firm's environmental performance while *environmental collaboration with customers seems to be the most effective way to enhance financial performance*. The results of article IV add to the discussion by Vachon and Klassen (2008), Large and Gimenez Thomsen (2011) and Green et al. (2012a), who encourage firms to use both collaboration and monitoring-based approaches to ensure the participation of suppliers in GSCM activities in order to gain performance benefits.

According to De Giovanni (2012), earlier research does not pay enough attention to the analysis of the indirect effects of GSCM on firm performance, which leads to an incomplete examination of causal relationships. The results of article IV imply that environmental monitoring by customers has an indirect effect on the environmental monitoring of suppliers through internal GSCM practices, that environmental monitoring by customers is linked to environmental collaboration with suppliers through internal GSCM and through environmental monitoring of suppliers and internal GSCM have an indirect impact on financial performance through environmental collaboration with customers. The findings imply that *the results of internal GSCM practices can be exploited financially only if internal initiatives are made in combination with environmental collaboration with customers*.

This thesis is also one of the first attempts to empirically analyse the linkages between GSCM practices and performance amongst logistics service providers. Although the sample comprises only LSPs offering road transport services, the results provide support the idea that *the relationships between environmental collaboration and firm performance in logistics services are essentially similar to those in manufacturing*. As suggested by Perotti et al. (2012), environmental collaboration had only a low impact on operational performance. However, similar to manufacturing, the results revealed that external environmental collaboration with customers had a positive impact on financial performance. The thesis addresses the need to focus on the relationship between GSCM practices and performance in the context of LSPs, in particular by using a survey method that can enable empirical generalisations in order to validate the results of exploratory case studies, as highlighted by Evangelista (2014) and Perotti et al. (2012).

8.2 Managerial contribution

Firms' perceptions of environmental threats and opportunities are highly related to their adoption of GSCM practices (Cousins et al. 2004). By remaining inactive, firms might be subject to considerable risks. They can either accept these risks or try to manage them through environmental collaboration or environmental monitoring. By adopting an active stance towards green supply chain management, not only can a firm mitigate risks but it can also achieve sustained competitive advantage.

This dissertation has illustrated how GSCM practices are connected to the financial, operational and environmental performance of firms. The performance outcomes of different types of GSCM practices need to be clear in order to encourage firms to implement a wide variety of GSCM initiatives (De Giovanni 2012). One of the main messages to practitioners is that the financial performance of a firm can be improved while also reducing negative effects on the natural environment – if the right type of GSCM is chosen. In order to achieve environmental, operational and financial performance benefits, firms should combine internal GSCM practices with activities targeted towards external supply chain partners, such as suppliers and customers. This study agrees with Yu et al. (2014) and suggests that many firms might forget the importance of external activities while pursuing internal environmental initiatives. Taking the results from manufacturing and logistics services into account, *firms need to extend their focus beyond organisational boundaries to benefit fully from GSCM adoption*.

The results of this thesis indicate that environmental monitoring is an enabler of environmental collaboration. Hence, the present study supports the notion put forward by previous studies (De Giovanni 2012; Gimenez and Sierra 2013; Paulraj et al. 2014) that a firm ought to evaluate and monitor the environmental performance of suppliers before investing in closer environmental collaboration with them. As illustrated in this thesis, internal GSCM practices and a stricter environmental monitoring-based approach towards suppliers are the most effective way to improve environmental performance. The results also imply that practitioners should be cautious regarding their expectations of operational performance improvements because it seems that firm characteristics have a larger impact on operational performance than environmental collaboration. Finally, if a firm desires financial performance gains from GSCM practices, internal GSCM alone is not enough as firms will need to collaborate with their customers. Hence, *managers should make their decisions about GSCM practices based on what their firm wants to achieve because each type of GSCM practice seems to have different kinds of performance implications*.

While making decisions about how to green the supply chain, managers should also bear in mind the competitive strategy of their firm. As pointed out by Longoni

and Cagliano (2015) and supported by the results of this thesis, environmental priorities can be integrated into traditional approaches to compete. The results of this thesis suggest that in particular firms pursuing marketing differentiation seem to improve their competitive advantage by having just small environmental effects. Alternatively, if environmental sustainability is not seen as a strategic imperative for a firm, it might be more reasonable to follow the lead of other members in the supply chain instead of using resources to overachieve. Nevertheless, these firms need to recognise the danger of losing early-mover advantages (e.g. Porter & van der Linde 1995; Reuter et al. 2010), such as new customers, premium prices and maximum time to adapt to future regulatory policies, if they only comply with the minimum environmental requirements necessary. Consistent with Caniëls et al. (2013), firms might realise that a certain level of environmental sustainability is an order qualifier which needs to be exceeded before a firm is considered to be a potential supplier.

8.3 Methodological contribution

Finally, the chosen data and methods of analysis provide an exceptionally wide sample with which to study GSCM practices and performance. The empirical data for this thesis is derived from several sources. The main empirical data were collected as part of two consecutive Finland State of Logistics surveys from 2012 and 2014. In articles II and III subjective survey data were combined with objective financial reporting data extracted from external databases. This methodological choice makes a novel contribution to existing literature, which tends to use only perception-based indicators (Markley & Davis 2007; Wang & Sarkis 2013). Moreover, numerous methods of analysis are used in the thesis, some of which are rather uncommon in GSCM research, e.g. generalised linear modelling. It is essential that researchers within the GSCM field recognise the impact of non-normal data and choose their methods of analysis accordingly.

8.4 Limitations and suggestions for future research

While sustainable supply chain management involves the three dimensions of the triple bottom line, this study concentrates on environmental sustainability and its drivers and performance implications. As suggested by Carter and Easton (2011) and Wu and Pagell (2011), a holistic analysis of the effects of sustainable SCM, integrating environmental, economic and social dimensions simultaneously, would enhance our understanding of how firms can balance all three dimensions without compromising performance. In addition, Wang and Sarkis (2013) call for a more

nuanced examination of the relationships between GSCM practices and performance. Hence, future research might help to understand these relationships by using, for example, mediation, moderation or non-linear relationships.

Given that this thesis focuses on the role of competitive strategy and customer requirements in GSCM adoption, numerous other factors, such as regulation, competitors, suppliers and employees were not analysed. Further effort should thus be put into examining the relationship between these presently excluded potential drivers and GSCM practices. Although there are previous studies that identify the drivers of GSCM practices (e.g. Zhu & Sarkis 2006; Lee 2008; Walker et al. 2008; Thun & Müller 2010), large-scale empirical analyses of their connection to GSCM practices and eventually firm performance would advance current theory.

The results of article I reveal that 24 per cent of the respondent firms did not excel in any competitive priority and can thus be considered as "stuck-in-the-middle". Given that previous research has associated stuck-in-the-middle strategies with lower (financial) performance (e.g. Porter 1980; Kim et al. 2004; Pertusa-Ortega et al. 2009; Leitner & Güldenberg 2010), it would be particularly interesting to investigate if stuck-in-the-middle strategies are also linked with lower environmental performance. Moreover, the findings of this thesis concerning the effects of GSCM practices only apply to internal activities and suppliers and customers. Future research could address the performance implications of GSCM practices with other stakeholders, such as non-governmental organisations, research institutions and authorities.

There is need for further theory building on the alignment between competitive strategy and GSCM strategies and its impact on firm performance. As suggested for example by Venkatraman (1989) and Blome et al. (2014), profile deviation analysis could be used as a tool to test if misalignment between competitive and GSCM strategies will worsen firm performance. The concept of alignment would provide firms with a tool for considering competitive and GSCM strategies simultaneously and for making holistic decisions within the firm and across the supply chain (Wu 2014).

Given that this thesis is based on cross-sectional survey data, future research could address the effects of GSCM practices on firm performance on a longitudinal basis. For example, Carter and Rogers (2008) suggest using a survey-based methodology to measure the level of a firm's environmental and social supply chain performance over time and combining that information with multi-year financial performance data. Moreover, as all firm-level variables, such as GSCM practices, can be considered to be decisions made by managers to affect the outcomes of their firm, the endogeneity of the independent variables could be tested (Semadeni et al. 2014). Previous research has suggested that economic performance has a significant positive effect on green production and GSCM

practices (Gotschol et al. 2014), which calls for an examination of reverse causal loops between environmental initiatives and performance.

Finally, Carter and Easton (2011) call for more research that uses the supply chain as a unit of analysis. Although article I analyses GSCM practices by making analyses on the tiers of several industries, future research would benefit by collecting data from actual supply chains or dyads to see if evidence for tightening environmental requirements, i.e. the green bullwhip effect (Lee et al. 2014), could be found.

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