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RESEARCH FRAMEWORK FOR THE CONNECTION BETWEEN ENVIRONMENTAL COLLABORATION AND FIRM PERFORMANCE

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in Operations and Supply Chain
Management

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Table of contents

1	INTRODUCTION	9
1.1	Background	9
1.2	Research objective and structure of the thesis	10
1.3	Pivotal concepts.....	11
1.3.1	Supply chain.....	11
1.3.2	Supply chain management	12
1.3.3	Supply chain collaboration	15
1.3.4	Firm performance.....	17
1.3.5	Terminology related to the environment.....	17
1.4	Limitations	19
2	SUPPLY CHAIN COLLABORATION.....	20
2.1	Main categories of supply chain collaboration	20
2.1.1	Internal collaboration	21
2.1.2	External collaboration	23
2.2	Barriers to supply chain collaboration	25
2.2.1	Interfirm rivalry	26
2.2.2	Managerial complexity	27
2.3	Factors enabling supply chain collaboration	28
2.3.1	Information sharing.....	29
2.3.2	Decision synchronization.....	32
2.3.3	Incentive alignment.....	34
2.3.4	Collaborative performance system	36
2.3.5	Integrated supply chain processes.....	38
2.4	The effects of supply chain collaboration	39
3	ENVIRONMENTAL MANAGEMENT AND COLLABORATION IN THE SUPPLY CHAIN.....	42
3.1	Theories applied in environmental management research	42
3.1.1	Institutional theory	42
3.1.2	Resource-based view	45
3.2	Environmental management in firms	48
3.3	Green supply chain management	52
3.4	Environmental collaboration in the supply chain.....	53
3.4.1	Internal environmental collaboration.....	54
3.4.2	External environmental collaboration.....	55

3.5	Illustration of green supply chain practices within a firm and with collaborative partners	58
4	DIMENSIONS OF FIRM PERFORMANCE	61
4.1	Economic performance of a firm	61
4.1.1	Financial statement ratios	61
4.1.2	Cash flow analysis	64
4.1.3	Market-based valuation.....	65
4.2	Intra-firm supply chain performance	66
4.3	Environmental performance of a firm.....	72
4.4	The connection between environmental collaboration, economic performance and intra-firm supply chain performance.....	75
5	RESEARCH METHODS AND RESEARCH FRAMEWORK	78
5.1	Matching research methods with research objectives.....	78
5.2	Characteristics of survey research methods	81
5.3	Characteristics of case study methods.....	84
5.4	Research methods to analyse environmental collaboration in the supply chain	86
5.4.1	Survey research.....	87
5.4.2	Case research	90
5.5	Research framework for the connection between environmental collaboration and firm performance	93
6	CONCLUSIONS AND FURTHER RESEARCH	97
6.1	Conclusions	97
6.2	Opportunities for future research	99
	REFERENCES.....	101
	APPENDICES	122

List of Figures

Figure 1	Main categories of supply chain collaboration (Barratt 2004, 32).....	20
Figure 2	Logistics integration with other departments (Kahn & Mentzer 1996, 10) ..	22
Figure 3	Collaborative supply chain framework (Simatupang & Sridharan 2005a, 261).....	29
Figure 4	Illustration of environmental management activities in a firm and with key suppliers and customers	59
Figure 5	Dimensions of logistics performance (Chow, Heaver & Henriksson 1994, 23).....	67
Figure 6	Case research process model (Stuart et al. 2002, 420)	85
Figure 7	Follow-up explanations model (quantitative phase emphasized) (Creswell & Plano Clark 2007, 73)	91
Figure 8	Research framework and connections between the constructs.....	93

List of Tables

Table 1	Benefits of supply chain collaboration.....	41
Table 2	Supply chain performance metrics framework (Gunasekaran et al. 2004, 345).....	71
Table 3	Evolutionary stage versus performance measure classification (Beamon 1999b, 340)	73
Table 4	Examples of studies on the connection between environmental performance/management and firm performance	77
Table 5	How to match research purpose with methodology (Voss, Tsikriktsis, Frohlich 2002, 198)	80
Table 6	Main multivariate analysis methods (Forza 2002, 186)	88
Table 7	Summary of hypotheses proposed in the framework	94
Table 8	Respondent companies by main sector of industry and size	122

List of abbreviations

BREEAM	Building Research Establishment Environmental Assessment Method, a voluntary environmental measurement rating for buildings
CPFR	Collaborative planning, forecasting and replenishment
CPS	Collaborative performance system
CRM	Customer relationship management
CSR	Corporate social responsibility
DfE	Design for environment, or eco-design
EBIT	Earnings before interest and taxes
EDI	Electronic data interchange
EM	Environmental management
EMAS	Eco-Management and Audit Scheme by the European Commission
EMS	Environmental management system
EPS	Earnings per share
EVA	Economic value added
GRI	Global Reporting Initiative, a non-profit organisation providing provides a comprehensive sustainability reporting framework
GSCM	Green supply chain management
ISO 1400	Standard for an environmental management system by the International Organization for Standardization
IT	Information technology
LEED	Leadership in Energy and Environmental Design, a voluntary environmental measurement rating for buildings by the U.S. Green Building Council
MVA	Market value added
NRBV	Natural-resource-based view
P/B	Price to book equity
RBV	Resource-based view
ROA	Return on assets
ROE	Return on equity
ROI	Return on investment
SCC	Supply chain collaboration
SCM	Supply chain management
SCOR	Supply chain operations reference model
SEM	Structural equation modelling
SME	Small- and medium-sizes enterprises
SRM	Supplier relationship management

1 INTRODUCTION

1.1 Background

In the broadest sense sustainability means balancing economic, social and environmental objectives of the present and future generations (World Conference on the Environment and Development 1987, 41). This thesis addresses the economic and environmental dimensions of sustainability, in particular environmental collaboration in the supply chain context. Firm environmental sustainability has received increasing attention since the 1990s, and it is almost certain that this growth will remain in the future (Sarkis 2001, 666). Reasons to this development range from tightening environmental regulation to ethical values of the management (Walker, Di Sisto, McBain 2008, 71). A significant body of research suggests that regulation is the major driver of corporate environmental efforts (e.g. Handfield, Walton, Seegers & Melnyk 1997, 295; Walton, Handfield, Melnyk 1998, 3; Walker et al. 2008, 72) but many authors also argue that environmental proactivity can result in competitive advantage (e.g. Hart 1995, 991; Russo & Fouts 1997, 537). Recently, the focus of environmental management has shifted more and more from organisation level to supply chain level (Linton, Klassen & Jayaraman 2007, 1078). Preuss (2005, 124) argues that environmental initiatives are impossible without the involvement of the supply chain management function. Since supply chain management is cross-functional and integrative in nature, and many its activities affect environment, it provides an excellent opportunity to support the organisation's efforts to become environmentally friendly (Wu & Dunn 1995, 22). As a result, integrating environmental thinking into supply chain management has been gaining increasing interest from practitioners and academia (Srivastava 2007, 54).

The relational view suggests that organisational capabilities can be built by combining resources existing in different organisations in the supply chain (Dyer & Singh 1998, 660; Vachon & Klassen 2008, 300). This perspective is supported by empirical evidence from studies on supply chain collaboration (e.g. Vonderembse & Tracey 1999, 34; Biehl, Cook & Johnston 2006, 16). The question then arises whether environmental capabilities can also be built jointly with supply chain partners? A body of literature argues that environmental management in the supply chain can indeed develop capabilities (Rao & Holt 2005, 910; Vachon & Klassen 2008, 301; De Giovanni & Esposito Vinzi 2012, 908). De Giovanni and Vinzi (2008, 301-302) suggest that one way that can lead to the development of capabilities is environmental collaboration, i.e. joint planning and decision making with regard to environmental issues.

Environmental collaboration, in turn, is suggested to have a positive impact on firm performance (Vachon & Klassen 2008, 302). Performance is a rather ambiguous con-

cept and it is most often measured in financial terms (Lebas 1995, 29). Supply chain management aims at improving firm performance by linking internal functions with external suppliers, customers, and other supply chain members (Kim 2006, 241). As a consequence, supply chain or logistics performance can be seen as one construct that should be taken into account when measuring overall firm performance.

The acceptance of environmental performance as an integral part of firm performance has grown in the recent years as the triple bottom line approach (i.e. measuring social and environmental performance in addition to economic performance) has become increasingly popular (Hubbard 2009, 180). Since environmental collaboration is not a widely used concept, the studies have mainly focused on environmental activities in the supply chain in general without separating collaborative activities from those that are monitoring oriented (Vachon & Klassen 2008, 299). The studies that have been undertaken (e.g. Vachon & Klassen 2008, De Giovanni & Esposito Vinzi 2012) have explored the connection between economic, environmental and manufacturing performance, but they have not covered supply chain performance. Therefore, the connection between environmental collaboration and firm performance, including economic, environmental and supply chain perspective, should be further studied.

1.2 Research objective and structure of the thesis

This study aims to 1) *build a theoretical framework of connections between environmental collaboration and firm performance* and 2) *suggest potential approaches to analyse whether these connections exist and what are their directions*. With ‘environmental collaboration’ this study applies Vachon and Klassen’s (2008, 299) definition that refers to intra- and inter-organisational interactions between supply chain members, including elements such as joint goal-setting and working together to reduce the environmental impacts of products and processes. In this study environmental collaboration is thus viewed in the supply chain context.

Inter-organisational collaboration is limited to key suppliers and customers, i.e. vertical collaboration. ‘Firm performance’ refers here to the economic and intra-firm supply chain performance of a company. ‘Economic performance’, in turn, refers to performance measured mainly with traditional financial statement based metrics. ‘Intra-firm supply chain performance’ is operationalized according to Lorentz, Töyli, Solakivi, Hälinen and Ojala (2012, 613) to include three dimensions: logistics costs, service performance and asset utilization.

Before collecting any data and analysing it, the researcher must create a theoretical model by 1) identifying and defining all the constructs, 2) presenting and discussing the role of the constructs, the linkages between them, and an indication of the nature and

direction of the relationships, 3) providing a clear explanation why these relationships are expected to exist, and 4) defining the conditions under which these relationships are expected to hold (Forza 2002, 156). Therefore, an extensive research framework is developed in order to find out key concepts, relationships and boundaries. The actual analysis of the relationships derived from the framework is out of the scope of this thesis. However, suggestions on how the analysis could be conducted will be provided. As a consequence, this study also critically reviews what kinds of research questions can be answered by analysing the quantitative and qualitative data.

This thesis is divided into six chapters. Chapter 1 introduces the research topic, research objective, and key concepts to the reader together with the research limitations. Chapters two, three, four and five provide an overview over the existing research. Chapter 2 focuses on supply chain collaboration. It intends to give the reader an overview of collaboration on a general level, without attempting to include the environmental aspect. Chapter 3 examines environmental management and collaboration in the supply chain. First, two broader theories applied in environmental management are briefly introduced, followed by a general overview on how environmental management practices are implemented in companies. The chapter then proceeds to describe environmental collaboration in the supply chain context. Chapter 4 is divided into four subchapters. The first three of them describe one dimension (economic, intra-firm supply chain, and environmental) of firm performance each, while the fourth subchapter provides a synthesis of how environmental collaboration is connected with firm performance. Chapter 5 first introduces how the research question impacts the choice of research methods and proceeds to present two potential research approaches, survey and case study research. Furthermore, the final section of Chapter 5 presents a research framework built on the concepts presented in the previous chapters. Conclusions are made in Chapter 6.

1.3 Pivotal concepts

1.3.1 *Supply chain*

The definition of a *supply chain* is an important starting point in any supply chain research. However, since the research in supply chain and supply chain management field is relatively new, there is a variety of definitions (Janvier-James 2012, 194). According to Beamon (1998, 281) a supply chain is:

an integrated process wherein a number of various business entities (i.e., suppliers, manufacturers, distributors, and retailers) work together in an

effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to retailers.
 Beamon (1998, 281)

In Beamon's (1998, 281) definition value is added to the raw materials and the chain finishes with the transfer of the finished goods to the customer. Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia (2001, 4) integrate more activities in the function of a supply chain:

a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.
 Nix et al. (2001, 4)

The definition of Ayers (2006, 5) also encompasses several processes:

[A supply chain:]Product life cycle processes comprising physical, information, financial, and knowledge flows whose purpose is to satisfy end-user requirements with physical products and services from multiple, linked suppliers.
 Ayers (2006, 5)

The range of processes forming the supply chain is broad, including e.g. sourcing, designing, manufacturing, transporting and selling physical products or services. The perspective of viewing the supply chain as comprising the whole product life cycle highlights the importance of product support after the sale. Physical distribution, information, financial resources and knowledge are all equally important flows in the supply chain. The flow direction is not limited. In addition to the forward flows to the customer, the backward flows such as product returns and payments must be taken into consideration. It must also be noted that also services have supply chains which can benefit from the same techniques as product manufacturers. (Ayers 2006, 5-6.)

1.3.2 Supply chain management

Supply chain management (SCM) is gaining interest of researchers and business management practitioners. Instead of being a support function within the company, the supply chain management encompassing all functions involved in serving the end customer has become a potential competitive advantage of companies. Despite the concept gaining popularity and importance, there is no universally accepted definition. Ballou, Gil-

bert and Mukherjee (2000, 9) start by defining the supply chain and use that definition in defining SCM:

The supply chain refers to all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users. Management refers to the integration of all these activities, both internal and external to the firm.

(Ballou, Gilbert & Mukherjee 2000, 9)

One of the most popular definitions is provided by the Council of Supply Chain Management Professionals (CSCMP):

Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies.

(Supply chain management Terms and Glossary 2010)

Stock and Boyer (2009, 691-711) state that most scholars agree that supply chain management includes coordination and integration, cooperation among chain members, and the movement of materials to the end customer but there is still lack of comprehensive and encompassing definition of SCM, which in turn hinders researchers and practitioners from advancing the theory and practice. Hence, Stock and Boyer (2009) propose their own definition based on a synthesis of a wide range of suggestions by academia, practitioners and hybrid sources:

The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction.

(Stock & Boyer 2009, 706)

Soni and Kodali (2008, 8) state that SCM has basically evolved from physical distribution and logistics. It is rather hard to draw a line between logistics and supply chain management. In 1998 the Council of Logistics Management defines logistics as 'part of the supply chain process that plans, implements, and controls the efficient, effective flow and storage of goods, services and related information from the point-of-origin to the point-of-consumption in order to meet customers' requirements.' (Lambert, Cooper & Pagh 1998, 3.) Today logistics is considered to be one of the functions contained within supply chain management. Ballou (2007, 338) summarises the above mentioned CSCMP's definition of supply chain management as to SCM having three dimensions: activity and process administration, interfunctional coordination and inter-organisational coordination. Activity and process administration is much of what logistics has been doing, i.e. managing activities such as transportation, inventories, warehousing, and order processing that are within the responsibility of the logistics function. According to Ballou (2007), inter-functional coordination refers to collaboration and relationship building with other functional areas within the same company. Inter-organisational coordination, on the other hand, consists of collaboration and coordination of product flows among other channel members, i.e. companies not owned by the focal firm. In conclusion, logistics is about managing the product flow activities within one enterprise, whereas SCM is viewed as managing the product flows across multiple companies.

According to Mentzer et al. (2001, 2) there are several reasons why SCM has become a hot topic among researchers and practitioners since the 1980s. First of them is the globalization of supply. Global sources of supply have forced companies to search for more efficient ways to coordinate the flow of materials in and out of the company. Having become more specialised, companies are increasingly replacing their own sources of supply with suppliers who can provide them with low cost and good quality material. Therefore it becomes critical to manage the entire supply network. (Lummus & Vokurka 1999, 12.) The key is closer relationships with suppliers. Closer coordination with suppliers and distributors is also required because the competition between companies and supply chains is on the basis of time and quality. (Mentzer et al. 2001, 2.) One of the first researchers to highlight the importance of the time-based competition was Stalk (1988, 45). According to him time is one of the most powerful sources of competitive advantage: 'Today's companies compete with flexible manufacturing and rapid-response systems, expanding variety and increasing innovation.' Hum and Sim (1994, 75) suggest that only time-based companies will be able to dominate their industries. The essence is to compress time in every phase of product creation and delivery cycle. Time-based strategies require a holistic approach to be developed for managing internal and external supply chain in order to gain competitive advantage (Rich & Hines 1997, 210).

Mentzer et al. (2001, 2) claim that a faster and more reliable delivery to the customer is no longer seen as a competitive advantage but as a prerequisite for being in the market. Customers require fast, timely and defect-free deliveries, which necessities cooperation with suppliers and distributors. Ballou (2007, 340-344) states that SCM aims at realizing the opportunities from integrated management of product flows across the functions of the focal company as well as between supply chain members. Collaboration among the members is the key to achieve those benefits. Supply chain collaboration is one of the key concepts in SCM literature and in this thesis, and will be discussed in the following section.

1.3.3 *Supply chain collaboration*

Collaboration can be defined as way by which all companies in a supply chain are actively working together towards common objectives, and which is characterised by sharing information, knowledge, risks and profits (Gruat la Forme, Genoulaz, Campagne 2007, 689). Collaboration in the supply chain should not only consist of information exchange and integration between suppliers and their customers, but also more tactical and joint decision making concerning e.g. collaborative planning, forecasting, distribution and product design and more strategic decision making concerning eg. network design (McLaren, Head & Yuan 2002, 350).

In the literature, collaboration is seen from two primary views: 1) as an inter-organisational business process, and 2) as a foundation of inter-organisational relationships. (Min, Roath, Daugherty, Genchev, Chen, Anrndt and Richey 2005, 239). According to the first view, collaboration can be seen as a business process in which collaborative partners work together towards shared goals that are mutually beneficial. For example Stank, Keller and Daugherty (2001, 31) state that collaboration is ‘a process of decision making among interdependent parties. It involves ownership of decisions and collective responsibility for outcomes’. In conclusion, a collaborative supply chain includes two or more independent companies working together to plan and execute supply chain operations with greater success than when acting alone (Simatupang & Sridharan 2002, 19).

The second view, collaboration as a foundation of inter-organisational relationships, is supported by various researchers (e.g. Bowersox, Closs & Stank 2003, 20-22; Ellram & Hendrick 1995, 41). They suggest that collaboration requires interfirm linkages in which parties share information, resources and risk. Bowersox et al. (2003, 20-22) call the collaboration between different supply chain members *cross-enterprise collaboration*. They remind that all inter-organisational arrangements are not collaboration. For example contracting and functional and process outsourcing do not qualify as collabora-

tion since they are command-and-control type of relationships with operational focus in performance compliance and cost. Cross-enterprise collaboration, on the other hand, emerges when two or more companies voluntarily agree to integrate their human, financial or technical resources in order to create a new, better business model. The participating companies voluntarily create joint policies and integrate operational processes to eliminate duplication of effort while seeking maximum productivity. Resources, such as talent, information, knowledge and money are committed at risk to the joint initiative.

In this research, a definition of supply chain collaboration (SCC) is integrated from Cao, Vonderembse, Zhang and Ragu-Nathan (2010, 6616) and Simatupang and Sri-dharan (2005a, 258):

Supply chain collaboration is a long-term partnership process where autonomous supply chain partners or units with common goals work closely together to achieve mutual advantages that are greater than the firms would achieve individually.

Supply chain collaboration is closely linked to the terms such as supply chain integration, supply chain coordination and supply chain cooperation. Flynn, Huo & Zhao (2010, 59) define supply chain integration as ‘the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes’. Some academia consider collaboration (working jointly), integration (combining to an integral whole) and cooperation (joint operation) to be part of supply chain coordination (e.g. Arshinder & Deshmukh 2008, 317), while others agree to Kahn’s (1996, 139) proposal that integration is a multidimensional process comprising two distinct processes of interaction and collaboration. While interaction is a structural nature of cross-departmental activities addressing formally coordinated activities, collaboration is unstructural, affective nature of cross-departmental relationships. Skjøtt-Larsen, Thernøe and Andresen (2003, 535-537) investigated collaboration in the CPFR (Collaborative Planning, Forecasting and Replenishment) framework through two dimensions, scope and depth. The scope of collaboration refers to the number of areas chosen to be relevant for the company’s collaboration with customers or suppliers. The depth of collaboration refers to the extent of process integration within the collaborative initiative. The depth varies between mere information exchanges to the coordination/synchronization of all activities. Lorentz (2008, 249) concludes that collaboration is a broader construct, including supply chain integration as one component.

The definitions of supply chain partnership resemble closely those of supply chain collaboration. For example, Yu, Yan and Cheng (2001, 114) describe supply chain partnership as ‘a relationship formed between two independent members in supply channels through increased levels of information sharing to achieve specific objectives and bene-

fits in terms of reductions in total costs and inventories'. As can be seen, the definition does not differ significantly from the definitions of supply chain collaboration. Only the objectives are more narrowly defined. In this research these four terms are treated as complementary to each other in case they fulfil the requirements of meaning a partnership process between the supply chain members working together to achieve mutual benefits.

1.3.4 Firm performance

Performance is a complex concept due to its multiple goals (Chow, Heaver and Henriksson 1994, 17). Many studies focus on financial metrics, such as net profit margins, ROA and ROE, while others consider it is a mix of financial and operational measures (Fabbe-Costes & Jahre 2008, 136). In this study *firm performance* consists of three dimensions: economic performance, intra-firm supply chain performance and environmental performance.

Economic performance of a firm means here how well a firm performs in terms of measures compiled from the financial statement (Laitinen 1988, 11-13). *Intra-firm supply chain performance* is operationalized with reference to Lorentz et al. (2012, 613) to include three dimensions: logistics costs, service performance and asset utilisation. *Environmental performance* refers to the definition of De Burgos Jimenez and Cespedes Lorente (2001, 1561) who argue that environmental performance is the minimisation of the negative impacts on natural environment resulting from the productive activities of a company and the social perception of this impact. Each of these three dimensions of firm performance is discussed in more detail in Chapter 4.

1.3.5 Terminology related to the environment

Definitions and terminology of environment are rather ambiguous and can mean different things to people in different professional fields (Gupta 1995, 36). Here *environment* refers to definitions provided by Gupta (1995):

In a more general and broader scope, the term [environment] refers to both the quantity and quality of natural resources, and the ambient environment which consists of the water, air, landscape, and atmosphere.
(Gupta 1995, 36)

Research and interest in environmental issues has led to the development of terminology related to the environment (Glavic & Lukman 2007, 1875). One of the key concepts is *sustainable development*. The most quoted definition is provided the World Commission on the Environment and Development (WCED), also known as the Brundtland Commission, that published its famous report 'Our common future' in 1987, including also the definition of sustainable development:

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

(World Conference on the Environment and Development 1987, 43).

The idea of sustainable development has gained a firm foothold in the past few decades. The concept of *corporate social responsibility* (CSR) has been formally defined already in 1953 by Bowen. In 2001 the Commission of the European Communities presented a green paper in which CSR was defined as

a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis.

(Commission of the European Communities 2001, 6)

The Commission of the European Communities (2001, 17) also proposed to mainstream CSR and called for *triple bottom line* reporting by companies on their economic, environmental and social performance. This study focuses on the environmental and economic dimensions.

The need to measure environmental performance in the firms has led to the development of *environmental management*. It aims at reducing the negative environmental impacts of the firm's products during their entire life cycle (Klassen & McLaughlin 1996, 1199). Further, in the recent decades the focus of environmental efforts has shifted from firm level to supply chain, thereby integrating environmental thinking into supply chain management (Linton et al. 2007, 1078.). This perspective is known as *green supply chain management* (GSCM). This study addresses one of the approaches of GSCM, namely *environmental collaboration*. In keeping with the definition of supply chain collaboration, also environmental collaboration requires working jointly for mutual objectives and it also requires direct involvement of an organization with its suppliers and customers (Vachon & Klassen 2008, 301). The definitions of environmental management, GSCM and environmental collaboration are discussed in more detail in Chapter 3.

1.4 Limitations

This thesis only addresses the economic and environmental sustainability, thus excluding the social dimension. Furthermore, this study explores environmental collaboration and performance on a firm level in a supply chain context. However, the environmental activities of a firm are viewed on a rather general level without attempting to cover more detailed operational decisions, such as emissions trading. The partners of environmental collaboration are here limited to suppliers and customers, excluding thus for example environmental activities with non-governmental organisations.

The framework developed in this is mainly applicable to manufacturing and trading firms. Hence, it cannot be applied as such to services companies, such as logistics service providers. In addition, the framework is expected to work best for medium-sized and large companies.

As stated in the objective of this thesis, this study aims to build a research framework and to propose methods to analyse it. The actual empirical testing of the framework is out of this study's scope. The research framework is based on an extensive literature review. The literature used in this thesis consists mainly of journal articles that were accessed through the Nelli portal of University of Turku, giving access to the databases such as EBSCO, Science Direct and ProQuest. The articles were searched with search criteria in English. The majority of the selected articles are published in journals within supply chain and operations management field and published between 2000 and 2013.

2 SUPPLY CHAIN COLLABORATION

2.1 Main categories of supply chain collaboration

Managing interfaces is central in supply chain management. An important part of SCM is coordination and control of different partners in the supply chain, including actors such as suppliers, customers, and third party service providers. Collaboration is therefore at the heart of supply chain management. (Martinsen & Björklund 2012, 562.) Barratt (2004, 32) divides supply chain collaboration into two main categories: vertical and horizontal (Figure 1). *Vertical collaboration* includes collaboration with customers, internally (across functions) and with suppliers, whereas *horizontal collaboration* includes collaboration with competitors, internally and with other, non-competitive organisations (Barratt 2004, 32). Horizontal collaboration occurs when these organizations (at the same level of the supply chain), producing similar products or different components of one product, cooperate to share resources such as distribution centres and manufacturing capacity (Simatupang & Sridharan 2002, 19; Barratt 2004, 32). This research will concentrate on vertical collaboration, i.e. internal collaboration and external collaboration with suppliers and customers.

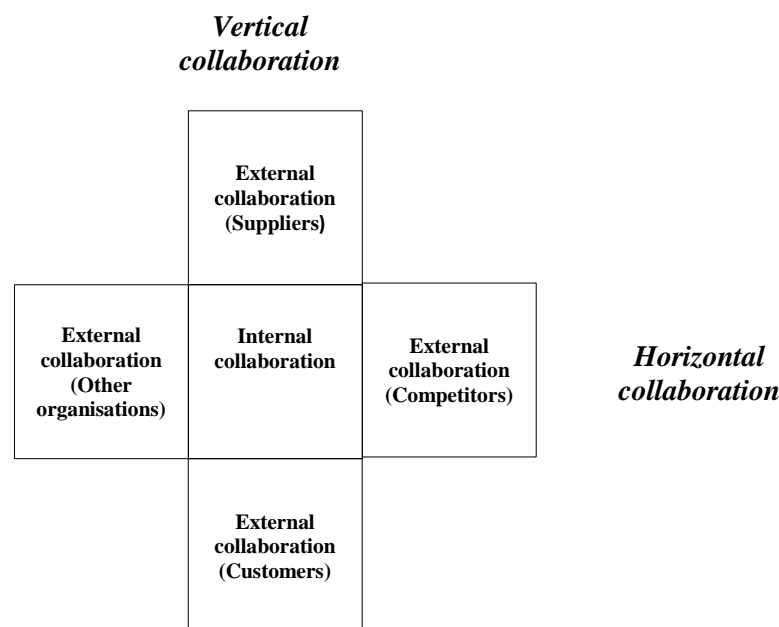


Figure 1 Main categories of supply chain collaboration (Barratt 2004, 32)

Barratt (2004, 32-33) suggests that perhaps the most important issue in supply chain collaboration is internal collaboration. Kahn and Mentzer (1996, 6) point out that ‘While logisticians often speak of ‘integration’ within a channel context, they have not given equal attention to integration within an interdepartmental context.’ Collaborative interdepartmental collaboration is required to deliver high quality services to customers. This kind of collaboration involves mostly informal processes based on trust, mutual respect and information sharing, the joint ownership of decisions, and collective responsibility for outcomes. (Ellinger 2000, 86.) Internal collaboration is not just about developing closer relationships or integrating processes between supply chain related functions, such as purchasing, manufacturing and logistics, but also needs to include marketing-commercial and R&D activities. Furthermore, collaboration needs to be developed at tactical and strategic levels in addition to the operational level. (Barratt 2004, 33.) Internal alignment are found in many companies’ dyadic interfaces such as between marketing and logistics (Ellinger 2000, 86) but only few companies have reached later stages of integration in which they shift focus to firm-wide integration (Chen, Mattioda, Daugherty 2007, 6) or integration up and downstream (Fawcett & Magnan 2002, 345).

2.1.1 Internal collaboration

Kahn and Mentzer (1996, 6) state that logistics should be integrated with other departments within the firm in order to improve customer service, management of inventory levels, forecast accuracy, and customer and employee satisfaction. Consistent with Kahn’s (1996, 139) definitions of SCC as consisting of two processes of interaction and collaboration, Kahn and Mentzer (1996, 10) propose a model of logistics integration with other departments (Figure 2). The model uses interaction and collaboration as the two axes of the matrix which form four regions of interdepartmental integration.

Interdepartmental interaction	High interaction	<ul style="list-style-type: none"> • Stable product lines • Stable markets • Available time • Lower uncertainty 	<ul style="list-style-type: none"> • Complex products • Complex orders • Mission-critical items • Key customer accounts
	Low interaction	<ul style="list-style-type: none"> • Department-specific activities • Third-party logistics 	<ul style="list-style-type: none"> • Product launches • New facility parameters • Special customer orders • High uncertainty • Short-term episode
		Low collaboration	High collaboration
Interdepartmental collaboration			

Figure 2 Logistics integration with other departments (Kahn & Mentzer 1996, 10)

In this model more interaction corresponds to a more structured (bureaucratic) approach to managing interdepartmental relations, as interaction adds structure. On the other hand, more collaboration corresponds to a more relational (open organisational culture) approach for cross-functional activities. High levels of interaction and collaboration correspond to more complex management situations. If only logistics department is included, then low interaction and low collaboration are needed. In this lower left corner are the logistics department-specific activities, such as purchasing of tyres for the truck fleet. If the collaboration is low but the interaction is high, the marketplace and product line are so stable that only formalized documentation is needed to keep the departments informed. This region of the model can also represent situation in which top management tries to force interdepartmental relationships but the departments itself consider the activities to be unnecessary. (Kahn & Mentzer 1996, 10-11.)

If, on the other hand, market situation is more uncertain and reaction times are shorter, higher collaboration is needed, especially if documented information is not available or is unreliable. An example of this could be a launch of new products, opening of a new facility or surprise orders from customers. Special circumstances are characteristic of low interaction and high collaboration, since this is not usually a good long-term position. High interaction and high collaboration is typical in situations where products are customized to the customer and/or if there are many order exceptions. Thus, high interaction is needed to clarify the customer's requirements, while high collaboration is required to ensure that the requirements are met. Interaction and collaboration are especially important if products are critical and it's a question of a key customer. (Kahn &

Mentzer 1996, 11-12.) Also Stank, Daugherty and Ellinger (1999, 21) agree that integration seems to enable the firms to better provide non-basic service. This situation of high interaction and high collaboration is the most difficult to manage because a balance between interaction and collaboration has to be found.

The benefits of interdepartmental integration according to Kahn and Mentzer (1996, 6) are in the improvement of customer service, lower inventory levels and better forecasting accuracy. Stank et al. (1999, 17) found that frequent collaboration between marketing and logistics functions is positively linked to firm performance in terms of responsiveness and flexibility. The study of Chen et al. (2007, 16) implicates that firm-wide cross-functional integration improves also financial performance in terms of sales volume, profit margin and return on assets, as well as competitiveness in the market. Moreover, partnerships help the companies to achieve faster time to market for new products, improved process technology adoption, lower transaction costs, and improved conformance quality, risk reduction, and reductions in capital investments (Biehl et al. 2006, 16).

However, some research, e.g. by Gimenez and Ventura (2005, 32-33), does not support the positive relationship between internal collaboration and firm performance. They noticed that integration between logistics and production contributed to achieving cost, stock-out and lead time reductions, in case there is no external collaboration. Integration between logistics and marketing did not contribute to these reductions. Gimenez and Ventura (2005, 33) assert that external collaboration has a greater influence on performance. In addition they note that external integration has a positive influence on internal integration. This is explained by the need to enhance internal integration in order to collaborate with the firm's (external) supply chain partners.

2.1.2 External collaboration

As mentioned above, internal collaboration must be firmly tied to external collaboration, in terms of developing closer relationships, integrating processes and sharing information with suppliers and customers (Barratt 2004, 33). The literature suggests two approaches to collaborate with supply chain partners: backward integration (upstream) and forward (downstream) integration. The study of Fawcett and Magnan (2002, 344) identified that backward integration with first-tier suppliers was the most common form of collaboration. Supplier relationship management (SRM) process can be used to determine how the relationships with suppliers will be developed and maintained. Close relationships will be developed with a small number of key suppliers based on the value they provide to the organisation over time. More traditional (arm's length) relationships are maintained with the other suppliers. (Lambert & Schwieterman 2012, 351.) In order

to enhance the supplier selection process, buying organisations are using supplier selection criteria, such as product quality, product availability, delivery reliability, and product performance (Vonderembse & Tracey 1999, 34).

Holweg, Disney, Holmström and Småros (2005, 172-178) identified four categories of collaborative arrangements in the supply chain. The first of these is the *traditional supply chain* in which there is no formal collaboration between the retailer and the supplier. The only information available to the supplier is the purchase order. In the next type, *information exchange*, the retailer and the supplier exchange demand information and action plans to align their forecasts for capacity and long-term planning. This eliminates unnecessary uncertainty and decreases the delays. The third type is called *vendor managed replenishment* or *vendor managed inventory*. In this type of a cooperative arrangement the supplier is given the responsibility for maintaining the retailer's inventory and subsequently service levels by placing the replenishment orders. The supplier has a full visibility of the stock at the customer's site. In the last category, *synchronized supply*, the supplier takes similarly responsibility for the customer's inventory replenishment and also uses this demand information in planning his own production activities. As a consequence, the demand information distortion is diminished, inventory levels are reduced, transportation resources are utilized better due to load consolidation, and the risk of running out of key items with longer lead times is in better control.

Close relationships with suppliers should be of benefit at an operational and at a strategic level. At the operational level the benefits come in the form of improved quality or delivery service, reduced cost or the combination of these. At the strategic level the close collaboration leads to improved product quality and innovation, and increased competitiveness and market share. (Kannan & Tan 2006, 756.) If the suppliers are involved in the buyer's product development and continuous improvement activities, they learn about the buyer's requirements, culture and decision-making, which in turn helps them to allocate their resources in best ways (Vonderembse & Tracey 1999, 33).

The definitions of supply chain (Section 1.3.1) and supply chain management (Section 1.3.2) emphasize the customer orientation. Fawcett and Magnan (2002, 344) identified forward integration with first-tier customers in addition to the above mentioned backward integration with suppliers. They noticed that the complete form of forward and backward was very rare and more of an ideal to integrate from 'supplier's supplier to customer's customer'. The study by Stank, Keller and Closs (2001, 33, 39) implicated that customer integration was the most critical competency related to improving performance. Customer integration is used to build distinctiveness with selected customers. The aim is to focus efforts on key customers for whom it is possible to provide unique and profitable product or service offerings the competitors can't provide. The term customer relationship management (CRM) can be used to refer to these activities to build and maintain the relationships with the customers. CRM can be viewed as a comprehen-

sive set of strategies for managing these relationships. Information technology and information systems can be used to support and integrate the CRM process. (Ngai 2005, 583.)

The buyer and the supplier can also collaborate on demand planning. Some organisations have adopted Collaborative Planning, Forecasting, and Replenishment (CPFR) approach to support the flows of goods, services and information between the trading partners. CPFR was co-initiated by Wal-Mart in 1995 (Burnette 2010, 32) and has gained popularity in grocery, apparel, general merchandise and medicine industries (Barratt & Oliveira 2001, 268). CPFR is referred to as ‘a set of business processes that help eliminate supply/demand uncertainty through improved communications/collaborations between supply chain trading partners’. An important part of CPFR is the customer and the supplier working together to satisfy the demands of the end customer. An important part of this is the two partners working together to generate more accurate forecasts. The benefits are similar to those of the supplier in collaborative arrangements, i.e. the manufacturer can plan its production and logistics better and design new products to match the customer’s requirements. (Attaran & Attaran 2007, 394.)

2.2 Barriers to supply chain collaboration

The benefits of supply chain collaboration seem to be evident in the literature. For example, several strategic, tactical and operational level benefits are mentioned in the literature, e.g. increased flexibility and responsiveness thus leading to better customer service levels, better forecasting accuracy, lower inventory levels, shorter time to market, and higher product and delivery quality (e.g. Kahn and Mentzer 1996, 6; Vonderembse & Tracey 1999, 34; Biehl, Cook & Johnston 2006, 16). Factors enabling supply chain collaboration have been identified by several researchers (see next sub-chapter), yet many companies struggle to achieve these objectives and a large percentage of supply chain collaboration efforts fail entirely (Fawcett, Magnan & McCarter 2008a, 93; Park & Ungson 2001, 38). Bowersox, Daugherty, Dröge, Germain and Rogers (1992, 150-152) list five reasons why alliances fail: lack of senior management support, lack of trust, fuzzy goals, uneven commitment, and loss of control. Park and Ungson (2001, 40) suggest that the barriers to supply chain collaboration can be classified under two categories: *interfirm rivalry* and *managerial complexity*. Interfirm rivalry is caused by misalignment of the partners’ objectives, while managerial complexity stems from the misalignment of the partners’ organisational structures, processes and culture (Park & Ungson 2001, 42-45). Several other classifications of barriers have been presented in the literature. For example Sandberg (2007, 283) proposes that barriers are related to either technology or human beings. However, these classifications can be included in

the two categories of Park and Ungson (2001, 40). Both types of barriers they proposed will be described below.

2.2.1 *Interfirm rivalry*

Briefly, interfirm rivalry is the tendency of the collaboration partners to compete rather than willingly cooperate. Examples of this kind of a barrier include internal and external turf protection and lack of trust in the partners. (Fawcett, Magnan & McCarter 2008b, 37.) People tend to hold to their comfort zones and therefore generally resist any changes to organisational boundaries and redefined roles and responsibilities. Therefore, when implementing supply chain collaboration, traditional organisational boundaries may prove to be difficult to overcome, since people desire to protect their 'turf'. (Fawcett & Magnan 2001, 39.) In order to eliminate 'turf wars' and uneasy relationships between different functions and organisations, trust is needed (Udin, Khan & Zairi 2006, 370). Trust has been defined as willingness to take risks (Johnson-George & Swap 1982, 1306; Mayer, Davis & Schoorman 1995, 712) and in an organisational context as 'the firm's belief that another company will perform actions that will result in positive outcomes for the firm, as well as not take unexpected actions that would result in negative outcomes for the firm' (Anderson & Narus 1990, 45). Trust has been identified to be an essential requirement for successful collaboration. In general, lack of trust results in inefficient and ineffective performance due to rising transaction costs. As for transaction costs, the rise is caused by verification, inspections and certifications of the partner. (Kwon & Suh 2004, 4.) Beccerra and Gupta (1999, 196) observed that transaction and agency costs were higher in low-trust relationships as managers have to spend more time and energy. Higher costs of monitoring were also mentioned as one negative aspect of lack of trust.

Kwon and Suh's (2004, 5) study proposes a positive relationship between trust and commitment in the relationship. According to the study, trust is 'a root in fostering such commitment'. Bowersox et al (1991, 151) state that commitment in the relationship is almost always uneven. Fawcett et al. (2006, 28-29) claim that dominant buyers often use their size to their advantage over the suppliers. This causes cynicism among the suppliers, who don't trust the buyer's talk about collaborative improvement. As a consequence, the suppliers are less willing to commit resources to the collaboration. It is especially important that the management all the way to the CEO is committed to the change related to the collaboration. (Fawcett, Ogden, Magnan & Cooper 2006, 26.) Moreover, involvement of mid- and lower-level managers is essential (Bowersox et al. 1992, 150). Only top management can give the resources needed to implement the collaboration and to realign the measures and rewards related to it, in order to make the

collaboration an organisation-wide priority (Fawcett et al. 2006, 26). Especially important is the funding for the development of communication activities (Bowersox et al 1992, 151). Top management is required to understand the operational and market effects of partnering and to develop a good understanding of the partnering organisation and their top management (Mentzer, Min & Zacharia 2000, 557). Without this top management commitment the collaboration is likely to fail.

2.2.2 *Managerial complexity*

Managerial complexity barriers include for example poor communication (Ellram 1995, 42), incompatibility of information systems or technology, inadequate measurement systems and conflicting organisational structures and cultures (Fawcett et al. 2008a, 37). One challenge of the management is to define mutual goals and to design adequate metrics to measure how they have been achieved. All parties of collaboration must share clear goals; otherwise the chances of success are significantly diminished (Bowersox et al. 1991, 151). Fawcett et al. (2008a, 102) interviewed managers engaged in supply chain activities and found that measurement has a great impact on attitude and behaviour of the employees. The interviewees seemed to think that existing measures do not promote collaboration but turf protection. The metrics tended to be functionally, financially and short-term oriented. According to Simatupang and Sridharan (2002, 17), the problem with cost-centric metrics is that they support minimizing individual costs instead of creating value to the end customer. Moreover, minimizing local costs might cause gaming phenomena among different functions within an individual firm. For example, a marketing manager strives to maintain larger inventories contrary to the logistics manager who tries to keep the inventories low.

Communication underlies most aspects of organisational functioning and is therefore critical for success of any partnership (Mohr & Spekman 1994, 138). Communication can be seen as an intangible investment in the collaboration (Mentzer et al. 2000, 556). Anderson and Narus (1990, 44) define communication as ‘formal as well as informal sharing of meaningful and timely information between firms’. Timely communication helps to build trust by assisting in resolving disputes and by aligning perceptions and expectations (Morgan & Hunt 1994, 25). Low level of information quality, little information sharing, and unequal participation in planning and goal setting suggest higher probability of partnership failure. (Mohr & Spekman 1994, 139.) Information quality refers to the accuracy, timeliness, adequacy, and credibility of the information. Information participation refers to which collaboration partners engage in joint planning and goal-setting. (Moncza et al. 1998, 559.) Moreover, the people engaged in collaboration may behave in a way that fosters communication problems, i.e. use foul language,

backbite, slander and be unwilling to discuss price increases (Smeltzer 1997, 43). In Ellram's (1995, 41) study poor communication was identified to be the most important reason why partnerships fail in both buyers and suppliers' perspective.

The utilisation of Internet-based technologies, such as e-mail, intranets, extranets, customer service websites and EDI, have facilitated communication between the supply chain partners but integration of IT systems may also prove to be one potential barrier to collaboration. Implementation of cross-organisational IT system is expensive, time-consuming and risky. Webster (1995, 38) studied information systems within automotive industry and found that bigger companies have better resources and expertise to develop technological capabilities. As small companies do not have these capabilities, they have problems when dealing with bigger companies who are not interested in sharing their expertise. Supply chain partners might also disagree on the adoption and specifications of the IT system, such as EDI standards. Employees may resist integrating IT systems in the supply chain because it often changes organisational hierarchy, work culture, and nature of work for some employees. (Jharkharia & Shankar 2005, 12-13.) Shaw (2000, 120) proposes that security and access privileges are the two most important issues in the implementation of intranet and extranet technology. The goal of security is to reduce the risk of losses caused by intrusion, system misuse, privilege abuse, tampering, fraud etc. (Kolluru & Meredith 2001, 233).

Collaboration partners may come from different national, cultural, social, political, and economic backgrounds. Similarity of cultural values is proposed to reduce misunderstanding, and culturally distant partners experience greater difficulties with their interaction. Lack of fit with a partner's culture also results in poor communication and mutual distrust. (Park & Ungson 2001, 44.) Doz (1988, 35) and Brown, Rugman and Vermeke (1989, 237), however, argue that differences related to national culture are minor compared to those related to interorganisational culture. Dissimilar organisational structures and processes tend to cause problems in coordination. Dissimilar partners may have to spend more time and energy to establish standard routines, which in turn leads to higher costs and mistrust. (Park & Ungson 2001, 45.)

The next subchapter describes factors that mitigate effects of the barriers to supply chain collaboration.

2.3 Factors enabling supply chain collaboration

Simatupang and Sridharan (2005a, 261) built a collaborative supply chain framework including five features: 1) Collaborative performance system (CPS), 2) information sharing, 3) decision synchronization, 4) incentive alignment, and 5) integrated supply chain processes. The framework is shown in Figure 3. Each feature can be seen as an

enabling factor facilitating collaborative actions and therefore mitigating the effects of the barriers described in the previous subchapter. The arrows represent the reciprocal relations among multiple connecting features of the framework. Supply chain members need to coordinate and match all five features. Changing one feature often necessitates changing the other features in consequence.

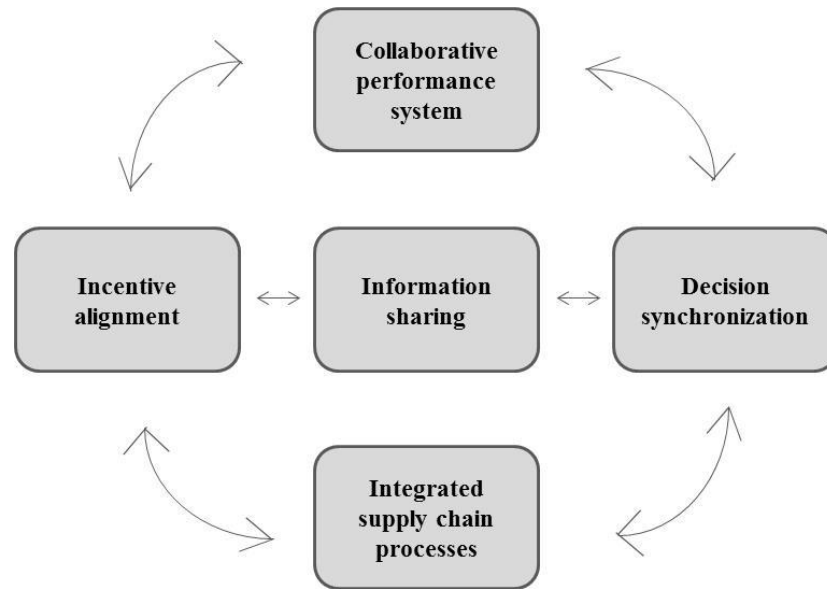


Figure 3 Collaborative supply chain framework (Simatupang & Sridharan 2005a, 261)

Each feature will be discussed in their own section below. Out of these five features information sharing, decision synchronization and incentive alignment were used by Simatupang and Sridharan (2005b, 46) to build a collaboration index to measure collaborative practice in the supply chain, which helps the chain members to identify the most important practices.

2.3.1 *Information sharing*

Information sharing has been cited to be the most important element in the trust-building process (Kwon & Suh 2004, 10). Today many supply chains are global and thus the pipeline time, i.e. the time it takes for the material to flow from one end to another, is long. This results in weakened confidence in the supply chain. As the pipelines get longer, it is more difficult for one company in the supply chain to know what goes on in other parts of the chain. Transparency in the supply chain is an effective way to reduce uncertainty (Christopher & Lee 2004, 390-391) and to combat the problem of demand information distortion known as the 'bullwhip effect', a situation in which de-

mand distortion increases as one moves upstream in the supply chain (Lee, Padmanabhan & Whang 1997a, 546). The causes of the bullwhip effect have been identified to be demand forecasting, order batching, price fluctuation, and rationing and shortage gaming (Lee, Padmanabhan & Whang 1997b, 95).

Asymmetric information can lead to sub-optimal decision making and opportunistic behaviour in the supply chain if the parties are unwilling to share private information about demand conditions, products and supply chain operations. The problem arises if the supply chain members are not aware of each other's plans and intentions. This prevents them from harmonizing their services and activities. In collaborative supply chains members share information both backward and forward. (Simatupang & Sridharan 2002, 17, 24.) Information sharing has been described as the glue that integrates all supply chain members (Simatupang, Wright & Sridharan 2002, 296). Cao et al. (2010, 6617) define information sharing as

The extent to which a firm shares a variety of relevant, accurate, complete and confidential ideas, plans, and procedures with its supply chain partners in a timely manner.

Cao et al. (2010, 6617)

Gavirneni, Kapuscinski and Tayur (1999, 16-17) studied information sharing in supplier-retail setting and propose three different types of information sharing: no sharing at all, partial information sharing and full information sharing. In their traditional setting, i.e. there is no information sharing at all, the supplier does not know the retailer's demand distribution or ordering policy. In the case of partial information sharing, the supplier knows the demand distribution of the retailer and also the inventory policy. If the customer shares full information, the supplier receives the information immediately for example via EDI (Electronic Data Interchange) links. Seidmann and Sundarajan (1998, 7) identified four levels of information sharing between organisations: 1) transactional, operational, strategic, and strategic and competitive levels. The first level is exchanging transactional order information aimed at reducing transaction costs and order cycle times. The organisations share transactional information such as order quantities and prices through an EDI system. The value the parties gain is not collective as each party improves their efficiency independently. Even if e.g. EDI is used to share the same demand data in a supply chain, the differences in forecasting methods and purchasing policies can still cause fluctuations in the order data placed with upstream (Lee et al. 1997b, 100).

The next level in Seidmann and Sundarajan's (1998, 7-8) model is sharing operational information. It occurs when one party owns valuable information whereas the other party is able to use this information more efficiently. An example of this is vendor man-

aged inventory (VMI). The buyer allows the supplier to manage the inventory of their own products at the buyer's site. If the supplier has expertise in managing larger inventories and has knowledge of the production schedule of the products both parties can reduce their costs. (Seidmann & Sundarajan 1998, 8.)

Above the two first levels of information sharing, strategic benefits can be expected in addition to operational benefits. In the third level, one party possesses information that is not valuable for the organisation as such, but is of strategic importance to the other party. These strategic benefits may lead to operational benefits of the party that donates the information. A case in point would be a retailer sharing the point-of-sales (POS) data with their supplier. The supplier can then use this data combined with other retailers' data and make accurate forecasts of the demand of their products, which in turn improves customer service. The buyer, on the other hand gets improved operational efficiency and lower transaction costs. (Seidmann & Sundarajan 1998, 9-10.)

In the fourth and highest level, the buyer can derive very little value of the information it possesses but the supplier can derive both strategic and competitive benefits from it. Strategic benefits are the same as in the previous level, e.g. better forecast, but in addition the supplier is given competitive advantage with the other competing suppliers in its industry. For example, the retailer can give the supplier access to all POS data in a product category. Hence the supplier can track the sales and demand information of the competitors' products. (Seidmann & Sundarajan 1998, 10-11.)

Not only should the companies concentrate on sharing information with their customers, they should also ensure that the information is high quality – time specific and specific to the knowledge needs of the company (Gosain, Malhotra & El Sawy 2004, 19). Information quality includes aspects such as accuracy, timeliness, adequacy and credibility of the exchanged information (Monczka, Petersen, Handfield & Ragatz 1998, 559). The traditional culture of seeing information as a source of power has resulted in the companies deliberately distorting information to mask their intentions not only from their competitors but also from their suppliers and customers (Mason-Jones & Towill 1997, 138). In order to reduce information distortion and to improve the information quality, companies must ensure that the information is as accurate as possible and it flows with minimum delay and distortion. Information quality was identified to be affected by supplier uncertainty, trust in supply chain partners and shared vision between supply chain partners. Supplier uncertainty is the extent of change and unpredictability of the suppliers' product quality and delivery performance. Higher levels of trust in supply chain partners and shared vision between supply chain partners and lower level of supplier uncertainty result in higher levels of information sharing and information quality. Moreover, top management's support for quality information sharing and understanding its benefits impacts positively information sharing. (Li & Lin 2006, 1643-1653.)

There has been debate whether shared information has value. Although some research claims that information sharing is not valuable (e.g. Graves 1999, 57), most research agrees that information sharing is of value. Christopher and Lee (2004, 391) assert that shared information reduces the need for safety stocks and ultimately leads to more responsive and demand driven supply chain lessening the impact of the bullwhip effect. The study of Zhao, Xie and Zhang (2002, 33) reveals that if the retailer places the order in advance to the supplier, the costs of both the retailer and supplier will decrease. When the retailer places the order some periods in advance, the supplier can use better its capacity and improve order fulfilment. Zhao et al. (2002, 33) found out that although ordering coordination is beneficial for both parties, it is more beneficial for the supplier as it can improve its capacity utilization and lengthen the planning horizon. Gavirneni et al. (1999, 20-21) observed that if the two-echelon supply chain with a single retailer and a capacitated supplier begins to share partial information, the savings vary from 10 % to 90 %, the average being 50 %. However, if capacity utilisation rate is high, the flexibility of the supplier is rather minimal and therefore it cannot utilise the information the customer shares. If the capacity utilisation is lower, the savings can vary between 1 % and 35 % if moving from partial information sharing to full information sharing.

2.3.2 *Decision synchronization*

Simatupang and Sridharan (2005a, 264) define decision synchronization as ‘the extent to which the chain members are able to orchestrate critical decisions at planning and execution levels for optimizing supply chain profitability’. Shared decision making can be seen as the key element of collaboration as a way of building and maintaining mutual partnerships (Harland, Zheng, Johnsen & Lamming 2004, 13). The activity of decision synchronization refers to constructing joint decision making processes including re-allocating decision rights in order to synchronize supply chain planning and execution seeking to match demand with supply. Decision synchronization is vital because the supply chain members have different decision rights (power to make decisions) and expertise about supply chain operations. For example, a retailer can make a decision concerning the order quantity but not order delivery. (Simatupang & Sridharan 2005a, 264.)

According to Biehl et al. (2006, 16) joint decision making is one of the most sophisticated forms of information sharing requiring high levels of trust and transparency. Simatupang and Sridharan (2005b, 46) assert that joint decisions are made in planning and operational contexts. The planning context combines decisions about long-term planning and measures such facets as selecting target markets, product assortments,

customer service level, promotion, and forecasting. The operational context, on the other hand, integrates order generation and delivery processes, such as of shipping schedules and replenishment of the products in the stores. Joint planning is used to achieve specific objectives by determining the best way to use the firms' resources (Cao et al. 2010, 6619).

In Simatupang and Sridharan's (2005a, 264) model decision synchronization provides collaborative performance system with feedback on how the performance metrics help the supply chain members to make effective decisions. Information sharing, on the other hand, is offered help to identify the kind and format of relevant data to be collected and transferred to the decision makers. In relation to incentive alignment, the role of decision synchronization is to devise appropriate incentive schemes for different supply chain members responsible for different levels of decision making. Moreover, decision synchronization helps the supply chain members to perform actions related to integrated supply chain processes, such as replenishment, transportation, and customer service.

Although much research agrees that the decisions should be made jointly, Kampstra, Ashayeri and Gattorna (2006, 316-317) state that it would be naïve to believe that power does not play any role in collaboration. As a consequence, they propose three main roles of the partners: collaboration leader, collaboration coordinator and remaining collaboration members. *Collaboration leader* is the initiator of the collaborative effort. It may or may not be the first entity to come with the idea but it has the power to prevent or promote the collaboration, as without the collaboration leader's approval there is no collaboration. The leader's role is to perform a multitude of activities varying from evaluating the partners, forming and communicating the vision and the strategy, coordinating collaboration meetings, linking relationships, monitoring overall performance, and providing incentive structures to improve performance.

The collaboration coordinator's role is to coordinate collaboration activities. While the collaboration leader focuses on leadership, the collaboration coordinator is responsible for management of the supply chain transformation. The collaboration coordinator can be the same entity as the collaboration leader, but also some other supply chain member or a non-member such as fourth-party logistics service provider. *Remaining collaboration members* are entities that are involved in the collaboration process but do not have the role of the leader or coordinator. These entities may have been forced to collaborate. However, if the process is carried out thoroughly, this kind of collaboration might be a good opportunity to improve profitability and to ensure continuity. (Kampstra et al. 2006, 317.)

2.3.3 *Incentive alignment*

Simatupang and Sridharan (2005b, 46) refer to incentive alignment as ‘the degree to which chain members share costs, risks, and benefits’. The aim is to motivate the members to act in a manner consistent with overall objectives, including making decisions that are optimal for the overall supply chain and revealing truthful private information. It includes determining costs, risks, and benefits as well as formulating incentive schemes. An effective incentive scheme encourages individual supply chain members to self-enforce their decisions’ alignment with the mutual objective of improving total profits. (Simatupang & Sridharan 2005a, 264-265.) Successful partnerships require that each partner shares gains and losses equitably and that the outcome of the collaboration is quantifiably beneficial to everyone (Manthou, Vlachopoulou & Folinas 2004, 241).

Five reasons to incentive misalignment are proposed in the literature:

- Hidden actions
- Hidden information
- Badly designed incentive schemes (Naraynan & Raman 2004, 96)
- Goal conflicts
- Different business logics (Lundin & Norrman 2010, 282)

Hidden information and hidden actions are two important challenges focal in the agency theory. Hidden actions are caused by the inability of companies to observe how other companies in the supply chain are acting and thus cannot persuade them to do what is the best for the whole chain (Naraynan & Raman 2004, 96). Problems arise when the different parties of the relationship have different risk preferences and conflicting goals (Bergen, Dutta & Walker 1992, 4). Hidden information occurs when one company has information or knowledge that others in the supply chain do not have (Naraynan & Raman 2004, 96). In the agency model the problems arise during partner selection. The other party (principal) does not know if the other party (agent) has the skills and abilities needed to perform the task (Bergen et al. 1992, 6).

Traditional incentive schemes are often badly designed as they are based on local costs and short-term concessions attempting to fill the gap in inventory between different supply chain members. Wrong kinds of incentives, such as local inventory cost, transportation cost and lot-size based quantity discounts, are tied to reducing internal costs of one stage in the supply chain instead of reducing total cost of the supply chain. (Simatupang et al. 2002, 298.) Goal conflicts stem from the fact that supply chain consists of a number of functions and companies, each of which having its own priorities and goals (Naraynan & Raman 2004, 96).

Goal congruence refers to the extent to which supply chain partners perceive their own objectives are satisfied by accomplishing the supply chain objectives (Cao 2010, 6618). Angeles and Nath (2001, 110) describe it as similarity, compatibility or fit

among partners of the chain. The degree of goal congruence impacts on the nature and amount of information the supply chain partners are willing to share with each other (Samaddar, Nargundkar & Daley 2006, 745). Goal incongruence can be caused by three factors: contract compensation, attractiveness of alternatives, and contractual flexibility. The compensation of the other party should be large enough to reward the party for the effort and risks required for the task. Furthermore, the contract must also be more appealing than the other available options. Finally, the contract should be renegotiable in case the conditions change. If the principal does not allow this, the agent might not be satisfied with the contract and the risk of opportunistic behaviour increases. (Rossetti & Choi 2008, 512.) Different goals and measurements can also be caused by the different business logic of the partners. This leaves them with conflicting objectives. (Lundin & Norrman 2010, 281.)

Cooper and Ellram (1993, 3) propose supply chain members to cross-own equity in each other and to invest in joint assets. This approach is characteristic in Japanese business consortia. This, however, is not very common in Western cooperative arrangements. Naraynan and Raman (2004, 99) provide three types of solutions targeted to the causes of incentive misalignment. The solutions are:

- contract based
- trust based
- information based

Altering contracts is necessary if the incentive scheme is badly designed. If incentive misalignment is caused by hidden actions, a contract rewarding or penalizing based on the outcomes can be a solution and ensure the trust of the parties. Ghoshal and Moran (1996, 23-24), however, argue that contracts may in fact have a negative impact on opportunistic behaviour by enhancing negative feelings, such as being distrusted. Handfield and Bechtel (2002, 375) maintain that perceived buyer dependence on supplier has a negative impact on trust the buyer places in the supplier. In their context the buyer dependence was a situation when there are few suppliers of an important commodity within a local market, or the supplier is the only party capable of providing the product or service. The buyers were using contracts as a countermeasure, but the contracts had only a minor impact on trust. In contrast, if the buyer's trust in supplier was strengthened if the supplier dedicated local facilities and equipment to serving the customer.

Information sharing was discussed in the previous section and it is seen as an important way to reveal hidden actions. An effective way is to measure more business variables thus making actions visible, or by disseminating information through the whole supply chain. (Naraynan & Raman 2004, 99-100.) Collaborative performance system is described in more detail below.

Incentive alignment interacts with the other features of Simatupang and Sridharan's (2005, 265) collaborative supply chain framework. Incentive alignment links perfor-

mance scoreboards from collaborative performance system (described below) to the incentives. Information sharing's role is to communicate the incentives to the chain members. In relation to decision synchronization, incentive alignment provides incentives for the motivation of the chain members to make effective decisions.

2.3.4 Collaborative performance system

Simatupang and Sridharan (2005a, 262) define collaborative performance system (CPS) as 'the process of devising and implementing performance metrics that guide the chain members to improve overall performance'. They argue that the process includes resolving two problems related to the mutual objective: who should be involved in determining the mutual objective, and what performance metrics should be applied with respect to the mutual objective. Furthermore, mutual objective is defined as reflecting the competitive factors that can be reached if the chain members build collaboration. Competitive factors are in the form of product and service advantages that the customers perceive superior compared to the competitors. Examples of these advantages include such as customer service, quality, price, supply chain costs, and responsiveness. These factors lead to the improvement of profit, return-on-investment and cash flow of each supply chain member. Collaborative performance measurement implies that each supply chain member gets access to performance information beyond their own organisation and give the others access to their own performance information (Busi and Bititci (2006, 15).

Different types of performance metrics are needed for different supply chain members. The difficulty of developing a collaborative culture and its appropriate performance measures has been identified as one of major obstacles to the successful implementation of a collaborative performance management system. (Busi & Bititci 2006, 15.) The use of resources, the desired output and flexibility have been identified as key components to a supply chain's success. Therefore a supply chain measurement system should emphasize three types of performance measures: resource measures, output measures and flexibility measures. Resource measures aim at a high level of efficiency, output measures at a high level of customer service and flexibility measures at the ability to respond to a changing environment. The three types of measures are interrelated and thus a performance measurement system should contain at least one individual measure of each type. (Beamon 1999a, 280.)

Resource measures comprise inventory levels, personnel requirements, equipment utilisation, energy usage, and cost. In general, resources are measured in terms of the minimum requirements (quantity) or a composite efficiency measure, i.e. how the resources are utilised to meet the objectives. Output measures include customer respon-

siveness, quality, and the quantity of final product produced. They can be presented numerically, e.g. number of produced items, time needed to produce an item or a set of items, number of on-time deliveries, or they can be more difficult to quantify, e.g. customer satisfaction or product quality. Output measures must correspond to the customer's goals and values, besides the organisation's own strategic goals. The third type of performance measures, flexibility, differs from the other two types. Flexibility measures potential performance while output and resource measures are actually demonstrated in the system's performance. For example, flexible systems are able to respond to demand variations, sudden machine breakdowns and poor supplier performance. (Beamon 1999a, 281-283.)

However, Barratt (2004, 38) asserts that the majority of supply chain metrics are actually metrics of internal logistics performance, and as such inappropriate to measure the performance of a supply chain as a whole. Simatupang and Sridharan (2004a, 16-20) propose a CPS system consisting of three learning cycles: exception cycle, improvement cycle, and review cycle. The adoption of the exception cycle helps the participating supply chain members to anticipate any changes in their upstream or downstream before these deviations harm the customer sales. Information is gathered jointly about the customer requirements, supply chain activities are planned, plans are executed and exceptions are managed. The objective is that the members can identify deviations and learn to respond to unattended events within their supply chain. The second learning cycle, called the improvement cycle, involves the supply chain members observing the supply chain execution and market changes in order to obtain information for improvement ideas. It is possible to learn continuously from the inabilities to respond to the customers' needs. The review cycle is the final of the three learning cycles. It includes the executives of the participating companies monitoring monthly or quarterly progress such as growth, sales, profits, and inventory turns to achieve mutual strategic objectives.

Ramanathan, Gunasekaran and Subramanian (2011, 861) argue that supply chain collaboration has two distinct phases: a pilot stage in which the partners test SCC and an advanced stage in which the partners are committed to SCC. As a consequence, the metrics to measure performance should be different for both stages. They propose two types of metrics: functional drivers and enhancers. The use of metrics for functional drivers is suggested at the pilot stage, whereas at the advanced stage the use of both metrics for functional drivers and enhancers is recommended. Functional drivers are common business objectives and supply chain processes, while enhancers are elements that enhance or support the collaboration. Business objectives include for example financial and operational objectives. Regarding supply chain processes, for example in Collaborative Planning, Forecasting and Replenishment (CPFR) approach the supply chain processes are divided into four stages of planning, forecasting, production and replenishment, and lately return as the fifth stage. Different metrics can be used to measure these processes,

e.g. capacity utilization, eagerness to plan, inventory, stock-outs and feedback on product returns.

Enhancers, on the other hand, can be divided into 1) degree of involvement, 2) information sharing, forecasting and technology, and 3) incentives. The degree of involvement can be measured through investment in collaboration and sharing decision making. The reliability of order generation will be increased if the partners share more information. It then leads to increased forecasting accuracy. Technology can be used to facilitate the information exchange, and its efficiency can be measured through how accessible the information is to the members. Incentive sharing attracts more members to the collaboration and thus needs to be revised periodically. Overall effectiveness of supply chain collaboration was in this model measured as the sum of responsiveness, flexibility and technological excellence. Responsiveness can be measured through e.g. product availability. It refers to the ability to respond to any unexpected changes in demand, whereas flexibility refers the ability to adapt to the changes with available resources. (Ramanathan et al. 2011, 861-862.)

Similar to the other features in Simatupang and Sridharan's (2005a, 263) model of collaborative supply chain framework, collaborative performance system requires information sharing to report data about performance status, while decision synchronization enables effective joint decision making targeted at optimizing performance metrics. Incentive alignment uses the performance metrics to compile benefit- and cost-sharing agreements. Feedback about the benefits of collaboration is then provided by integrated supply chain processes. Thus regular contacts among the members and feedback on the performance of the supply chain are needed.

2.3.5 *Integrated supply chain processes*

Simatupang and Sridharan (2005a, 265) define integrated supply chain processes as 'the extent to which the chain members design efficient supply chain processes that deliver products to end customers in a timely manner at lower costs.' Partners of collaboration are requested to invest time, money, technology, training etc. Integration may involve also physical resources, such as equipment and technology. Suppliers are often required to invest in equipment that can be used for only one customer's requirements (asset specificity). (Harland, Zheng, Johnsen & Lamming 2004, 10.)

Chen, Daugherty and Roath (2009, 67) take the boundaries of integration into consideration by dividing process integration into internal and external process integration. They also state that *connectivity* and *simplification* are the principal elements of integration. Connectivity is linkages among relevant functional areas and business processes, and it is important in both internal and external context. On the one hand, if the business

processes are transaction-oriented, connectivity is needed to ensure the smooth flow of transactions through functional areas. On the other hand, if the business processes are focused on structuring relationships, connectivity is needed to establish relationships between organisations. Simplifying business processes refers to connecting relevant business processes and eliminating duplication within them. In other words, re-engineering of the processes is needed to improve efficiency and effectiveness. Part of successful process integration is the creation of common operational policies and procedures.

The objective of integrated supply chain processes is to enable the collaboration members to achieve the key performance indicators stated in the collaborative performance system discussed above. Effective supply chain operations require synchronized decision-making. Moreover, performance metrics of integrated supply chain processes serve as inputs for incentive alignment. Lastly, easy detection and correction of problems provides information sharing with better visibility on process status. (Simatupang & Sridharan 2005a, 265-266.)

2.4 The effects of supply chain collaboration

As Barratt (2004, 32) states, a firm can collaborate internally, or with customers, suppliers, competitors and other organisations. This study focuses on collaboration between the focal firm and its suppliers and customers. It is also important to tie the internal and external collaboration together. According to Frohlich and Westbrook (2001, 191), the extent of the integration is crucial. Therefore they categorize it into five different strategies, called 'arcs of integration', including inward-facing, periphery-facing, supplier-facing, customer-facing and outward-facing. According to this logic, a firm is inward-facing if it has low integration with both customers and suppliers opposing to outward-facing in which the firm has high integration with suppliers and customers. Periphery-facing integration is used to describe integration that is above lower quartile with either customers or suppliers but still under upper quartile with both stakeholder groups. In accordance with the category names, customer- and supplier facing integration mean above upper quartile integration with the main stakeholder group but under average with the other. Frohlich and Westbrook (2001, 193) found that outward-facing firms outperformed other strategies. The results are in accordance with the growing body of literature stating that upstream and downstream collaboration in the supply chain differentiates performance.

As described, strategic decision can affect the extent of collaboration with customers and suppliers. However, interfirm rivalry and managerial complexity are significant barriers. In order to overcome barriers, Simatupang and Sridharan (2005a, 261) suggest

a collaborative supply chain framework including five features, namely information sharing, decision synchronization, incentive alignment, collaborative performance system, and integrated supply chain processes. Table 1 provides a summary of benefits related to implementing these features.

It can be concluded that supply chain collaboration produces a number of operational, tactical and strategic benefits. The ultimate goal is to define mutual goals and work together to achieve benefits that are greater than the firm would achieve without partners. The table also shows that the five features interact with each other. For example, incentive alignment encourages more extensive information sharing. Min et al. (2005, 249) undertook a survey study followed by in-depth interviews and concluded that efficiency, effectiveness, and profitability and reinforcement and expansion of the relationship were perceived as the most significant benefits of supply chain collaboration. Collaboration can also focus on a more specific topic, such as IT or environmental issues. However, the underlying goals and antecedents of such collaboration are not essentially different from those that have been presented in this chapter in a more general form.

Table 1 Benefits of supply chain collaboration

Feature of SC collaboration	Benefit	Author
Information sharing	Builds trust among SC partners	Kwon & Suh 2004 Li & Lin 2006
	Creates shared vision among SC partners	Li & Lin 2006
	Reduces transaction costs	Seidmann & Sundarajan 1998
	Counteracts bullwhip effect	Christopher & Lee 2004
	Improves customer service	Seidmann & Sundarajan 1998
	Builds competitive advantage	Seidmann & Sundarajan 1998
Decision synchronization	Builds and maintains mutual partnerships	Harland et al. 2004
	Determines efficient ways to use resources	Cao et al. 2010
	Devises incentive schemes	Simatupang & Sridharan 2004a
	Improves profitability and ensured continuity	Kamstra et al. 2006
Incentive alignment	Motivates chain members to make decisions optimal to the SC	Simatupang & Sridharan 2005a
	Encourages self-enforcement of the decision alignment	Simatupang & Sridharan 2005a
	Encourages information sharing	Samaddar et al. 2006
Collaborative performance system	Develops performance metrics to guide chain members to improve overall SC performance	Simatupang & Sridharan 2005a
	Helps to anticipate changes in upstream or downstream	Simatupang & Sridharan 2004a
	Provides information for improvement ideas	Simatupang & Sridharan 2004a
Integrated supply chain processes	Ensures smooth flow of transactions through functional areas	Chen et al. 2009
	Helps to establish relationships between organisations	Chen et al. 2009
	Improves efficiency and effectiveness	Chen et al. 2009
	Enables members to achieve KPIs	Simatupang & Sridharan 2005a
	Provides inputs for incentive alignment	Simatupang & Sridharan 2005a
	Improves visibility on process status	Simatupang & Sridharan 2005a

3 ENVIRONMENTAL MANAGEMENT AND COLLABORATION IN THE SUPPLY CHAIN

3.1 Theories applied in environmental management research

Environmental management aims at reducing the negative environmental impacts of the firm's products during their entire life cycle (Klassen & McLaughlin 1996, 1199). Environmental management combines strong management systems and product and production technologies designed to minimize their environmental effects (Zsidisin & Siferd 2001, 61-62). Nowadays most studies agree that companies are increasingly aware of the possibilities provided by environmental proactivity, although Walton et al. (1998, 3) claim that traditionally environmental management has been seen as detrimental to business. The adoption of environmental management practices has been explained by factors external to the focal firm, such as regulation and competitive pressures, and by the characteristics of the firm (Delmas & Toffel 2004, 209-210). Bansal (2005, 197) states that environmental management and change in companies' environmental strategies are generally approached from two theories: institutional theory and resource-based view. Both perspectives are described in detail in the following sections. The theoretical perspective of this study is mainly on the resource-based view and its two extensions, the relational view and the natural resource based view.

3.1.1 Institutional theory

The institutional theory builds upon the premise that social and cultural pressures imposed on organisations have an impact on organisational practices and structures (Scott 1998). A key concept is *organisational field* which is defined as

a community of organizations that partakes of a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside of the field.

(Scott 1998, 129)

The organisational field determines the legitimacy of actions taken by a firm (Marshall, Cordano & Silverman 2005). Suchman (1995, 574) defines legitimacy as 'a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions'. In short, legitimacy means acceptance within a society. Managerial decisions

can significantly affect how legitimate a company is seen. Bansal and Clelland (2004, 94) extended Suchman's definition of legitimacy and defined *corporate environmental legitimacy* as 'the generalized perception or assumption that a firm's corporate environmental performance is desirable, proper, or appropriate'. In other words, the company's environmental legitimacy is determined by how its organisational field perceives the company's environmental performance.

DiMaggio and Powell (1983, 149-152) argue that there are three types of institutional mechanisms influencing the managerial decisions: coercive, mimetic and normative isomorphism. Isomorphism refers to 'a constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions'. Coercive pressure is exerted by other organisations upon which the focal company is dependent on or by cultural expectations within the society. Mimetic pressure derives from uncertainty. Faced with technological or environmental uncertainty or with the lack of clear objectives, companies may model on other organisations they perceive as successful. The third source of isomorphism is normative pressure resulting from professionalization. Normative pressures include industry standards, best practices, and conventional wisdom. They originate from formal education and professional networks attempting to normalize a given field by setting clearer boundaries and by providing more standardised and routinized conditions associated with a given profession. (Milstein, Hart & York 2002, 153.)

Jennings and Zandbergen (1995, 1031-1034) were among of the first to extend institutional theory to environmental management. They assert that the adoption of environmental practices is mainly due to coercive pressures. Their hypothesis is that an increase in coercive pressure will result in increased probability of firms adopting a form or structure of a practice. They assume, however, that mimetic and normative forces are much more common if the state does not exert direct coercive pressure. Some practices are adopted not because the state requires it, but because it is considered to give a company competitive advantage or to become an industry standard. Also Zhu and Sarkis (2007, 4335) argue that the adoption of environmentally conscious supply chain management practices is moderated by three forces: regulatory (coercive) pressures, market (normative) pressures, and competitive (mimetic) pressures. All these pressures can affect an organisation's responsiveness to adoption of environmental management initiatives.

Delmas and Toffel (2004, 212) studied the impact of coercive and normative pressure on the adoption of environmental management practices focusing on the subset of actors that they believe to have most influence: governments, customers, competitors, interest groups, and industry associations. Clarkson (1995, 106-107) divide these stakeholders into two groups: primary and secondary stakeholders. Primary stakeholders are groups without whose support and participation the company cannot survive, e.g. cus-

tomers, suppliers, shareholders, employees, and government. Secondary stakeholders include those groups who influence or are influenced by the company but are not essential to its survival, for example media and interest groups. Gonzalez-Benito and Gonzalez-Benito (2006, 96) consider that the organisation's survival and success depends on its capacity to create value to these stakeholders by responding to their demands. The organisations can adopt a more proactive or reactive approach when responding to the demands.

Jennings and Zandbergen (1995, 1031) assert that coercive pressures, in the form of regulations and regulatory enforcement, have been the primary reason for adopting environmental practices. Failure to comply with these regulations may result in loss of earnings, bad reputation and even loss of the license to operate (Bansal 2005, 202). Delmas (2002, 99-100) highlights the role of governments in the firms' decision to adopt ISO 14001 environmental standard. Governments can either facilitate the adoption by providing some flexibility to the regulatory system or by threatening to issue mandatory environmental management standard that might be more stringent than voluntary ones. Government can also enhance the reputation of first adopters, thereby increasing the likelihood of mimicry of other firms. Moreover, the information and search costs related to the adoption of a standard can be reduced by providing technical assistance to potential adopters. Kagan, Gunningham and Thornton (2003, 61) argue, however, that aggressive style of regulation is likely to cause legalistic and political resistance, whereas more cooperative and flexible regulatory enforcement will result in higher levels of compliance, at least if the regulators are able to credibly impose sanctions on those who fail to cooperate.

Several studies (e.g. Berry & Rondinelli 1998, 38; Walker et al. 2008, 79) propose that the companies' approach to environmental management has evolved from regulatory-driven to more proactive, and consequently the importance of market and competitive pressures has increased. Zhu and Sarkis (2007, 4337) define market pressure as coming from downstream customers and consumers, who exert coercive and mimetic pressure (Delmas & Toffel 2004, 213). In addition, non-governmental organisations can intensify economic pressures by increasing public awareness of polluting firms and organising consumer boycotts (Kagan et al. 2003, 68). On the one hand, if manufacturers do not feel pressure from customers, they may be unwilling to implement innovative environmental practices, which in turn can lead to worse environmental performance, loss of customers and thus worse economic performance (Zhu & Sarkis 2007, 4338). On the other hand, firms operating in a monopolistically competitive market can expect the customers to be willing to pay premium price for environmentally friendly products (Khanna & Anton 2002, 543). Hall (2000, 458) points out that despite a number of surveys conducted claim that consumers are increasingly aware of green products, these kinds of surveys usually measure only the consumers' attitudes to ethical issues instead

of purchasing. The surveys might reflect what the consumers perceive is the ‘politically correct’ answer instead of what they actually feel.

As stated by Zhu and Sarkis (2007, 4339), the role of competitive factors in the adoption of corporate environmental practices is increasing. If a practice, such as recycling parts, is considered to have become an industry standard, the company is likely to mimic other companies within the same industry rather than questioning the practice’s value (Jenning & Zandbergen 1995, 1034). Multinational organisations play a key role in the diffusion of practices across national borders by submitting them to subsidiaries and other organisations in the host country (Arias & Guillen 1998, 124). Moreover, companies are likely to mimic the example of the most successful companies in the industry (Delmas & Toffel 2004, 213). There have also been voluntary industry-wide environmental initiatives, such as in US wine industry (Marshall et al. 2005, 94).

3.1.2 *Resource-based view*

In addition to institutional theory, resource-based view (RBV) is widely used in explaining the adoption of environmental management practices. The first person to introduce the term resource-based view to the general public was Wernerfelt (1984). He saw the firms as a broader set of resources than in the traditional view in which only categories such as labour, capital and land are taken into account. By a resource he meant ‘anything which could be thought of as a strength or weakness of a given firm’. Resources can be tangible, such as financial reserves, and capital equipment, or intangible, such as skills of employees and firm reputation (Grant 1991, 118). The potential importance of firm-specific resources was first acknowledged in the work of e.g. Edward Chamberlin and Joan Robinson in the 1930s, concerning monopolistic competition (Fahy 2000, 94). The idea was further developed by Penrose (1959). Penrose argued that internal conditions shape the way firms grow. However, even after Wernerfelt’s article it took some five years for the resource-based view to gain influence (Wernerfelt 1995). The early resource-based theorists believed that the current view of a firm’s success being determined solely by external environment was unrealistic and turned to Penrose’s work (Russo & Fouts 1997, 536).

The concept of competitive advantage is central to the resource-based view. Porter (1980) has developed extensively the concepts of cost leadership and differentiation as important sources of competitive advantage. In order to gain an attractive relative position, a firm must perform activities at a lower cost than rivals, or perform some activities in unique ways that create value to the customer and enable the company to command a premium price (Porter 1991, 102). Moreover, he has developed frameworks to analyse the external forces affecting a company’s competitive position. His well-known frame-

work (1979, 141) introduces five forces that govern competition in an industry: intra-industry rivalry, threat of new entrants, bargaining power of customers, bargaining power of suppliers and threat of substitutes. Barney (1991, 101-106) argues that Porter's work, however, is not built upon the resource-based view. On the contrary, two simplifying assumptions were made: 1) firms within the same industry are identical in terms of strategically relevant resources that they control and the strategies they pursue, and 2) if there is any heterogeneity within an industry, it will be short-lived because the resources used to implement strategies are highly mobile. The resource-based view substituted these assumptions by arguing that the firms within an industry can be heterogeneous in regard to strategic resources they control, and that this heterogeneity can last longer as resources are not perfectly mobile. Imitation reduces the profitability of an industry (Porter 1979, 142), and thus to have a potential of sustained competitive advantage a resource must be valuable, rare, inimitable and there cannot be strategically equivalent substitutes that are either not rare or imitable. If there are such firm-level resources, sustained competitive advantage can be attained. (Barney 105-106.) Porter views strategy as mainly industry-driven, whereas RBV posits that a strategy should be defined by unique resources (Spanos & Lioukas 2001, 960).

Building on resource-based view, Hart (1995, 991-992) developed the *natural-resource-based view* (NRBV) in which strategy and competitive advantage stem from capabilities facilitating environmentally sustainable economic activities. Hart (1995, 999) notes, however, that purely internal approach may prove to be inadequate since external legitimacy and reputation are also of great importance. He argues that external legitimacy-based approach does not jeopardize competitive advantage and may in fact reinforce and differentiate firm's position through good reputation. According to Hart (1995, 998-1003), for a resource to be valuable, rare, inimitable and non-substitutable, it must possess three characteristics: it must be 1) causally ambiguous (or tacit), 2) socially complex and 3) firm-specific.

Moving from end-of-pipe solutions to pollution prevention is people intensive and requires tacit knowledge difficult to duplicate quickly. A more advanced strategy, product stewardship, provides a firm competitive advantage by accumulating socially complex resources, such as capabilities to integrate the perspectives of external stakeholders into internal decision making. Finally, a resource must be firm-specific, which is achieved by developing new competencies and technologies.

As mentioned above, organisational capabilities affect the firm's ability to benefit from a proactive environmental strategy (Hart & Dowell 2011, 1467). Organisational capabilities depend on a firm's ability to integrate the knowledge of many individual specialists rather than on the extent of knowledge the employees possess. Competitive advantage rests upon the inimitability of capabilities (Grant 1996, 116-117) and bundling them creates complexity which further impedes imitation from competitors (Riv-

kin 2000, 826). Moreover, some studies on resource-based view have addressed how companies sustain their competitive advantage in rapidly changing environments (Hart & Dowell 2011, 1471). Resource-based theory relies in general on protecting and leveraging existing resources (Russo 2009, 307). Teece, Pisano and Shuen (1997, 515) refer to this ability to create new forms of competitive advantage as dynamic capabilities. Dynamic capabilities are innovative responses to changing environments, such as rapid technological change, or when the future markets and competition is hard to forecast. Aragon-Correa and Sharma (2003, 74) argue that proactive environmental strategy is a dynamic capability. They use Eisenhardt and Martin's (2000, 1111) conceptualization of dynamic capabilities and argue that proactive environmental strategies are dependent on specific and identifiable processes, are socially complex and specific to organisations, require path-dependent and embedded capabilities of stakeholder integration, and are nonreplicable or inimitable (Aragon-Correa & Sharma 2003, 74). Russo (2009, 310-311) studied dynamic capabilities in the context of ISO 14001 standard adoption. He found that early adopters of the standard were able to capture lasting benefits. In addition, path dependency effects were identified, i.e. the longer a firm operates under an environmental certification, the greater its benefits. Aragon-Correa and Sharma (2003, 84) note however, that adopting a few environmental practices or a proactive environmental strategy for a limited time period might not be sufficient to gain sustained competitive advantage. Instead, continuous improvement and innovation, and development of managerial and organisational knowledge are required.

Many studies highlight the importance of top management support to environmental initiatives (e.g. Berry & Rondinelli 1998, 46; Gonzalez-Benito & Gonzalez-Benito 2006, 93). Gonzalez-Benito and Gonzalez-Benito (2006, 93) present two arguments why top management support is essential: 1) resources to implement environmental initiatives are more easily available if the person responsible for these resources supports the plans, and 2) interdepartmental collaboration and coordination is often required and it's easier to endorse from the top. The attitudes held by managers significantly affect how a company approaches environmental issues. A manager may choose to keep the traditional approach of the company or challenge it. (Ghobadian, Viney, Liu & James 1998, 17.) Teece et al. (1997, 515) emphasize the role of management as adapting, integrating and reconfiguring organisational skills, resources and functional competences. Managerial attention and the framing of environmental questions have been identified as one of the factors that affect the firm's ability to gain from environmentally proactive strategies (Hart & Dowell 2011, 1468). In the traditional view, once resources are identified, they need to be developed and protected (Fahy 2000, 99). One of the most important resources is knowledge, which environmental training helps to build (Sarkis, Gonzalez-Torre & Adenso-Diaz 2010, 165). Moreover, training can

change attitude and behaviour among managers and employees (Sammalisto and Brorson 2008, 299).

Conventional RBV assumes that a firm must fully own resources to create value. An extension of RBV, the *relational view*, says that critical resources can extend beyond firm boundaries. Primary sources of inter-organisational competitive advantage are 1) relation-specific investments, 2) inter-firm knowledge sharing routines, 3) complementary resource endowments, and 4) effective governance. (Dyer & Singh 1998, 662) Relational rents can only be extracted from resources that are intentionally committed and jointly owned by the alliance partners, and thus involve the shared resources of the focal firm and its partner (Lavie 2006, 645). This type of rent cannot be generated individually by either alliance partner (Dyer & Singh 1998, 675).

3.2 Environmental management in firms

Sroufe, Montabon, Narasimham and Wang (2002, 29) assert that environmental management practices are generally classified in three categories in academic literature: strategic, tactical and operational. Operational decisions are daily-based and typically involve personnel at the shop-floor level (incl. waste reduction, resource reduction, and resource allocation). Tactical decisions concern middle management and affect medium-term deployment of resources (incl. SCM, design and development, and recognition of environmental performance). Finally, strategic decisions involve top management and have a long-term impact on the direction of the firm (incl. corporate environmental policy, strategic environmental alliances). (Sroufe et al. 2002, 25.) The analysis of Sroufe et al. (2002, 33) showed that tactical-level environmental practices were relatively less common than operational or strategic practices. Especially supply chain management practices were scarcely used. Activities across all three levels must be coordinated and integrated if the firm wants to commit to environmental initiatives.

As described by Sroufe et al. (2002, 25) strategic level decisions have a long-term impact on the firm. Roome (1992, 16) views strategic management as ‘a planned and programmed adjustment of the structures, systems, and activities of a business in response to perceived and anticipated changes in the business environment, taking into account the organisation’s capacity to change’. Roome (1992, 16) states that the purpose of strategic management is to ensure the development of the organisation along a route that permits the effective and efficient realization of the goals while remaining flexible to meet challenges along this way. Roome’s (1992, 18) analysis suggested that most companies were reactive to environmental threats, and need to track their potential environmental vulnerabilities and link them to business strategy and environmental policy.

Roome's (1992, 18-19) well-known classification of strategic options places these strategies along a continuum ranging from most reactive to most proactive. Non-compliance, compliance and compliance plus strategies are based on standards of compliance with legislative requirements and pressure from stakeholders. *Non-compliance* can occur through managerial default and it is an option taken by firms that cannot react to changing environmental standards because of high costs, existing liabilities or managerial inertia. *Compliance* is a reactive strategy in which environmental problems are solved as legislation sets agenda. A company adopting this strategic stance does neither anticipate changing the environmental agenda nor take control of its environmental priorities. Consequently, these companies are likely to be left behind by more proactive competitors. *Compliance plus* suggests that the firm moves to a more proactive, strategically led management style. These companies aim at integrating their environmental management systems with business strategy. By doing this, the company has control over the direction and pace of its environmental performance. In addition to these three strategic options, the company can also strive towards commercial and environmental excellence or leading edge. *Commercial and environmental excellence* presumes that environmental management is good management. Firms operating at this high level are likely to have core corporate and managerial values focused on the achievement of quality, which will apply similarly to the environmental impacts of the company. *Leading edge* strategy revolves around 'state of the art' in environmental management. Leading edge companies set standard for other companies. In addition to Roome (1992, 18), there are several other authors, such as Hart (1995, 992), Henriques and Sadosky (1999, 88) and Buysse and Verbeke (2003, 457), who have provided their own classifications based on the degree of the firm's proactivity.

Surveys conducted in the U.S., Canada and UK in 2010 by CIMA, AICPA and CICA with more than 2000 respondents found that 79 % of larger companies had a formal sustainability strategy while only 33 % of smaller companies had a strategy (Evolution of corporate sustainability practices 2010). However, in keeping with Roome's (1992, 18) conclusion, most companies were driven by compliance and regulatory demands. The survey results showed that in SMEs sustainability was a priority for up to 20 % of respondents, and in larger companies from 33 to 47 %. Therefore sustainability does not seem to be high priority in majority of companies. (Evolution of corporate sustainability practices 2010.) Corporate & environmental sustainability survey conducted in 2009 in Australia by Effective Governance and BDO Kendalls and identified lack of strategic direction as major difficulty in developing sustainability programmes. Especially justification of sustainability was particularly problematic. (2009 Corporate & environmental sustainability survey.)

Effective sustainability initiatives are linked to business strategy and each functional area should contribute to reducing environmental risks, cutting costs, driving revenue

growth, spurring innovation and enhancing firm reputation, employee dedication etc. (Esty & Simmons 2011, 19). Business functions can be classified in several different ways. Esty and Simmons (2011) divide them into office activities, buildings and facilities, information technology, product design, sourcing and procurement, manufacturing and processing, logistics and transport, marketing and sales, legal and regulatory affairs, and accounting and finance. Product design, sourcing and procurement, manufacturing and processing, and logistics and transport functions are often considered within the framework of green supply chain management, which will be described in its own section. The remainder of this section will focus on how to implement greener practices in the remaining functions.

Esty and Simmons (2011, 125) state that although office activities do not generate significant environmental impacts, they are symbolically important. It is easier to involve the employees in the implementation of corporate environmental strategy if they see commitment in their surroundings. They list key areas in which greener office can be achieved: 1) lightning, heating, ventilation and air conditioning, and water, 2) printing, copying, and faxing, 3) computers and electronics, 4) cleaning, 5) waste reduction and recycling, 6) kitchen/food/cafeteria, 7) office supplies, furniture, paint, and carpeting, 8) employee commuting, and 9) business travel and transportation (Esty & Simmons 2011, 138-140.) The key is to promote the ideology of reducing, reusing and recycling, promote smarter printing and paper use and go digital whenever possible, use environmentally friendly materials in the office and green the company's meetings, avoid business travels and encourage employees to commute in greener modes of transport. Esty and Simmons (2011, 144) also encourage to apply best environmental practices to existing buildings or new construction. Recently, several voluntary environmental certification systems for buildings have emerged, such as LEED (Leadership in Energy and Environmental Design, U.S.), Energy Star (U.S.), Green Globes (U.S.) Green Star (Australia), and BREEAM (Building Research Establishment Environmental Assessment Method, UK). Research by Fuerst and McAllister (2011, 66) suggests that eco-certified buildings obtain rental and sales price premium, in addition to cutting costs and saving environment.

Information technology can also be used to create a more sustainable environment. IT affects the environment in several ways. Manufacturing computers and their components consumes a significant amount of resources and generates emissions and hazardous waste. The rising energy consumption of different electronic equipment results in increased greenhouse gas emissions, and the old equipment are discarded and end up in landfills. For this reason green IT aims at designing, manufacturing and using computers, servers and other associated sub-systems efficiently and effectively with minimal or no impact on environment. Besides IT itself becoming greener, it can support other en-

vironmental initiatives by offering modelling, simulation and decision support tools. (Murugesan 2008, 25-26, 32.)

Green marketing is referred by Prakash (2002, 285) as 'the strategies to promote products by employing environmental claims either about their attributes or about the systems, policies and processes of the firms that manufacture or sell them.' Since the late 1980s, there was a burst of corporate activity in the area of green marketing in response to research claiming increased environmental awareness, growing consumer interest and willingness to pay for greener products but that does not necessarily translate into action (Peattie & Crane 2005, 358). In order to utilise the potential of green marketing or sales, a good understanding of the customers' needs, attitudes and buying behaviours is needed (Esty & Simmons 2011, 272). The best green and marketing efforts are not merely 'add-ons' (Esty & Simmons 2011, 269) or a post-hoc identification of environmental features in existing products (Peattie & Crane 2005, 361) but result of careful analysis of how sustainability fits into the firm's overall business and sales strategy (Esty & Simmons 2011, 269). Managers need to evaluate if the company needs to green its products, processes or systems. On the one hand, if a company in general highlights brand attributes, it would be better to green the product. On the other hand, if the company wishes to build its corporate image, it might be wise to green the processes or systems. (Prakash 2002, 293-294.)

According to Esty and Simmons (2011, 287) businesses tend to follow a certain pattern in their attitudes towards environmental regulations: 1) company begins with resistance, 2) moves to compliance, 3) goes beyond compliance, and 4) finally see law and regulation as an element of strategy. In order comply with environmental regulations, the firm must know relevant laws and regulations. Larger companies usually have a legal team to manage this, while smaller companies usually use outside advice. If the company takes a more proactive approach to environmental matters and exceeds current legal standards, it might want to raise the standards. This helps the firm to create competitive advantage as low-standard competitors do not have the same cost advantage. This implies using regulations as an element of strategy, which is a rarely recognized opportunity. (Esty & Simmons 2011, 294.)

In addition, finance and accounting is required to look through a sustainability lens as well. Environmental accounting expresses environmental and social liabilities as environmental costs (de Beer & Friend 2006, 548). Bartolomeo, Bennett, Bouma, Heydkamp, James and Wolters (2000, 33) divide environmental accounting into four categories; environmental management accounting and energy and material accounting being targeted at internal decision support, while financial reporting and social accountability reporting are targeted at external stakeholders. The idea behind environmental accounting tools is that leaders can make better decisions if they account for real costs and benefits that usually get ignored (Esty & Simmons 2011, 304). Berry and Ron-

dinelli (1998, 44-45) suggest that full cost (environmental) accounting is one approach to be proactive. If the full cost of environmental performance is known, many costs can be eliminated by simply changing operational practices. Furthermore, environmental costs, such as wasted raw material, do not add value and constitute thus a potential source for cost savings. Finally, understanding environmental cost and performance of processes and products results in more accurate pricing and value of goods and services.

3.3 Green supply chain management

The focus of environmental management has shifted from facility or organisation level to supply chain level. This shift signifies a step towards broader adoption and development of sustainability as the supply chain examines the entire product life cycle. (Linton et al. 2007, 1078.) Preuss (2005, 124) stresses the importance of supply chain management function by stating that from the life cycle perspective, environmental initiatives are impossible without the involvement of SCM function. Srivastava (2007, 53-54) argues that *green supply chain management* (GSCM) is gaining interest among researchers and practitioners, driven by increasing deterioration of the environment. He defines GSCM as

integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life.

(Srivastava 2007, 55)

A number of other possible definitions of GSCM have been presented in the literature. Hervani, Helms and Sarkis (2005, 334) state that ‘GSCM = Green Purchasing + Green Manufacturing/Materials Management + Green Distribution/Marketing + Reverse Logistics’. Both Srivastava and Hervani et al. include ‘closing the loop’, i.e. end-of-life practices used to recycle, reuse and remanufacture materials (Hervani et al. 2005, 334). Rao and Holt (2005, 899) define that GSCM includes ‘environmental initiatives in inbound logistics, production or the internal supply chain, outbound logistics, and in some cases reverse logistics, including and involving material suppliers, service contractors, vendors, distributors and end users working together to reduce or eliminate adverse environmental impacts of their activities’. The core idea is the same in all these definitions: to integrate environmental issues in the supply chain including all phases in the product life cycle.

Vachon and Klassen (2008, 301-302) divide green supply chain practices into two dimensions: environmental collaboration and environmental monitoring. They define environmental collaboration as ‘the direct involvement of an organization with its suppliers and customers in planning jointly for environmental management and environmental solutions’. They suggest that environmental collaboration focuses more on the means by which more environmentally friendly operations and products can be achieved and less on the immediate outcome of the environmental efforts with customers or suppliers (e.g. compliance to regulations). Environmental collaboration is also characterised by a good understanding of each partner’s responsibilities and capabilities in terms of environmental management. Even if an organisation has implemented an environmental management system and managed to enhance internal environmental performance, the benefits may diminish if the organisation’s supply chain network does not share the same environmental goals (Darnall, Jolley and Handfield 2008, 34).

Of the two approaches suggested by Vachon and Klassen (2008, 301), this study focuses on environmental collaboration. More specifically, the focus is on vertical collaboration (Barratt 2004, 32; Figure 1) i.e. within the firm and with the firm’s key suppliers and customers. The next sub-chapter therefore describes environmental collaboration in more detail.

3.4 Environmental collaboration in the supply chain

Preuss (2005, 133) studied Scottish manufacturers and found that sample companies were applying three principal approaches to managing supply chain relationships in terms of environmental challenges. The first option was simply to ignore environmental issues but that approach was rather rare and only found in smaller companies. The most common approach was an arm’s length approach, in which suppliers are merely expected to meet the acceptable standard of today. The customer stipulates the environmental requirements with only little communication and leaves the supply chain to decide how these criteria are best met. A more active approach includes a significant amount of collaboration between customer and suppliers in order to find out how today’s environmental standard can be exceeded.

The relational view proposes that organisational capabilities can be developed by combining resources existing in different supply chain members (Dyer & Singh 1998, 675; Vachon & Klassen 2008, 300). As described in Chapter 2, supply chain collaboration yields numerous benefits, such as better operational performance in terms of lead times, productivity and quality. Meanwhile, NRBV suggest that sustained competitive advantage can be built upon resources related to environmental management (Hart 1995, 988-991). Social complexity prevents easy replication and can be generated

through environmental collaboration. Put together, these two views suggest that environmental collaboration in the supply chain can create competitive advantage.

This study divides environmental collaboration into internal and external. Internal environmental collaboration concerns firm-specific internal practices and does not involve business partners, while external environmental collaboration consists of all joint environmental programs implemented by the supply chain partners (De Giovanni & Esposito-Vinzi 2012, 908). Both internal and external practices are essential for implementing GSCM practices (Zhu, Sarkis & Lai 2008a, 12).

Shi, Koh, Baldwin and Cucchiella (2012, 57) developed a framework combining GSCM and NRBV. They are used to use the term ‘intra-organisational environmental practices’ instead of internal collaboration and ‘inter-organisational environmental practices’ instead of external collaboration. The meaning of the constructs are however essentially similar despite different terms used. Intra-organisational, or in this study internal, environmental practices are causally ambiguous resources whereas inter-organisational, or here external, environmental practices are socially complex resources, both prerequisites for resources potentially giving access to sustained competitive advantage. Internal and external environmental collaboration are described in more detail in the next two sub-chapters.

3.4.1 *Internal environmental collaboration*

Shi et al. (2012, 56) refer to internal environmental collaboration as “intra-organisational environmental practices”, which involves proactive environmental practices covering all energy, material consumption, emissions and waste related to an organisation’s ‘in-house’ processes. According to Zhu et al. (2008a, 12), internal environmental management is one of the most important GSCM practices a firm can adopt in order to improve its environmental performance. An environmental management system (EMS) can be one approach to address environmental practices within the organisation. Environmental management systems is defined by Khanna and Anton (2002, 541) as ‘a collection of internal efforts at formally articulating environmental goals, making choices that integrate the environment into production decisions, identifying opportunities for pollution (waste) reduction and implementing plans to make continuous improvements in production methods and environmental performance’. In Europe, the two most widespread EMSs are ISO 14 001 and EMAS (Gonzalez, Sarkis & Adenso-Diaz 2008, 1024), both international guidelines for integrating corporate environmental protection policies, programs, and practices. ISO 14 001 was established by the International Organization for Standardization whereas EMAS was developed by the European Commission. (Morrow & Rondinelli 2002, 159.) These systems are expected to provide

benefits such as cost savings, management control improvements, better compliance with customer requirements and smaller liability risks. (Gonzalez et al. 2008, 1024.)

Darnall et al. (2008, 32-34)) suggest that an EMS may encourage some organisations expand their environmental considerations beyond the borders of the organisation. They suggest that relationship between an EMS and GSCM practices can affect an organisation's environmental sustainability, since together they offer a more comprehensive means of defining and establishing sustainability among supply chain network. Many concepts related to internal greening of the supply chain also overlap with practices with external stakeholders. Examples include green purchasing and design for environment, which are often done in collaboration with suppliers (Rao & Holt 2005, 902). Shi et al. (2012, 57) argue that internal collaboration is essentially management routines developed over time within the organisations, and as such a causally ambiguous resource.

Section 3.1.2 provided some insight why top management support is essential for the success of environmental initiatives: 1) the availability of resources and 2) easier endorsement of collaboration from top. Moreover, informing mid-level managers about possibilities of environmentally conscious practices is extremely important in order to gain their support. Similarly, inter-departmental and cross-functional collaboration and coordination is required. Cross-functional project teams may facilitate implementation of green initiatives, e.g. in terms of recycling strategies, socially responsible buying, and joint development of cleaner technologies (Bowen, Cousing, Lamming & Faruk 2001, 176-177). Such teams are also needed to implement product stewardship strategy (Hart 1995, 1001). The top management should communicate policy and plans to employees, support cultural change, reward and empower employees for corrective action and improvement, and review the progress of the EMS implementation (Daily & Huang 2001, 1544).

3.4.2 *External environmental collaboration*

According to the resource-based view of the firm bundled resources improve the firm's potential to create value. Strategic alliances are used to get access to other firms' valuable resources. (Das & Teng 2000, 31.) Vachon and Klassen (2008, 306) found that collaboration with customers on environmental issues can create synergy fostering improvement e.g. in product quality across the broader supply chain network ranging from supplier to customer. As explained in Chapter 2, information exchange, decision synchronization, incentive alignment, appropriate performance measurement systems, and integrated supply chain processes are in a key role in the success of collaborative relationships (Simatupang & Sridharan 2005a, 261).

Collaborative activities with suppliers include e.g. (1) providing materials, equipment and other services supporting mutual environmental goals, (2) integrating suppliers through joint planning sessions in relation to the environment, (3) facilitating activities enabling information and knowledge sharing, and (4) cooperating with suppliers to improve their waste reduction initiatives and source reduction strategies (Paulraj 2009, 457). Shi et al. (2012, 57) call external environmental collaboration ‘inter-organisational environmental practices’ and divide them into three categories: green purchasing, design for environment, and green distribution. *Green purchasing* or *green supply* refers to attempts to improve environmental performance of purchased inputs or of suppliers that provide them (Bowen et al. 2001, 175). Shi et al. (2012, 57) argue that green purchasing is a socially complex resource, ‘as establishing a consensus among supply chain members would involve multiple teams and organisations, requiring firms to continuously synchronise their operations and communications to ensure a reliable, environmentally collaborative supply chain’.

Vachon and Klassen (2008, 301) note that mere unidirectional and control-oriented activities, such as site audits, questionnaires and other buyer’s requirements, are not included in environmental collaboration. Green purchasing contributes to specific issues, such as reduction of waste produced, material substitution through environmental sourcing of raw materials and waste minimization of hazardous materials (Rao & Holt 2005, 900), e.g. through materials that are either recyclable or reusable, or have already been recycled. Supplier selection will also be an important decision at this stage. (Sarkis 2003, 399.) However, Vachon and Klassen (2006, 799) point out that simply requiring the supplier to fulfill certain environmental criteria and monitoring whether the supplier complies to ‘voluntary’ (i.e. non-governmental) or regulatory standards is not environmental collaboration. Instead, it belongs to the category of environmental monitoring in which only arm’s length relationships are maintained.

The goal of *design for environment* (DfE) or *eco-design* is to consider the entire product life cycle when designing environmental aspects into a product or a process (Sarkis 1998, 160), and it helps to deal with disposal problems at the end of the product’s life (Berry & Rondinelli 1998, 43). Waste is best eliminated in design stages of products and processes (Zsidisin & Siferd 2001, 271) as minimizing end-of-pipe waste has only marginal impact (Handfield, Walton, Seegers & Melnyk 1997, 311). DfE programmes can reduce manufacturing cycle time, differentiate products and provide a competitive advantage in markets that value environmental attributes (Kurk & Eagan 2008, 723).

Product stewardship strategy by Hart (1995, 993) requires that external stakeholders are integrated into product design and development processes, which in turn makes them more complex to replicate and hinders competition. Shi et al (2012, 57) also emphasize the inter-organisational nature of DfE. Naturally internal integration with differ-

ent functions, such as marketing, finance, manufacturing etc., is needed (Zsidisin & Siferd 2001, 273). Supplier involvement is highlighted, as a wrong choice of a supplier could ruin the reputation of a product or the producer (Pujari 2006, 82). Nevertheless, Handfield, Melnyk, Calantone and Curkovic (2001, 191-193) point out that the use of DfE tools is often too sporadic and done in an ad hoc manner as an afterthought. They claim that designers are not willing to reduce waste unless organisational leader provide them the structure, goals, and incentives to do so.

Green distribution consists of green logistics, green packaging and reverse logistics (Shi et al. 2012 58). Network design, planning and management are issues a logistics manager must consider first when thinking about outbound logistics. Environmentally conscious practice usually favours fewer shipments, less handling, shorter movements, more direct routes and better space utilization. Good packaging, on the other hand, can reduce environmental impacts by reducing materials usage, by increasing space utilisation in the warehouse and in the trailer, and by facilitating handling in the warehouse. (Wu & Dunn 1995, 29.) Min and Galle (1997, 11) state that effective green packaging is essential for the success of the company's environmental programme since packaging represents a major source of solid waste. Sarkis (2001, 674) notes that in the product design phase the packaging might be in fact more critical environmental factor than the product itself.

Reverse logistics focuses mainly on the return of recyclable and reusable products and materials in the forward supply chain (Sarkis 2003, 399). Reverse logistics affect considerably network design as it has characteristics, such as coordination of two markets, supply uncertainty, returns disposition decisions, postponement, and speculation (Srivastava 2007, 61). When using recycled materials for production, the company is heavily dependent on its customers as suppliers of used materials and products (Sarkis 2001, 678). Systems adopting returnable packaging require a strong customer-supplier relationship and an effective reverse logistics channel (Sarkis 2003, 399). Shi et al. (2012, 58) concur that green distribution as a whole necessitates a large number of supply chain members to coordinate and integrate environmental management into their distribution functions of transportation mode, packaging, labelling and reverse logistics, thus forming a socially complex resource.

Knowledge of a supplier's business through a collaborative relationship enables the buying company to improve their understanding of environmental impacts of their purchasing activities and may lead to mutual environmental improvements (Simpson & Power 2005, 62). A broader concept than green purchasing used in the literature is *green supplier development*. Bai and Sarkis (2010, 1202) categorize green supplier development practices in three major groups: green knowledge transfer and communication (e.g. training supplier on environmental issues, technological advise, information sharing), investment and resource transfer (e.g. solve supplier environmental technical

problems, investments in supplier capacity building, incentive scheme for environmental performance), and management and organisational practices (e.g. setting long term plans, requiring ISO 14 000 certification, building top management support within buying and supplier organisation). Collaboration with suppliers promotes understanding between the customer and the supplier on the environmental effect of both partners' activities. Communication and information exchange are facilitated, and confidence in inter-organisational relationships is built. (Bowen et al. 2001, 177.) According to Gold, Seuring and Beske (2010, 238) such trust is an outcome of a long-term close interaction between supply chain partners. Skjoett-Larsen (1999, 45) argues that trust is a valuable inter-organisational resource itself that cannot be traded or replicated easily by competitors.

Internal and external knowledge transfer is extremely important in supply chain management and the same principle also applies to green supply chain management. Information sharing is especially important for building trust (Kwon & Suh 2004, 10) as described in Chapter 2. Brachos, Kostopoulos, Soderquist and Prastacos (2007, 32) argue that the effectiveness of knowledge transfer is determined by a combination of trust, motivation, learning orientation, social interaction and top management support. For example, developing cleaner technologies requires a number of people who have tacit knowledge (Hart 1995, 1000). Vachon and Klassen (2007, 803) suggest that sharing tacit knowledge is a prerequisite of deepening technological integration e.g. in product development, and as such it can be expected to positively influence cooperative activities related to environmental issues. Interactive information networks among manufacturers, suppliers and customers reduce the risk of information asymmetry (Wu, Cheng & Huang 2010, 45).

3.5 Illustration of green supply chain practices within a firm and with collaborative partners

As described earlier in this chapter, firms may decide to adopt environmental practices for various reasons, ranging from stakeholder pressure to striving for sustained competitive advantage from environmental capabilities. Environmental threats and vulnerabilities must be integrated in the strategy (Roome 1992, 18) and each business function should contribute to achieving the environmental targets (Esty & Simmons 2011, 19). The focus of environmental initiatives has shifted to supply chain level (Linton et al. 2007, 1078), and thus supply chain management function has a central role in addressing them (Preuss 2005, 124). As a result, green supply chain management practices are gaining increasing interest. Vachon and Klassen (2008, 301-302) divide them into environmental monitoring and environmental collaboration. Figure 4 illustrates these prac-

tices. It is divided into two parts. The upper part represents how environmental management should be implemented in all functions. Hence, environmental management in the figure does not refer to a function called ‘environmental management’ but is intended to illustrate how environmental management should be integrated in the activities of every functional area. It should also be noted that the order of the business functions is not indicative of any reciprocal ranking between the functions. The lower part of the figure focuses on supply chain management function, and in particular green supply chain management.

The order of the activities along the continuum from monitoring to collaboration is only indicative. For example green purchasing can be very monitoring-oriented if simply applied through certain environmental criteria the supplier must fulfill to be selected (Vachon & Klassen 2006, 799). On the other hand, it can be very collaborative involving multiple teams and integrating operations and communications (Shi et al. 2012, 57).

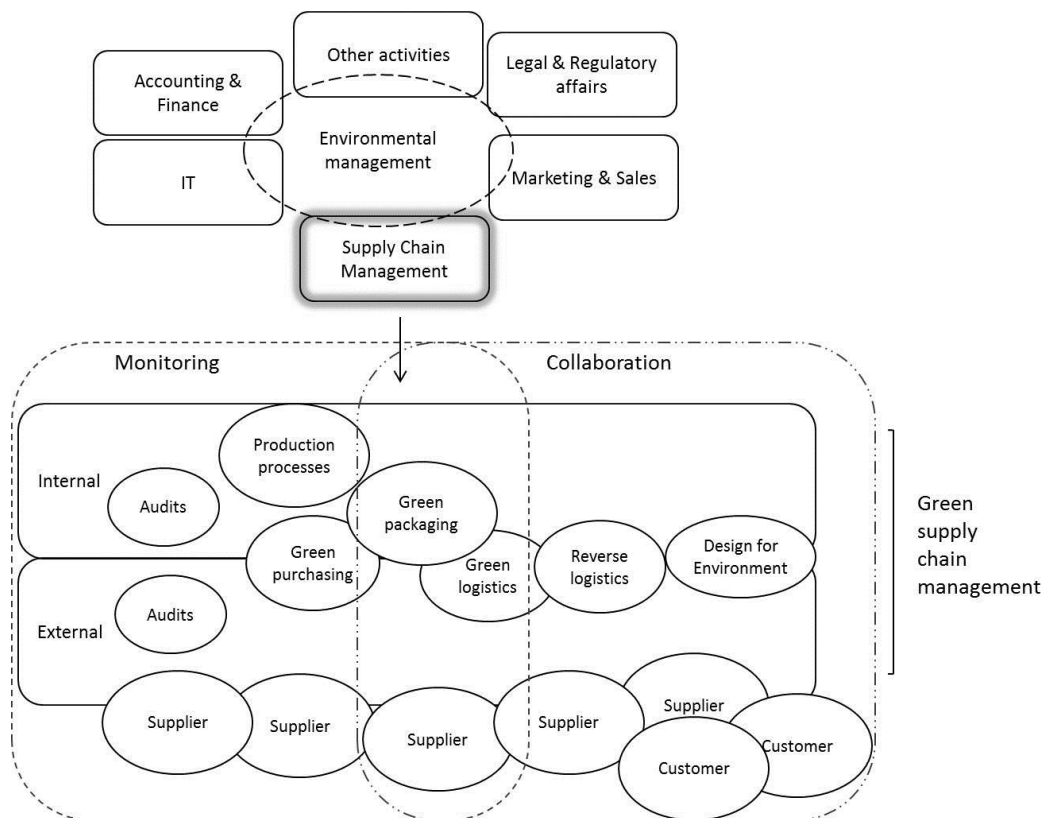


Figure 4 Illustration of environmental management activities in a firm and with key suppliers and customers

The figure highlights that many of the GSCM activities are performed both internally and externally. Moreover, the activities can be performed in monitoring-oriented or collaborative relationships. External relationships are illustrated in Figure 4 as the interface between external environmental activities, and suppliers and customers. Since monitor-

ing here refers to monitoring by the focal firm, the circles representing the customers are presented in the collaboration part of the figure.

As described in this chapter, literature suggests that sustained competitive advantage can be built upon resources related to environmental collaboration in the supply chain, whether they are internal causally ambiguous resources or external socially complex resources related to integrating different supply chain partners. A competitive advantage suggests that the firm performs better in some aspects than its competitors (Li, Ragu-Nathan, Ragu-Nathan & Rao 2006, 111). The next chapter therefore discusses the potential connection between environmental collaboration and firm performance in terms of economic, intra-firm supply chain, and environmental performance.

4 DIMENSIONS OF FIRM PERFORMANCE

4.1 Economic performance of a firm

What is performance? It is often used yet difficult to define objectively. Lebas (1995, 23) defines performance as ‘potential for future successful implementation of actions in order to reach the objectives and targets.’ Moreover, performance is case and decision-maker specific. Traditionally accounting has been responsible for defining and measuring performance (Lebas 1995, 29). According to Laitinen (1988, 11-13), the economic performance of a firm often means how well it performs in terms of measures compiled from the financial statement, since good or bad operative performance inevitably affects the financial statement. Financial performance measures are used to indicate whether the firm’s strategy, implementation and execution contribute to improved profit. Typical financial metrics include profitability, growth and shareholder value. Financial measures have been accused of not improving customer satisfaction, quality, cycle time, or employee motivation (Kaplan & Norton 1992, 77.) Modern financial statement analysis can be divided into performance-based financial statement analysis, cash flow analysis and market-based valuation (Kallunki & Kytönen 2002, 14). The next sections present some of the most used financial indicators. The aim is not to provide in-depth understanding on how to evaluate a firm’s economic performance but rather a brief overview on key indicators.

4.1.1 *Financial statement ratios*

4.1.1.1 *Profitability*

According to Foster (1986, 67) ‘profitability refers to the ability of a firm to generate revenues’. Profitability can be measured absolutely or relatively. Absolute profitability is measured as the difference of revenue and expenses, i.e. profit. Relative profitability describes profit relative to equity invested in the firm. (Yritystutkimus 2011, 60.)

Gross profit is nowadays mainly used only in wholesaling and retailing. Gross profit is the difference between net sales and the cost of producing the product or service (Yritystutkimus 2011, 60). Gross profit cannot be used as the basis to analyse the pricing of the company since it is an aggregate metric. The purchasing prices of the companies may also impact gross profit, since most large companies can purchase raw material at a lower price than smaller companies. If the consumer prices are same, the larger company’s profit margin is better. (Kauppalehti Balance 2012a.)

Return on investment (ROI) is one of the most important relative ratios provided by financial statement analysis. It can be calculated as follows (Yritystutkimus 2011, 64):

$$\text{ROI (\%)} = \frac{\text{Net income} + \text{Financing costs} + \text{Taxes}}{\text{Capital employed}} \times 100 \quad (1)$$

The comparability of ROI ratios of different companies may be weakened by the lack of information about how much of the liabilities is interest-bearing and how much is interest-free (Yritystutkimus 2011, 65).

Return on equity (ROE) is the most important traditional accounting measure for shareholders and potential investors who attempt to evaluate a firm (Ellinger, Ellinger, Yang & Howton 2002, 12). It measures the performance of the firm relative to shareholder investment and can be calculated as follows (Foster 1986, 67):

$$\text{ROE (\%)} = \frac{\text{Net income}}{\text{Shareholders' equity}} \times 100 \quad (2)$$

ROE allows potential investors to compare similar firms and provides shareholders with an indication of their firm's return (Ellinger et al. 2002, 12). Sufficient ratio is determined by the return requirement of the investors (Kallunki & Kytönen 2002, 78) but in general ROE of over 20 % is considered excellent and 15-20 % good. The risk level of the investment should be taken into account: the higher the risk, the higher ROE should be. (Kauppalehti Balance 2012b.)

EBIT-% (earnings before interest and taxes), or operating profit, measures the firm's profit excluding interest and taxes. It can also be used to compare firms within an industry and even between industries. EBIT-% of over 10 per cents is considered to be good while a ratio below 5 % is considered weak. (Yritystutkimus 2011, 61-62.)

$$\text{EBIT-\%} = \frac{\text{Earning before interest and taxes}}{\text{Sales}} \times 100 \quad (3)$$

Finally, net profit is the money left after paying all expenses. The profit ratio can be calculated by dividing net profit by turnover. (Kallunki & Kytönen 2002, 79.) The ratios provided here are only some examples of how to measure profitability. All in all, measuring current and profitability is vital for any business since profitability is the ultimate goal without which no business can survive. (Yritystutkimus 2011, 60.)

4.1.1.2 Solvency

Solvency refers to the ratio of equity and current liabilities. It is also used to describe how the firm can meet its long-term fixed expenses. Equity ratio refers to the proportion of equity used to finance a firm's assets. It is calculated by dividing total shareholders' equity by total assets. The higher the ratio, the better. If the shareholders' proportion of the assets is high, the company has better chances to pay interest rates to the creditors. (Kallunki & Kytönen 2002, 80.)

Net gearing describes the extent of nonequity capital to finance the assets of the firm (Foster 1986, 65) and can be calculated as follows. The higher the ratio, the more indebted the company is.

$$\text{Net gearing} = \frac{\text{Total liabilities} - \text{Cash and equivalents}}{\text{Total assets}} \times 100 \quad (4)$$

The ability of a firm to meet its long-term liabilities is especially important during weak economic conditions on the market when sales have typically decreased and too high interest payments can cause a financial crisis in the firm (Kallunki & Kytönen 2002, 80).

4.1.1.3 Liquidity

Even if profitability and solvency of a company were on a good level, the company must also meet its short term liabilities. Liquidity refers to the ability of a firm to meet these liabilities when they fall due. (Foster 1986, 61.) Cash flow analysis can be used to analyse the dynamic liquidity. In static liquidity analysis liquidity is assessed at a certain point of time and the amount of short-term marketable securities and cash is compared to that of current liabilities. (Yritystutkimus 2011, 71.) Two most frequently used liquidity ratios are quick ratio and current ratio (Foster 1986, 61):

$$\text{Quick ratio} = \frac{\text{Cash} + \text{short-term marketable securities} + \text{accounts receivables}}{\text{Current liabilities}} \quad (5)$$

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}} \quad (6)$$

The higher both ratios, the higher the liquidity position of the firm. Quick ratio of over 1 and current ratio of over 2 is considered to be good. (Foster 1986, 61.)

4.1.1.4 *Working capital*

Working capital management is a significant aspect of corporate finance as it directly affects liquidity and profitability of the firm (Raheman & Nasr 2007, 279). Supply chain assets consist of accounts receivable, inventories, plant, property and equipment. One generally used working capital metric is cash-to-cash cycle time or cash conversion cycle, which is a composite metric describing how much time is required to turn money invested in raw material to money collected from the customer. (Neely, Gregory & Platts 1995, 43.) It is calculated as follows:

$$\begin{aligned}
 & \text{Total inventory days-of-supply} \\
 & + \text{Days-of-sales-outstanding} \\
 & - \text{Average-payment-period to suppliers} \\
 & = \text{Cash-to-cash cycle (Neely et al. 1995, 43.)}
 \end{aligned}
 \tag{7}$$

Inventory days-of-supply is a ratio of inventories to cost of goods sold while days-sales-outstanding depicts the ratio of accounts receivable to average-daily sales (Neely et al. 1995, 43). As is the case with warehousing and inventory carrying costs, inventory days-of-supply depend also on the amount or value of the goods in the inventory (Lorentz et al. 2012, 614). Measuring cash-to-cash is important for accounting and supply chain perspectives. For accounting purposes, cash-to-cash can be used to measure liquidity and firm valuation. A shorter cash-to-cash cycle time leads to higher present value of net cash flows generated by the assets and thus leads to a higher firm value. For supply chain management purposes it represents an important measure that bridges across inbound material activities with the suppliers, through manufacturing, and the outbound and sales activities with the customers. (Farris & Hutchison 2002, 291.)

4.1.2 *Cash flow analysis*

Although financial statement ratios provide an indication of the financial health of the company, using cash flow analysis can also provide useful information on the firm. Cash flow statement depicts the firm's continual investment in working capital and fixed assets required to run the firm, while the income statement does not do that. (Temte 2005, 89.) Operating cash flow records the actual cash inflows and outflows from the normal operations of the company. The operating cash flow is different from operational profits in the income statement due to credit sales and purchases. For example, profits may be increased by sales for which payment has not yet been received. (Tham & Velez-Pareja 2004, 96.)

Credit professionals are interested in cash flow statements because they help them to determine whether cash flow is sufficient to cover not only interest but also principal payments on long-term debt and capital lease obligations. Also equity investors can use cash flow statements, since companies having difficulties in paying their debts would also have difficulties in paying dividends on a regular basis. Especially information on free cash flow, i.e. cash flow available for equity holders that can be used for purposes such as common dividends and stock buybacks, is of interest. (Mulford & Comiskey 2005, 311-312.)

4.1.3 Market-based valuation

Market based valuation focuses on analysing the share price and the risk. One function of the financial market is to disseminate information. For example the stock market continuously depicts how the investors value the company and how the management has succeeded in increasing the value of the investors' portfolio. Information in the financial statement is based on historical data whereas the share price in the stock market represents how the investors expect the firm to develop in the future. Combining these two sources will result in ratios that improve the investors' availability to assess the state of the company. (Kallunki & Kytönen 2002, 119, 132.)

Earnings per share (EPS) is a market-based ratio measuring profitability of the firm. It can be calculated as follows (Kallunki & Kytönen 2002, 132):

$$\text{Earnings per share} = \frac{\text{Net income}}{\text{Outstanding shares}} \quad (8)$$

The annual change of EPS ratio depicts how the profitability of the company has developed but does not contain any information on the share price. The analysis can be continued by dividing the current share price with EPS to get the price/earnings (P/E) ratio. It can be interpreted as the under or overvalue of the share price. Also lower risk firms usually have higher P/E ratios since the cash flows of such firms are usually more valuable for investors due to lower uncertainty. (Kallunki & Kytönen 2002, 133-134, 136.)

Price to book equity (P/B) ratio illustrates what the investors think about the firm's future growth (Kallunki & Kytönen 2002, 139). It can be calculated as follows (Kaupalehti Balance 2013):

$$\text{Price to book equity} = \frac{\text{Market price per share}}{\text{Book value per share}} \quad (9)$$

As can be seen, P/B ratio compares market price to the book value. The market price depicts the investors' evaluation of the future development of profits. If the market price is high compared to the book value, the market assesses that the future profits and therefore the growth expectations are high. (Kallunki & Kytönen 2002, 139.)

Economic Value Added (EVA) is increasingly popular among managers. It measures the difference between the return on the company's capital and cost of the capital. (Young 1997, 335.) Stern and Shiely (2001, 15) conclude it to be simply 'the profit that remains after deducting the cost of the capital invested to generate that profit'. The concept of Market Value Added (MVA) is also closely connected to EVA. MVA the difference between the market value of the company and the total capital (including equity and debt) invested in the company over the years, which the managers should try to maximize. With regard to the relationship between EVA and MVA, MVA is the present value of the firm's expected future EVAs. EVA is calculated as follows: (Young 1997, 336.).

$$\begin{aligned}
 & \text{Net sales} \\
 & - \text{Operating expenses (Incl. taxes)} \\
 & = \text{Operating profit} \\
 & - \text{Capital charges} \\
 & = \text{EVA}
 \end{aligned}
 \tag{10}$$

Capital charges are the firm's 'invested capital' times the weighted average cost of capital. If EVA is properly implemented, it can align the interests of managers and shareholders. The bonuses of managers can be tied to EVA and as a consequence the managers should start thinking and acting like the owners. (Young 1997, 336-337.)

In addition to financial figures and market-based ratios, economic performance can be operationalized by e.g. firm's relative growth (Töyli, Häkkinen, Ojala & Naula 2008, 61). Generally speaking, a firm's growth can be measured in terms of *inputs* (e.g. investment funds, employees), the *value* of the firm (e.g. assets, market capitalisation and EVA) or *outputs* (e.g. sales revenues and profits) (Garnsey, Stam, Heffernan & Hugo 2003, 8). Moreover, in studies related to environmental issues, for example cost savings and market share have been used to operationalize economic performance (De Giovanni & Esposito Vinzi 2012, 911).

4.2 Intra-firm supply chain performance

Hundreds of studies have been carried out to define how to measure and define supply chain or logistics performance. Although it is possible to find differences between SCM

and logistics, the two are often used as synonymous concepts in performance literature as the approach and measures used in performance studies are highly similar in these two fields. (Töyli et al. 2008, 58, 60.) Chow et al. (1994, 23) provide a figure incorporating various dimensions of logistics performance. (Figure 5).

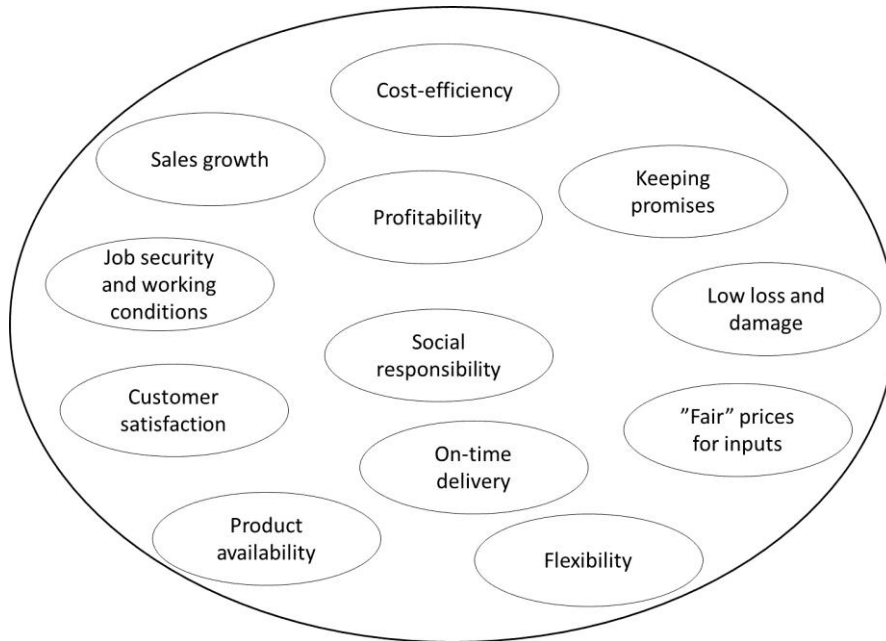


Figure 5 Dimensions of logistics performance (Chow, Heaver & Henriksson 1994, 23)

As can be seen in the figure, these measures focus on firm's internal supply chain/logistics operations. In fact, they are the firm's internal goals and thus logistics performance can be defined as the extent to which these goals are achieved. In general, performance measures used by most firms are not effectively measuring supply chain performance, as majority are single-firm measures (Lambert & Pohlen 2001, 2, 23).

Cost is traditionally the primary component but multiple other dimensions have been suggested, including time and speed, agility and flexibility, and quality and productivity (Lai, Ngai & Cheng 2004, 322). Logistics costs constitute a significant proportion of business costs. However, the definitions of logistics costs vary considerably. (Engblom, Solakivi, Töyli & Ojala 2012, 29.) The logistics cost components used here and by Lorentz et al. (2012, 613-614) include 1) transportation costs (incl. packaging costs), 2) warehousing costs, 3) inventory carrying costs, 4) administration costs. Warehousing costs and capital costs of inventory holding depend on the amount or value of the inventoried goods. These four components seem to be generally in use but their limits are defined in different ways. In addition, 'other logistics costs' component is added as the fifth cost component, following Engblom et al. (2012, 29). The 'other logistics costs' include everything else that cannot be easily divided and measured.

Elgazzar et al. (2012, 223) emphasize that managers should be aware of the connection between supply chain performance and the company's financial strategy, as well as how daily actions can affect financial performance. Logistics costs are only one aspect of this. Working capital, described above, is a common indicator to measure also supply chain performance. For SCM purposes cash-to-cash cycle provides a measure ranging from inbound material activities with suppliers to outbound logistics and sales activities with customers. (Farris & Hutchison 2002, 292.) It also tries to explain how the firm's financial activities impact suppliers and customers (Hofmann & Kotzab 2010, 309). According to Protopappa-Sieke and Seifert (2010, 440) financial supply chain management is increasingly recognised as means to improve profitability. Despite this, the interdependency of financial and operational flows is rarely acknowledged.

According to Neely et al. (1995, 83) quality is an important dimension of performance and thus needs own metrics. Beamon (1999a, 282) notes, though, that product quality is difficult to express numerically. Gunasekaran et al. (2004, 343) argue that the quality of delivered goods is of utmost importance among delivery performance measures. Together with on-time deliveries and service systems to meet customer needs it forms a key to the value of the product perceived by the customer. Traditionally quality has been defined in relation to conformance to specifications and measured with e.g. number of defects produced and cost of quality. When total quality management (TQM) approach has become more popular, the focus has shifted to customer satisfaction. Quality is often measured by using customer opinion surveys, statistical process control and Six Sigma. (Neely et al. 1995, 84-85.)

Fawcett and Cooper (1998, 354) underline customer focus and the need to measure customer satisfaction. Perfect order fulfilment, defined by Fawcett and Cooper (1998, 355) as 'complete orders delivered to customers by requested date and time in perfect condition, including all documentation', is extremely important since receiving wrong products requires that the customer re-replaces an order and returns the goods (Stock & Lambert 1992, 76). Inaccuracy also greatly reduces the confidence of the customer towards the company (Chan 2003, 539). Lee and Billington (1992, 67) criticise the use of traditional order fill rates for not identifying which divisions or functions are responsible for late deliveries and for not taking the degree of order lateness into account. Even if two companies have the same order fulfilment rate, say 90 %, they might fill the remaining ten per cent differently. Total order cycle time measures the time elapsed from the receipt of the order to its delivery to the customer (Fawcett & Cooper 1998, 355). Reduction in order cycle time leads to reduction in response time, which directly affects customer service (Gunasekaran et al. 2001, 336).

Since the business environment is ever-changing, flexible systems are needed to handle variability (Beamon 1999a, 281; Chan 2003, 539). Fawcett and Cooper (1998, 355), Stock and Lambert (1992, 76) and Beamon (1999a, 284) suggest using supply

chain responsiveness as an additional measure of supply chain performance. It refers to ability to respond rapidly to market changes or emergency orders. Vickery, Calantone and Dröge (1999, 17) examine flexibility from a customer oriented perspective and classify flexibility in the following categories: 1) product flexibility, 2) volume flexibility, 3) launch flexibility, 4) access flexibility and 5) responsiveness to target markets. *Product flexibility* refers to the company's ability to customize the product to meet customer specifications. *Volume flexibility* means the ability to effectively increase or decrease aggregate production in response to customer demand. Kumar, Fantazy, Kumar and Boyle (2006, 311) use a slightly different classification. Instead of volume flexibility they propose *sourcing flexibility* referring to the ability of supply chain partners to increase or decrease supply levels to meet the demand. Volume changes may require close coordination between the manufacturer and its suppliers (Vickery et al. 1999, 17) and the sourcing function is said to be flexible if it can respond to sudden increases in the amount raw material with extra supply capacity (Kumar et al. 2006, 312). *Launch* (Vickery et al. 1999, 17) or *new product flexibility* (i.e. product development cycle time) can create relative advantages in market share, customer satisfaction, profit and long-term competitive advantage especially in high growth markets (Kumar et al. 2006, 312). *Access* or *delivery flexibility* is the ability to provide widespread distribution coverage. The final type of flexibility is the firm's ability to respond to the changing needs of its target market. (Vickery et al. 1999, 17.) All these types of flexibility are relevant to the performance of the company.

There are several terms used to refer to how the firm performs in terms of its internal logistics/supply chain operations. Zhu, Sarkis and Lai (2008b, 272) use the term *operational performance*, which includes items such as delivery reliability, product quality, and inventory levels. *Supply chain performance* is often used but in reality most studies do not use inter-organisational metrics to measure it (Fabbe-Costes & Jahre 2008, 139). This study uses the concept of *intra-firm supply chain performance* by Lorentz et al. (2012, 613) who use the term 'intra-firm' to highlight that the perspective is limited to how the properties of the inter-firm supply chain affect performance of the focal firm. Lorentz et al. (2012, 613) define intra-firm supply chain performance as logistics costs, service performance, and asset utilisation, which, according to Töyli et al. 2008, 61), have been commonly featured in previous studies. Customer service performance is defined as perfect order fulfilment and order cycle time, while asset utilisation includes cash-to-cash cycle time and inventory days of supply (Lorentz et al. 2012, 613). Töyli et al. (2008, 65) use the term *logistics performance* instead of intra-firm supply chain performance but the operationalization is the same. As can be seen, the dimensions of intra-firm supply chain performance overlap some dimensions traditionally used to measure economic performance, such as cash-to-cash cycle.

In order to find whether there is a connection between environmental collaboration, intra-firm supply chain performance and economic performance, it must be decided how to measure performance. Neely et al. (1995, 80) define performance measurement as ‘the process of quantifying the efficiency and effectiveness of action’. Performance measurement systems are essential in supply chain management. Choosing appropriate performance measures is prerequisite for an effective performance measurement system (Beamon 1999a, 276). Kaplan and Norton (1992, 71) argue that traditional financial performance measures are outdated in terms of skills and competencies companies are trying to master today. However, focusing on purely operational measures leads to a fuzzy picture of the firm’s performance. Neely (2005, 1265) studied that evolution of performance measurement research and found that the research questions have not changed much over time. The development of performance measurement system is still enduring. A great number of academic research has been devoted to remedy the inadequacies of current performance measurement system, and a multitude of different types of performance measures has been suggested. Therefore Kaplan and Norton (1992, 72) suggested a balanced scorecard which focuses on four most critical measures: customer, internal, innovation and learning, and financial. The idea is to reduce the number of measures and provide the managers only a handful of key measures. In 2004 a Bain & Company survey of more than 700 companies in five continents found out that 62 per cent of responding organisations were using balanced scorecard (Hendricks, Menor & Wiedman 2004, 1). Another widely used framework is Supply Chain Operations Reference model (SCOR) developed by the Supply Chain Council in 1997 (Shepherd & Gunter 2006, 247).

Gunasekaran, Patel and Tirtiroglu (2001, 72) assert that the distinction between metrics at operational, tactical and strategic level is unclear. Gunasekaran, Patel and McGaughey (2004, 335, 345) provide a classification in which each metric can be assigned to the level where it is most appropriate. *Operational level metrics* assess the results of decisions of low-level managers. *Tactical level metrics* deal with resource allocation and measure targets that need to be met in order to achieve strategic objectives. *Strategic level metrics* affect top management’s decisions, reflecting firm policies, financial plans, competitiveness and how well the corporate goals are achieved. The framework also aligns the metrics to four basic links constituting a supply chain, namely plan, source, make, and deliver. The framework by Gunasekaran et al. (2004, 345) is depicted in Table 2.

Table 2 Supply chain performance metrics framework (Gunasekaran et al. 2004, 345)

Supply chain activity/process	Strategic	Tactical	Operational
Plan	Level of customer perceived value of product, Variances against budget, Order lead time, Information processing cost, Net profit Vs productivity ratio, Total cycle time, Total cash flow time, Product development cycle time	Customer query time, Product development cycle time, Accuracy of forecasting techniques, Planning process cycle time, Order entry methods, Human resource productivity	Order entry methods, Human resource productivity
Source		Supplier delivery performance, supplier lead time against industry norm, supplier pricing against market, Efficiency of purchase order cycle time, Efficiency of cash flow method, Supplier booking in procedures	Efficiency of purchase order cycle time, Supplier pricing against market
Make/Assemble	Range of products and services	Percentage of defects, Cost per operation hour, Capacity utilization, Utilization of economic order quantity	Percentage of defects, Cost per operation hour, Human resource productivity index
Deliver	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule, Effectiveness of delivery invoice methods, Percentage of finished goods in transit, Delivery reliability performance	Quality of delivered goods, On time delivery of goods, Effectiveness of delivery invoice methods, Number of faultless delivery notes invoiced, Percentage of urgent deliveries, Information richness in carrying out delivery, Delivery reliability performance

As can be seen in the table, performance can be measured in numerous ways. The SCOR model includes also the return process, but otherwise the idea is the same: supply chain performance must be measured at multiple levels. Beamon (1999a, 280) maintains, however, that current supply chain performance measurement systems are inadequate because they rely too heavily or solely on costs as primary performance measure. Moreover, these systems are inconclusive, are not aligned with strategic goals of the company, and do not consider the effect of uncertainty. As described before, Beamon (1999) proposes the use of resource measures, output measures and flexibility measures as the cure. Although there have been several attempts to create new metrics for SCM

context, performance measurement systems are criticized for lack of alignment with strategy, for lack of integration of financial and non-financial measures, for lack of systems thinking and viewing the supply chain as a whole entity, and for loss of the supply chain context (Chan 2003, 536). In general, performance measurement systems should be dynamic and present at several levels; products and processes should be included, systems and measures are best developed in teams, and they should be derived from and linked to corporate strategy; measures should be easily communicated and linked with reward scheme; accountability of measures should be clearly assigned; and the system should provide management intelligence instead of simply compiling data (Hervani et al. 2005, 332).

4.3 Environmental performance of a firm

Defining environmental performance is not a straightforward task. Even though there are frequently judgements about which companies are ‘greener’ there is not a generally accepted definition of what constitutes environmental performance¹ (Henri & Journeault 2010, 65). Lankoski (2000, 10) defined in her dissertation environmental performance simply as ‘the level of harmful environmental impact caused by a firm so that the smaller the harmful environmental impact the better the environmental performance and vice versa’. Also Stanwick and Stanwick (1998, 197) refer to environmental performance as the level of pollution emissions released by the organisation. Wood (1991, 693) takes a broader perspective and defines corporate social performance as a ‘a business organization's configuration of principles of social responsibility, processes of social responsiveness, and policies, programs, and observable outcomes as they relate to the firm's societal relationships’. Environmental performance can be considered to be an integral part of corporate social performance, and as a consequence this definition could also be applied to environmental performance. In ISO 14 0001 environmental management system environmental performance is defined as ‘measurable results of the environmental management system, related to an organization's control of its environmental aspects, based upon its environmental policy, objective and targets’ (ISO 14 001 definitions 2010). De Burgos Jimenez and Cespedes Lorente (2001, 1561) conclude that environmental performance refers to the minimisation of the negative impacts on natural environment resulting from the productive activities of a company and the social perception of this impact.

¹ Lober, D. (1996) Evaluating the environmental performance of corporations. *The Journal of Managerial Issues*, Vol. 8(2), 184–205.

However, in several studies environmental performance is simply measured as emissions or the reduction thereof (e.g. King & Lenox 2001; Zhu et al. 2008b; de Giovanni & Esposito Vinzi 2012). Environmental performance metrics are needed to evaluate the environmental performance of activities, processes, hardware and services. There are a plenty of environmental performance indicators covering all levels of management (strategic, tactical and operational) and being tangible and intangible. The choice of environmental indicators is greatly influenced by the organisation's evolutionary stage in environmental management. Reactive organisations are more likely to choose indicators related to meeting the regulations, whilst more active proactive organisations may also provide information on greenness of products and processes and green supplier selection metrics. (Hervani et al. 2005, 339-341). Beamon (1999b, 340) lists evolutionary stages and the performance measures with which the stage is most likely associated. They are depicted in Table 3.

Table 3 Evolutionary stage versus performance measure classification (Beamon 1999b, 340)

Evolutionary stage	Performance measure classification
1. Problem solving	Waste emissions and exposure hazard; economic
2. Managing for compliance	Waste emissions and exposure hazard; economic; product characteristics
3. Managing for assurance	Economic; product characteristics; economic/emissions
4. Managing for eco-efficiency	Product characteristics; economic/emissions; resource use
5. Fully integrated	Product characteristics; economic/emissions; resource use; product recovery

Exposure hazard refers to the estimated annual risk of adverse effects in humans and biota, while economic performance measures in the earliest stages of environmental management refer to the life-cycle cost for the manufacturer, purchasing and operating cost for the consumer and average total life cycle cost saving associated with design improvements. At later stages the economic measures are replaced with economic/emissions metric, meaning eco-efficiency, i.e. adding the most value with least use of resources and the least pollution. Product recovery consists of re-manufacturing, re-use and recycling and is measured e.g. in terms of per cent of recycled materials. (Beamon

1999b, 340.) In ISO 14031 standard ² environmental performance measures are divided into three categories:

- Management performance indicators: evaluating the organisation's efforts to influence its environmental performance, e.g. example environmental costs or budget, percentage of environmental targets achieved and time spent responding to environmental incidents
- Operational performance indicators: evaluating organisation's operational environmental performance, e.g. raw materials used/unit produced and average fuel consumption of vehicle fleet
- Environmental condition indicators: indicating local, regional, national or global conditions of the environment and which are useful for measuring the impact of an organisation on the local environment; e.g. contaminant concentration in ground or surface water, and area of contaminated land rehabilitated (Shaw, Grant & Mangan 2010, 326.)

Monitoring all these types of measures also reflects the broader definition of environmental performance as being not only the negative impact on natural environment but also the activities of the organisation. In short, management performance indicators describe the measures undertaken by the management to influence the firm's environmental impacts. These indicators provide internal information on the efforts of management but fail to offer any information on the environmental performance per se. Thus relying solely on management indicators would be misleading because they do not highlight and in some cases even mask the actual material impacts. Operational performance indicators provide the basis for internal and external communication of environmental data, for example what is needed for EMAS or GRI reporting. Environmental condition indicators are usually only used by individual companies that are the main cause of a local impact on a region, such as the water quality downstream for the pulp and paper sector. All indicators should be comparable, target-orientated, balanced, continuous, frequent, and comprehensible (Jasch 2000, 82-83).

As described earlier, balanced scorecard approach is often suggested as a remedy for complicated performance measurement systems and it could also incorporate environmental performance measures. Balanced scorecard contains four dimensions that create and sustain corporate value: 1) financial perspective, 2) customer perspective, 3) internal business processes perspective, and 4) learning and growth perspective. These four perspectives are connected through chains of cause and effect: Learning and growth actions impact internal business process outcomes, internal business process actions

² ISO (2009) ISO 14001:2004, environmental management systems – requirements with guidance for use

impact both customer and financial outcomes, and improved customer value results in stronger financial performance. Many companies have integrated key sustainability indicators in each of the four perspectives. Companies that have defined sustainability as a key corporate value or strategic imperative might choose to create a fifth, sustainability perspective, which communicates management's strong concern on these objectives and issues. (Epstein & Wisner 2001, 2, 7-8.)

4.4 The connection between environmental collaboration, economic performance and intra-firm supply chain performance

Several researchers have demonstrated that integrating supply chain with suppliers and customers is beneficial for the firm's performance (e.g. Frohlich and Westbrook 2001, 193; Rosenzweig, Roth & Dean 2003, 450) but the question arises if environmental collaboration yields similar benefits. The relation of environmental and firm performance has mainly been studied in terms of financial performance (e.g. Russo & Fouts 1997, Klassen & McLaughlin 1996). Mahapatra (1984, 35-37) studied pollution control expenditures across six different industries and compared it to the average market returns. He concluded that investors view pollution control as 'a drain on resources which could have been invested profitably, and do not 'reward' the companies for socially responsible behaviour.'

Klassen and McLaughlin (1996, 1212) found that positive environmental events were rewarded by the marketplace through an improved market valuation. The results of Russo and Fouts (1997, 549) show that higher environmental performance was associated with higher financial performance, and that the performance was strengthened by industry growth. It should be highlighted at this point that these studies focused on environmental performance and not on environmental collaboration. For example Klassen and McLaughlin (1996, 1203) used environmental awards for measuring environmental performance, whereas Russo and Fouts (1997, 544) used the environmental ratings by the Franklin Research and Development Corporation, including e.g. compliance records and expenditures.

De Giovanni and Esposito Vinzi (2012, 910) used the terms 'internal environmental management' and 'external environmental management' but used partly the same five-item scale than Vachon and Klassen (2008) in external environmental management. De Giovanni and Esposito Vinzi (2012) also had items directly related to environmental performance. Their results showed that internal and external environmental management influence positively environmental performance and economic performance but the effect of external environmental management is smaller in both cases. On the other hand, environmental performance does not affect economic performance, contrary to

previous research finding by e.g. Klassen and McLaughlin (1996) or Russo and Fouts (1997). In conclusion, the results of the previous studies are rather controversial and thus the connection between environmental collaboration and economic performance needs further research.

Further, research on connection between environmental collaboration and intra-firm supply chain performance is even scarcer. Vachon and Klassen (2008, 305) studied the relationship between environmental collaboration and manufacturing performance. They used both objective and perceptual metrics and collected objective data for two dimensions of manufacturing performance: quality and delivery. The scrap rate of production was used for measuring quality, and on-time delivery, throughput time and set-up time were used to evaluate delivery performance objectively. Moreover, perceptual items covering cost, quality, delivery and flexibility were asked from respondents. As can be seen, their construct of manufacturing performance has some items similar to Lorentz et al. (2012, 613) who measured intra-firm supply chain performance. Vachon and Klassen (2008, 311) found that environmental collaboration with primary suppliers was positively related to delivery and flexibility performance while environmental collaboration with customers was mainly linked to better quality performance. As a consequence, they conclude that upstream collaboration is essentially linked to process-based performance in the form of fast and reliable deliveries, and greater ability to respond to unforeseen events. On the contrary, downstream collaboration is connected to product based performance in the form of conformance to specifications and durability.

Table 4 presents some studies on the connection between environmental performance or management and firm performance.

Table 4 Examples of studies on the connection between environmental performance/management and firm performance

Study	Environmental variables	Performance variables	Main findings
Klassen & McLaughlin (1996)	Environmental awards	Stock returns	Environmental awards have a positive and significant impact on stock returns
Russo & Fouts (1997)	Environmental ratings by the FRDC, incl. compliance, expenditures, waste reduction	ROA	Environmental performance has a positive and significant impact on ROA
Cohen et al. 1997	Number of environmental litigation proceedings, noncompliance penalties, oils spills, toxic chemical releases, superfund sites	ROA, ROE, Total risk-adjusted return to shareholders	Greener firms seem to be doing as well or better than their more polluting counterparts but causality is still rather unclear
King & Lenox (2001)	Total emissions, relative emissions, industry emissions	Tobin's q	Lower total emissions significantly and positively connected to higher Tobin's q
Vachon & Klassen (2008)	Environmental collaboration with customers and suppliers	Manufacturing performance	Environmental collaboration with primary suppliers was predominantly linked to superior delivery and flexibility performance. Environmental collaboration with customers was predominantly linked to better quality performance.
De Giovanni & Esposito Vinzi (2012)	Internal EM, external EM, environmental performance (reduction of emissions, waste, hazardous materials and environmental accidents)	Profit, market share, Cost saving	Internal and external EM have a positive and significant impact on environmental performance and economic performance but no connection between environmental performance and economic performance.

As can be seen, most studies in Table 4 agree that environmental performance positively influences firm performance, which is most often measured in financial terms. The linkage between environmental performance or collaboration and supply chain/logistics performance has not been studied. In conclusion, there seems to be some contradictory evidence on the connection between environmental and economic performance, and clear lack of evidence on the connection between supply chain performance and environmental issues.

5 RESEARCH METHODS AND RESEARCH FRAMEWORK

5.1 Matching research methods with research objectives

A major objective of any research effort is to create knowledge, which is done primarily by building new theories, by extending old theories and by discarding the theories or elements in current theories that are not able to stand the scrutiny of empirical research (Handfield & Melnyk 1998, 321). Theory is the foundation for all scientific research. Empirical research can either build theory or verify theory (Flynn, Sakakibara, Schroeder, Bates, Flynn 1990, 253). *Exploratory*, or *theory building*, studies usually focus on theory development and *explanatory*, or *theory testing*, studies, on hypothesis testing (McCutcheon & Meredith 1993, 243). This is in line with Eriksson and Kovalainen (2008, 41) who argue that there are two differing views about the role and position of theory in business research. The first view emphasizes the relevance of ‘grand’ theory, which is consistent and widely known and adopted among researchers. The main purpose of empirical evidence is to test existing theory and join in the process of redefining it. The other view is more flexible and emphasizes the social nature of all scientific activity. From this point of view theory can be understood as a collection of ideas under on-going redefinition instead of stable and rigid formalizations. Quantitative research often prefers the former idea while qualitative the latter.

As can be seen, the objective of the research influences on the choice of research design. There are several potential research designs that can be used in SCM context, such as

- surveys
- single case study
- multiple case studies
- field study
- panel study
- focus group (Flynn et al. 1990, 256-257)

Surveys are the most common research approach in SCM and operations management context (Kotzab 2005, 127). Surveys rely on self-reports of factual data, as well as opinion (Flynn et al. 1990, 257). Case studies are divided in single case studies and multiple case studies (Yin 2003, 39). According to Eriksson and Kovalainen (2008, 118) *single case study* or *intensive case study* ‘aims at understanding a unique case from the inside by providing a thick, holistic and contextualized description’ while *multiple* or *extensive case study* ‘aims at elaboration, testing or generation of generalizable theoretical constructs by comparing (replicating) a number of cases’. Case study method will be described in more detail below. *Field studies* are a form of case study in which

multiple cases are involved and are selected with some definite research pattern in mind (Meredith 1998, 443). A *panel study* obtains the consensus of experts (Flynn et al. 1990, 257). Delphi study is probably the most used technique of panel study. In a Delphi study experts respond in writing to a series of questions and their anonymous answers are distributed to all members of the panel. The members are allowed to revise their responses in subsequent rounds until a consensus is reached. A *focus group* is otherwise similar to a panel study, but the group is physically assembled and each response is given to the entire group orally, rather than in written form. (Flynn et al. 1990, 257.) Besides the analysis of the contents of the group discussion, the researcher can analyse how ideas and experiences are constructed through social interaction in the group (Eriksson & Kovalainen 2008, 190).

According to Yin, (2003, 5) the three conditions affecting the choice of method are 1) the type of research question posed, 2) the extent of control the researcher has over actual behavioural events, and 3) the degree of focus on contemporary events. Meredith (1998, 442) compares rationalist research with case/field research. Rationalism is based on the assumption that the phenomenon studied exists ‘out there’, independent of the research context or the assumptions of the researcher and generally employs quantitative methods, such as optimization models, simulation, and surveys, to *describe* or *explain* phenomena. On the other hand, case or field study uses both quantitative and qualitative methods to *understand* the phenomena. Meredith (1998, 443) also points out that the goal of case studies, understanding, can only be considered knowledge within the confines of someone’s, typically the researcher’s, perceptual framework, and thus is not ‘out there’ in the rationalist sense, i.e. standing by itself and obvious to anyone looking at it.

Yin (2003, 5) states that questions are traditionally classified in ‘what’, ‘who’, ‘where’, ‘how’ and ‘why’ type of questions. According to Yin (2003, 5) surveys are good for examining ‘who’, ‘what’, ‘where’, ‘how many’, and ‘how much’ type of questions whereas case study is particularly good for ‘how’ and ‘why’ questions. ‘What’ questions can be exploratory, which can be studied by using any research strategy. However, if a ‘what’ question is in fact a form of ‘how many’ or ‘how much’, the question favours survey method. Also ‘who’ and ‘where’ are likely to lead to choosing a survey strategy. In contrast, ‘how’ and ‘why’ types of questions are more explanatory in nature and usually favour the use of case studies, histories and experiments. (Yin 2003, 5-6.) ‘How’ and ‘why’ questions can lead to theory testing but more importantly to theory development (Voss, Tsikriktsis & Frohlich 2002, 199).

Voss et al. (2002, 198) modified Handfield and Melnyk’s (1998) work and illustrated the connection between research purpose, research question and typical research method (Table 5). The first column of the table describes the purpose of research at each stage. The research question column illustrates some typical questions that the researcher

might consider answering at each stage. Research structure column concerns the design of the study.

Table 5 How to match research purpose with methodology (Voss, Tsikriktsis, Frohlich 2002, 198)

	Purpose	Research question	Research structure
<i>Exploration</i>	Uncover areas for research and theory development	Is there something interesting enough to justify research?	In-depth case studies Unfocused, longitudinal field study
<i>Theory building</i>	Identify/describe key variables Identify linkages between variables Identify 'why' these relationships exist	What are the key variables? What are the patterns or linkages between variables? Why should these relationships exist?	Few focused case studies In-depth field studies Multi-site case studies Best-in-class case studies
<i>Theory testing</i>	Test the theories developed in the previous stages Predict future outcomes	Are the theories we have generated able to survive the test of empirical data? Did we get the behavior that was predicted by the theory or did we observe another unanticipated behaviour?	Experiment Quasi-experiment Multiple case studies Large-scale sample of population
<i>Theory extension /refinement</i>	To better structure the theories in light of the observed results	How generalizable is the theory? Where does the theory apply?	Experiment Quasi-experiment Case studies Large-scale sample of population

Voss et al. (2002, 198) divided research in four stages: exploration, theory building, theory testing, and theory extension/theory refinement. *Exploration* is needed to develop research ideas and questions. Stuart, McCutcheon, Handfield, McLachlin and Sam-

son (2002, 421) argue that paucity of theory, complexity and lack of well-defined definitions and metrics favour the use of case study method, as illustrated in the table. In the *theory building* stage the research aims at identifying the key variables and the connections between them (Voss et al. 2002, 198). Handfield and Melnyk (1998, 328) assert that theories emerge when the terms and relationships in empirical generalizations are made more abstract by introducing terms that refer to non-observable constructs. In building relationships between constructs, the researcher attempts to achieve two objectives. The first of them is to generalize the nature of relationships between key variables (often in the form $x \rightarrow y$), which constitutes the ‘how’ component of the theory. In addition, the theory must contain ‘why’, why these relationships exist. As explained above, ‘why’ and ‘how’ type of questions favour case study method.

Unsurprisingly, *theory testing* stage aims to test the theories developed at earlier stages. Hypotheses are generated in advance of the study and are tested by the data collected (Flynn et al. 1990, 253). As presented in the table, the purpose is to see if the theories are able to survive the test of empirical data. Even if case study method is used in the previous stages, survey-based research is typically used at the theory testing stage in order to achieve triangulation (Voss et al. 2002, 199) and optimize generalization. The purpose of *theory extension/refinement* is to better structure theories in the light of the observed results. This process focuses on external validity, i.e. generalization to broader populations and settings (Handfield & Melnyk 1998, 332). Survey research relies on statistical generalization whereas case studies rely on analytical generalization (Yin 2003, 37). With case research, generalization is from each case to a broader theory, not from samples to populations (Stuart et al. 2002, 430).

This study addresses only empirical research methods, in particular survey research and case study research. According to Boyer and Swink (2008, 339) operations and supply chain management is a social science. Thus, although systems and decisions can be modelled, empirical data is essential for developing and validating of models. The next two sections describe the characteristics of survey research and case study research.

5.2 Characteristics of survey research methods

Survey research is the predominant method in SCM research. In 1995 Mentzer and Kahn (1995, 240-241) reviewed articles from 1978-1993 and found that 53.4 % of performed logistics research used surveys. Kotzab (2005, 127) repeated the research ten years later and found that surveys were still predominant but the ‘market share’ of surveys had declined to 44 per cent. A survey provides a low-cost and non-invasive way of measuring aspects of operational or supply chain issue. Measures in a survey can be

targeted at specific factors or attributes which may not be directly observable. For example, many behavioural variables are latent and can be only assessed through perceptual measures. (Boyer & Swink 2008, 339.)

According to Pinsonneault and Kraemer (1993, 77), surveys conducted for research purposes have three characteristics. Firstly, the purpose of the survey is to produce quantitative descriptions of some aspects of the studied population. Secondly, the main way of collecting information is by asking people structured and predefined questions. The responses constitute the data to be analysed. Thirdly, information is usually collected from a fraction of the studied population – a sample – but it is collected in a way that enables the researcher to generalize the findings to the population. Forza (2002, 155) argues that survey research is often distinguished between exploratory, confirmatory, and descriptive. *Exploratory survey research* takes place in the early stage of research on the phenomenon of interest. Its purpose is to gain preliminary insight on a topic and to provide a basis for more in-depth survey. In the preliminary stages exploratory survey research can help to determine the concepts to be studied in relation to the phenomenon, how to best measure them and how to discover new facets of the phenomenon. Further, it can help to provide preliminary evidence of association among the concepts and, at a later stage, to explore the valid boundary of a theory.

Confirmatory survey research, also known as theory testing or explanatory research, takes place when knowledge of the phenomenon has been formulated in a theoretical form using well-defined concepts, models and propositions. In confirmatory survey data is collected to test the adequacy of the concepts related to the phenomenon, the hypothesized linkages between the concepts and the validity of the boundaries of the model. (Forza 2002, 155.) The relationships between variables are the focus of the research. ‘How’ and ‘why’ variables should be derived from theory-based expectations. The theory includes an element of cause and effect that not only assumes that there is a relationship between the variables but assumes directionality (i.e. relationship is positive or negative. (Pinsonneault & Kraemer 1993, 80.) *Descriptive survey research* is carried out to understand the relevance of the phenomenon and its distribution in the population. The main purpose is not theory development, even though the results can provide hints for theory building and theory refinement. (Forza 2002, 155.) The hypothesis is not causal but simply that common perceptions of the facts are or are not in odds with reality (Pinsonneault & Kraemer 1993, 80).

Moreover, survey designs can be distinguished as cross-sectional or longitudinal depending on how they address time. If the research aims at describing a population or document and test differences in a sub-sample at one point in time, a *cross-sectional* approach would be appropriate. Data is collected at one point in time, which in turn limits causal inferences because temporal priority is difficult to establish. On the other hand, if the research objective is to examine a dynamic process changing over time and

the consequences of the phenomenon, a *longitudinal* design is the most appropriate. Classic longitudinal study therefore collects data at least at two different points in time. (Pinsonneault & Kraemer 1993, 81)

Survey research has in general the advantages of being precise and thus offering testability and reliability. Measurable quantitative variables can be carefully specified and precisely tested or checked by another researcher. Another advantage is the knowledge and wide acceptance of the standard procedures. (Meredith 1998, 443.) Naturally there are also disadvantages. Using perceptual measures can cause measurement errors stemming from subjectivity and bias. Other limitations relate e.g. to difficulties with respondents' interpretations of measures, potential lack of knowledge, and representations of the unit of analysis. (Boyer & Swink 2008, 340.) Malhotra and Grover (1998, 411) have divided sources of error stemming from translating latent variables into measurable factors into four categories. *Measurement error* is the error in measuring latent constructs, which can be reduced by careful validation of the instrument. *Sampling error* is the error in selecting the study population and the representativeness of the sample with respect to the population. *Internal validity error* refers to error introduced if other explanations can explain the observed relationships. Lastly, *statistical conclusion error* reflects the possibility of null hypothesis being rejected and that mathematical relationships between the hypothesized variables exist.

Yin (2003, 34) identified four tests that are generally used to assess the quality of research in all social sciences. The four tests are: 1) construct validity, 2) internal validity, 3) external validity, and 4) reliability. *Construct validity* tests the establishment of correct operational measures for the concepts being studied. *Internal validity* tests the establishment of a causal relationship, whereby certain conditions are proved to lead to other conditions. This test applies only for explanatory or causal studies. *External validity* measures the extent to which the results of the study can be generalized. *Reliability* measures whether the operations of the study can be repeated, with the same results.

Golicic, Davis and McCarthy (2005, 16) claim that quantitative research methods optimize control and generalizability (external validity), while qualitative research maximizes realism (internal validity) but the researcher should assess all the above-mentioned tests. Construct validity comprises two components: convergent and discriminant validity. Together they measure whether the measure is similar within itself and yet sufficiently different from other measures. In quantitative research for example factor analysis can be used to test construct validity. If the items of each variable load together but do not cross load onto other variables, there is evidence of construct validity. Internal validity can be justified by discussing why causality exists and why alternative explanations are unlikely. More formal methods can also be used, such as follow-up interviews or observation of multicollinearity among variables. Structural equation models can also be used to test causality. (Malhotra & Grover 1998, 413-414.) External validity of the

results suffers from low response rates, which is a typical problem in logistics related survey research. Researcher can increase the external validity and reliability by conducting and reporting tests for nonresponse bias. (Wagner & Kemmerling 2010, 372.) The most common tests to estimate reliability are 1) test-retest method, 2) alternative form method, 3) split halves method, and 4) internal consistency method. The test-retest method calculates correlations between responses to same questions from the same respondents collected at different points of time. Alternative form method obtains responses through different measures from the same respondents at different points of time. The split halves method divides the measured items into two subsets and correlates the answers obtained at the same time to them. Internal consistency can be calculated by using e.g. Cronbach's alpha, which is the most popular indicator of reliability in operations management survey research. (Forza 2002, 177.)

5.3 Characteristics of case study methods

Case study method has been claimed to be a neglected yet powerful tool in operations and SCM research (Meredith 1998, 441; Stuart et al. 2002, 419). Case study is an empirical inquiry that 1) investigates a contemporary phenomenon within its real-life context, especially when 2) the boundaries between the phenomenon and its context are not clearly evident (Yin 2003, 13). Meredith (1998, 442-443) defines that

a case study typically uses multiple methods and tools for data collection from a number of entities by a direct observer(s) in a single, natural setting that considers temporal and contextual aspects of the contemporary phenomenon under study, but without experimental controls or manipulations.

Meredith (1998, 442-443)

Case studies can be used for different types of research purposes, such as theory building, theory testing, and theory extension/validation (See Table 5 above) (Voss et al. 2002, 197). However, case method is most often used for theory building approach (Boyer & Swink 2008, 340). Consequently, there are also exploratory, descriptive and explanatory case studies (Yin 2003, 3). In addition, case studies should not be confused with qualitative research. Case studies can be based on a mix of qualitative and quantitative evidence. (Yin 2003, 15.) Stuart et al. (2002, 420) propose a five-stage research process model in order to ensure rigor in case study research (Figure 6). The stages are generic and therefore applicable in any research approach.

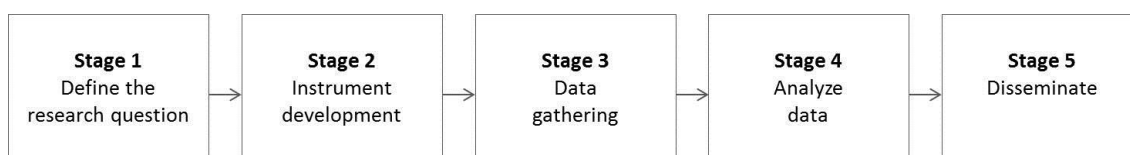


Figure 6 Case research process model (Stuart et al. 2002, 420)

Case methods enable the examination of a topic in great depth (Boyer & Swink 2008, 340). Meredith (1998, 443-444) cites three strengths of case study identified by Benbasat, Goldstein and Mead (1987): 1) The phenomenon can be studied in its natural setting and meaningful, relevant theory generated from the observation of actual practice; 2) the case method allows especially ‘why’ type of questions be answered with a relatively full understanding of the nature and complexity of the complete phenomenon; and 3) the case method suits early, exploratory investigations where the variables are still unknown and the phenomenon is not fully understood. At the same time, the difficulties in doing case research include for example the requirement of direct observation in the actual contemporary situation (cost, time, access barriers), the need for multiple methods, tools and entities for triangulation, the lack of controls, the complications of context and temporal dynamics (Meredith 1998, 444), the inability to generalize and prescribe, and potential bias in the perceptions of the researchers (Boyer & Swink 2008, 340). The extent of pre-determined framework is indeed under debate (Koulikoff-Souvion & Harrison 2005, 269). Yin (2003, 28-29) maintains that a preliminary theory must be prior to conducting any collection. The role of theory development separates case study method from related methods, such as ethnography and grounded theory. This might however lead to the data collection be limited by the predetermined decisions of what to look at (Koulikoff-Souvion & Harrison 2005, 269).

As described above, case studies can be intensive or extensive. Intensive case study refers to choosing a unique case to provide a holistic understanding, whereas extensive case study refers to choosing multiple cases to elaborate, test and generate generalizable constructs by comparing a number of cases. (Eriksson & Kovalainen 2008, 118.) Unlike survey design, choosing case study sites should be based on theoretical rather than statistical reasons. As a consequence, the cases are meant to be exemplary rather than representative. (Koulikoff-Souvion & Harrison 2005, 270.) Pettigrew (1990, 275-276) proposes three tactics to case selection: 1) Go for extreme situations, 2) Go for polar types, or 3) Go for high experience levels of the phenomena under study.

The objective of intensive case studies is not to produce generalizable knowledge. Even extensive case studies cannot produce generalizations that would hold for a certain population. (Eriksson & Kovalainen 2008, 121,125.) Contrary to statistical generalization in which inferences are made about a population based on a sample, the findings of

case research can be generalized through analytic generalization. In analytic generalization the previously developed theory is used as a template with which to compare the empirical results of the case study. If two or more cases are shown to support the same theory replication may be claimed. (Yin 2003, 32-33.)

Parallel to survey studies, case studies must also demonstrate validity and reliability. Yin's (2003, 34) four tests (described in the previous section) are equally important in case study approach. To demonstrate internal validity, the researcher needs to keep a record of evidence of other factors that may be alternative explanations for the observed relationships (Stuart et al. 2002, 425). According to Stuart et al. (2002, 425), the primary concern for case studies are construct validity (Are the operational measures correct for the phenomenon?) and internal validity (Do the causal relationships exist, instead of spurious relationships?). To ensure construct validity, the researcher must look for multiple sources of evidence, using the technique of triangulation. *Triangulation* means the use and combination of different methods to study the same phenomenon. Such methods can include e.g. interviews, questionnaires, direct observation, content analysis of documents, and archival research. (Voss et al. 2002, 206.) In addition to triangulation of methods, there are also other types of triangulation, namely triangulation 1) of methodologies, 2) of data, 3) of theories, and 4) of researchers (Eriksson & Kovalainen 2008, 293). These forms can be used separately or in combination.

5.4 Research methods to analyse environmental collaboration in the supply chain

Research methods are grounded in philosophical traditions that differ among the various quantitative and qualitative research methods (Golicic et al. 2005, 18). This research follows the positivist paradigm, believing that knowledge of the world is obtained through applying the scientific methods to experiences and empirical world (Eriksson & Kovalainen 2008, 18). Positivist approach focuses on facts, looks for causality and formulates hypotheses and then tests them. For those reasons, positivism is well suited for studying the relationships between environmental collaboration and firm performance. However, positivism has been criticized for ignoring people and concepts, which has resulted in the application of the phenomenological paradigm in the social sciences. (Mangan, Lalwani & Gardner 2004, 567.) The interpretive perspective emphasizes meanings and interpretations (Craighead, Hanna, Gibson & Meredith 2007, 26). People understand collaboration in different ways, which might call for an interpretive and thus qualitative approach. As a consequence, a mixed method approach is suggested. Voss et al. (2002, 198) propose that appropriate methods for theory testing would be experiment, quasi-experiment, multiple case studies and large-scale sample of population. The

next two sub-chapters therefore discuss a mixed method consisting of survey research and multiple case studies.

5.4.1 Survey research

As mentioned above, the majority of research in the SCM and operations management field is based on survey research. Since survey research aims at finding causality and testing them through hypotheses (Mangan et al. 2004, 567), it is well suited for testing whether there is a connection between environmental collaboration and firm performance. As described by Yin (2003, 5), survey methods are appropriate for studying ‘who’, ‘what’, ‘where’, ‘how much’, and ‘how many’ type of questions. As the purpose is to analyse the connection between environmental collaboration and firm performance, the research will be performed to test theory and causal relationships between the variables. This type of research is known as explanatory or confirmatory. According to Pinsonneault and Kraemer (1993, 80) a central research question in explanatory survey research is ‘Does the hypothesized causal relationship exist, and does it exist for the reasons posited?’ In regard to the focus of this thesis, the research question would therefore be ‘Does environmental collaboration affect firm performance?’

According to Forza (2002, 184), most statistical tools in any applied field should be multivariate or it will be treated only superficially. Multivariate analysis refers to the simultaneous analysis of more than two variables. Table 6 presents some of the most used multivariate analysis methods. Several methods presented in the table could be used to analyse the survey data in question. Structural equation modeling (SEM) has recently become one of the preferred analysis tools among operations management researchers (Shah & Goldstein 2006, 148). SEM combines aspects of factor analysis and multiple regression enabling the researcher to simultaneously examine a series of inter-related dependence relationships among the measured variables and latent constructs as well as between numerous latent constructs. The role of theory is particularly pronounced in SEM because it is considered a confirmatory analysis. (Hair, Black, Babin & Anderson 2010, 634). Path analysis and confirmatory factor analysis are two special cases of SEM regularly used in operations management. Path analysis models specify patterns of directional and non-directional relationships among manifest variables, and only error terms are allowed as latent variables. Confirmatory factor analysis requires that latent variables and their associated manifest variables are specified before the data analysis. This is accomplished by restricting the manifest variables to load on specific latent variables and by determining which latent variables are allowed to correlate. (Shah & Goldstein 2006, 149.)

Table 6 Main multivariate analysis methods (Forza 2002, 186)

Multivariate technique	When used	Function
Multiple regression	With a single metric dependent variable presumed to be related to one or more metric independent variables	To predict changes in the dependent variable in response to changes in the several independent variables
Multiple discriminant analysis	When the single dependent variable is dichotomous or multidichotomous and therefore nonmetric	To understand group differences and predict the likelihood that an entity will belong to a particular class or group based on several metric independent variables
Multivariate analysis of variance (MANOVA) Multivariate analysis of covariance (MANCOVA)	When the researcher designs an experimental situation to test hypotheses concerning the variance in group response on two or more metric dependent variables	To simultaneously explore the relationship between several categorical independent values and two or more dependent metric variables
Canonical correlation	An extension of multiple regression analysis	To simultaneously correlate several metric independent variables and several dependent metric variables
Structural equation modeling	When multiple separate regression equations have to be estimated simultaneously	To simultaneously test the measurement model and the structural model
Factor analysis	When several metric variables are under analysis and the researcher wishes to reduce the number of variables to manage or find out the underlying factors	To analyse interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions
Cluster analysis	When metric variables are present and the researcher wishes to group entities	To classify samples of entities into a smaller number of mutually exclusive subgroups based on the similarities among the entities

SEM could therefore be a powerful way to test the causality between environmental collaboration and the dimensions of firm performance. However, it might be worthwhile to consider the issue of causality a bit further. *Reflective measurement theory* is based on the idea that latent constructs cause the measured variables, and thus error results are caused by inability to fully explain these measured variables. In contrast, a *formative measurement theory* posits that the measured variables cause the construct. The error then is due to inability of measured variables to fully explain the construct. (Hair et al. 2010, 702.) De Giovanni and Esposito Vinzi (2012, 912) argue that environmental and economic performance are actually formative rather than reflective indi-

cators traditionally used in SCM research. Thus each item captures a specific aspect of performance and only their joint combination forms the construct. Moreover, also intra-firm supply chain performance qualifies as a formative construct, since it is formed by logistics costs, service performance and asset utilization, and if there was an improvement in any of these measures, intra-firm supply chain performance would increase. Conversely, if intra-firm supply chain performance increased, it might not result in an increase in all three measures.

However, using formative measures is more challenging than using conventional reflective measures as they require for example a different validation process (Hair et al. 2010, 751) and there is a lack of clear guidelines for validating and analysing formative constructs (Petter, Straub & Rai 2007, 640). Reflective models are easier to work with and are traditionally thought to best represent many individual difference characteristics and perceptual measures. Nevertheless, an incorrect modelling of a factor can lead to misinterpretation and wrong conclusions. Therefore the type of measurement model should be carefully determined based on the true nature of the construct being studied. (Hair et al. 2010, 751.)

Many studies have used subjective metrics to measure environmental performance. For example Rao (2002) and De Giovanni & Esposito Vinzi (2012) asked the respondents to express whether they disagree or agree with the statement regarding environmental actions taken by the firm, and if the actions had had minor, moderate or substantial benefits in specific categories, such as reduction of emissions or improved compliance. The use of reflective measures may lead to various method biases, such as consistency motif in which people try to appear consistent and rational, or social desirability, in which the respondent answers as to present themselves in a favourable light regardless of their true feeling of the topic (Podsakoff, MacKenzie, Lee & Podsakoff 2003, 881).

Objective data could be gathered from sustainability reports but there would be a problem of comparing such metrics between different industries. According to Stanwick and Stanwick (1998, 201) the use of pollution emissions ignores the measurement of environmental performance of firms in relatively low polluting industries. The result may be a bias toward heavy manufacturing firms. Moreover, mostly only large firms publish such reports, which would result in a biased sample.

Appendix 1 uses Finland State of Logistics 2012 as an example of potential data to analyse the connection between environmental collaboration and firm performance. Finland State of Logistics data, however, lacks some pivotal information. For example environmental performance is not addressed at all. Thus, one approach could be to conduct a follow-up survey with subjective metrics on environmental performance as well as antecedents of environmental collaboration. Furthermore, in order to get a more holistic picture of the phenomenon, it might be worthwhile considering mixed methods

research design, i.e. to combine quantitative and qualitative data. This approach is discussed in the next section.

5.4.2 Case research

The use of multiple methods (both quantitative and qualitative) is often desirable to cross-check each other. Thus the confidence in findings can be enhanced. (Malhotra & Grover 1998, 410.) Despite this, mixed methods in supply chain management research is rare. Mixed methods can choose either a qualitative or quantitative path. If the Finland State of Logistics 2012 survey data was chosen as the starting point, the quantitative path would be chosen. A formal theory grounded in the reviewed literature is built in this study, which in turn enables the generation of hypotheses. After the initial research approach, in this case quantitative, the research progresses to the qualitative approach to gain new insights. It also needs to be decided whether both methods are equally important for the analysis.

If qualitative data is used as a secondary method, it is referred to as interpretation. If the methods are equally important, the research design is *complementary*. The sequence of methods is not relevant. However, the data is analysed and interpreted in a single report. On the contrary, *interpretation* seeks to explain and confirm the findings of the survey study. The qualitative part can therefore be collected sequentially, but it is used concurrently in the interpretation and report of findings. Combining qualitative data offsets the lack of flexibility and depth of the survey questionnaire, and therefore provides a more holistic picture. (Golicic & Davis 2012, 727, 733, 736.) If Finland State of Logistics 2012 data, together with additional follow-up survey data, was used, the research design would likely be complementary. Creswell and Plano Clark (2007, 72) call it the *follow-up explanations model* (Figure 7). As in complementary research design, the researcher needs qualitative data to explain or expand on quantitative results. The two-phase structure makes the model straightforward to implement as two methods are used in separate phases and only one type of data is collected at a time. (Creswell & Plano Clark 2007, 73-74.)

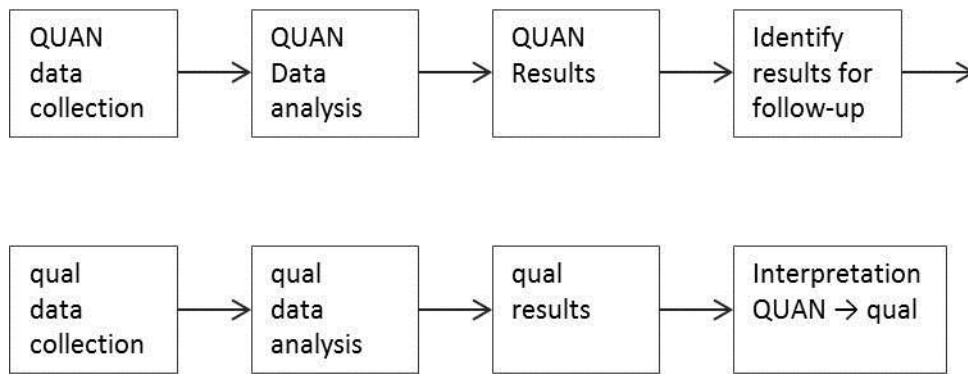


Figure 7 Follow-up explanations model (quantitative phase emphasized) (Creswell & Plano Clark 2007, 73)

As illustrated in Table 5, multiple case studies would be an appropriate choice for theory testing purposes in qualitative phase of research. Based on Pettigrew's (1990, 275-276) guidelines, sampling selection could be done by applying three tactics 1) extreme situations, polar types, or 3) high experience levels, as explained before. As the objective here is to study environmental collaboration, we could suppose that company size might affect the resources used to environmental collaboration. This is supported by Zhu, Geng, Fujita and Hashimoto (2010, 383) stating that according to the resource-based theory, larger firms might have better financial resources and capabilities to handle environmental issues. Moreover, larger firms are usually under greater scrutiny of non-governmental organisations, consumers etc. Therefore, larger firms probably have higher experience levels in environmental issues including environmental collaboration. On the other hand, Lee (2009, 1103) noted that studies of green management focusing on SMEs are very scarce in business and management literature, and therefore studying SMEs might provide some fruitful insights and possibly theoretically interesting comparisons. This argument then favours choosing polar types (i.e. SMEs vs. large firms) as sample cases.

Another key question is the number of respondents in each case company. According to Voss et al. (2002, 205), if the events being studied can have different interpretations or viewpoints, a researcher might consider multiple respondents. Collaboration can be indeed interpreted in different ways, and also respondents in different functions of the firm may have differing opinions regarding its outcomes, drivers etc. Moreover, in order to explore whether the firms collaborate internally, it would be wise to have respondents in several functions. By asking same questions from several people, the reliability of the data can be enhanced (Voss et al. 2002, 205).

Structured interviews are typically main sources of data in case research (Voss et al. 2002, 204) and often made with a positivist 'what' question in mind (Eriksson & Kovalainen 2008, 81). The advantage of structured interviews is that the questions are then standardized and the individual responses can be more easily compared. However, the

questions need to be carefully worded and allow the respondents to provide a fresh commentary about it. (Yin 2003, 91.) In addition, the questions are mostly only 'what' questions, thereby limiting access to unanticipated insights (Eriksson & Kovalainen 2008, 81). However, in collecting data for analysing the relationship between environmental collaboration and firm performance, a semi-structured interview might be more suitable. It allows collecting material in a somewhat systematic and comprehensive way (Eriksson & Kovalainen 2008, 82) but still gives flexibility to focus on unique characteristics of each case. Usually the items included in the interview protocol have some theoretical underpinning. When collecting data for analysing the suggested framework of environmental collaboration and firm performance, such items could be internal and external drivers of environmental collaboration or benefits associated with environmental collaboration, covering all three dimensions of firm performance presented in the framework.

In addition to data produced for the research in question, there already exists empirical data that can be used for research purposes, such as documents and media texts (Eriksson & Kovalainen 2008, 126). For the purposes of this research for example environmental policy documents and sustainability reports might provide valuable information on environmental collaboration and environmental performance. Tate, Ellram and Kirchoff (2010, 21) state that the comparability of statements in CSR reports with the actual commitment is somewhat questionable. They performed content analysis on CSR reports and found ten recurrent themes, one of which related to supply chain. It included items such as suppliers, materials, inputs, manufacturing, development, and sourcing. Hence, it might be possible to evaluate e.g. environmental collaboration with suppliers based on CSR reports. Preuss (2005, 137-138) found an inconsistency between environmental policy documents and reality of corporate greening. Although the documents promised a proactive approach to the environment involving also the supply chain, in reality these activities were generally undertaken by large companies within industries that are already under public scrutiny over their environmental performance. Therefore it might be interesting to compare the rhetoric used in environmental policy reports regarding environmental collaboration and the actual degree of collaboration.

In order to ensure the reliability of the information in the case study, a chain of evidence must be maintained. The chain of evidence enables an external observer to follow the derivation of evidence, ranging from research questions to ultimate conclusions. Therefore a case study protocol needs to be developed. The protocol includes the data collection instrument as well as procedures and general rules to be followed. The protocol is essential when doing a multiple case study. In addition to case study questions, an overview of the project, and guidelines for field procedures and reporting should be included in the protocol. In order to strengthen validity, the results of the case studies should be compared with the expected results drawn from theory. Moreover, replication

logic should be applied, meaning choosing cases that are supposed to yield similar results or contrasting results but for predictable reasons. (Yin 2003, 46, 69, 105, 116.) All these procedures should also be applied to research on environmental collaboration and firm performance to ensure the quality of findings. Since this connection has mainly been analysed through quantitative methods, the case study method has a potential of providing new insights and even extending the theory.

The last section of this chapter summarises the literature review of this thesis into a research framework and proposes hypotheses to test it.

5.5 Research framework for the connection between environmental collaboration and firm performance

Based on the literature review, a research framework for the connection between environmental collaboration and firm performance was built (Figure 8). It illustrates potential connections between environmental collaboration and different dimensions of firm performance.

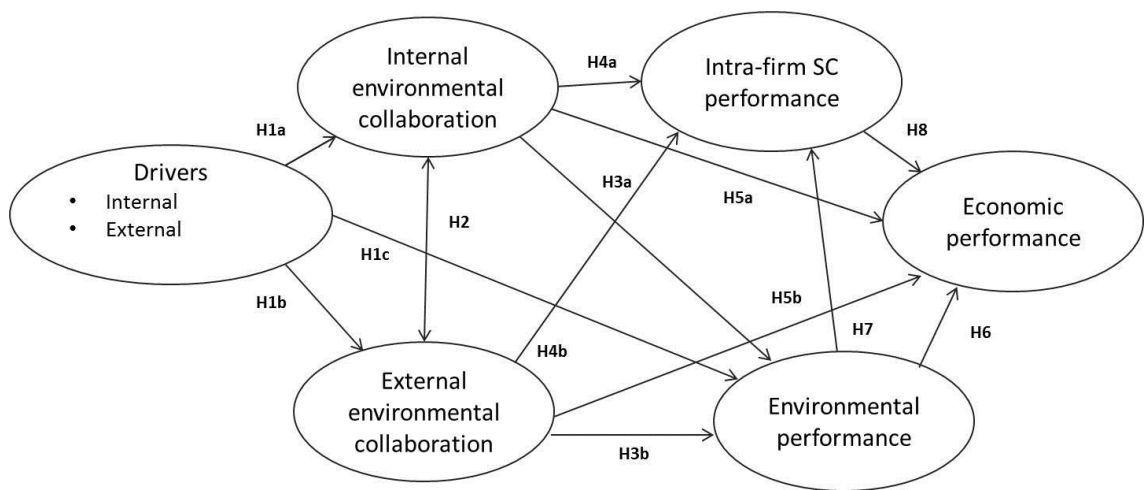


Figure 8 Research framework and connections between the constructs

As can be seen, environmental collaboration is divided into internal and external environmental collaboration due to their different nature (e.g. De Giovanni & Esposito-Vinzi 2012, 908). Vachon and Klassen (2008) studied only external collaboration and had separate constructs for upstream and downstream collaboration. However, for example Zhu and Sarkis (2004), De Giovanni and Esposito Vinzi (2012), Zhu, Sarkis and Lai (2013) have combined upstream and downstream collaboration into one construct. Thus, also this study has a single component for external environmental collaboration. Firm performance is here divided into three constructs discussed in Chapter 4, i.e. eco-

conomic performance, intra-firm supply chain performance, and environmental performance.

The rest of this chapter discusses the connections between the constructs presented in the framework and their directions. A number of hypotheses were created to test the proposed framework, and they are summarised in Table 7. These hypotheses are also referred to in the illustration of the research framework (Figure 8).

Table 7 Summary of hypotheses proposed in the framework

Hypothesis	Previous literature
H1a: Internal and external drivers affect internal environmental collaboration. H1b: Internal and external drivers affect external environmental collaboration H1c: Internal and external drivers affect environmental performance	e.g. Walker et al. (2008); Zhu & Sarkis (2007)
H2: Internal and external environmental collaboration are positively related.	e.g. Stank et al. (2001)
H3a: Internal environmental collaboration is positively related to environmental performance. H3b: External environmental collaboration is positively related to environmental performance.	e.g. Zhu & Sarkis (2004); De Giovanni & Esposito Vinzi (2012)
H4a: Internal environmental collaboration is positively related to intra-firm supply chain performance. H4b: External environmental collaboration is positively related to intra-firm supply chain performance.	e.g. Vachon & Klassen (2008); Zhu et al. (2013)
H5a: Internal environmental collaboration is positively related to economic performance. H5b: External environmental collaboration is positively related to economic performance.	e.g. De Giovanni & Esposito Vinzi (2012), Zhu et al. (2013)
H6: Environmental performance is positively related to economic performance.	e.g. Klassen & McLaughlin (1996); Russo & Fouts (1997); King & Lenox (2001)
H7: Environmental performance is positively related to intra-firm supply chain performance.	e.g. Vachon & Klassen (2008); Zhu et al (2013)
H8: Intra-firm supply chain performance is positively related to economic performance.	Töyli et al. (2008)

Walker et al. (2008, 70) grouped drivers of GSCM into internal and external. It is worth noting that the term ‘drivers’ in Figure 8 also refers specifically to the drivers of environmental initiatives. Internal drivers are organisational factors, such as personal and ethical values of the management and investors. Moreover, many environmental

initiatives also aim at cost reduction through minimizing waste and pollution. It might also be possible that the collaboration with suppliers and customers has already been initiated for other purposes, such as demand planning (Holweg et al. 2005, 175). Therefore, existing collaboration in other SCM fields could be one driver for environmental collaboration.

External drivers include regulatory, customers, competition, society, and suppliers (Walker et al. 2008, 71). This is in keeping with Zhu and Sarkis (2007, 4352) who argue that market, regulatory and competitive forces influence organisations to have better environmental performance. One approach to achieve this is to collaborate, since according to the relational view organisational capabilities can be developed together with supply chain members (Dyer & Singh 1998, 675; Vachon & Klassen 2008, 300). Therefore the arrows in the framework are from the drivers to internal and external environmental collaboration and directly to environmental performance. It is rather natural to expect joint environmental initiatives to reduce environmental impacts of the firm's operations, thus a positive impact on environmental performance is expected. Moreover, for example the results of Stank, Keller and Daugherty (2001, 39) show that internal and external supply chain collaboration are positively linked, thus the same linkage is expected for environmental collaboration as well.

Internal and external collaboration are hypothesized to have a connection also with intra-firm supply chain performance and economic performance. The direction of effect between environmental collaboration or environmental performance and intra-firm supply chain performance cannot be predicted very easily, as research in the topic is virtually non-existent. On the one hand, a positive impact could be expected due to e.g. cost savings related to increasing efficiency in transportation (Wu & Dunn 1995, 26). In addition, Vachon and Klassen (2008, 306) found a positive relationship between collaboration with suppliers and delivery performance in regard to e.g. on-time deliveries. On the other hand, for example customer delivery times might increase as slower transport modes and fewer shipments would be preferred (Wu & Dunn 1995, 26).

Recently Zhu et al. (2013, 8-11) used path analysis to evaluate performance outcomes of internal and external GSCM practices and institutional drivers of such practices. They also studied the impact on operational performance that contained items of increased amount of goods delivered on time, decreased inventory levels and scrap rates, improved product quality, increased product line and improved capacity utilization. Results support the positive connection between GSCM practices and operational performance. Although operational performance is not operationalized using items of intra-firm supply chain performance (logistics costs, service performance, and asset utilization), the results of Zhu et al. (2013) suggest that environmental collaboration might have a positive impact on intra-firm supply chain performance. Thus a positive relationship is expected in this framework as well.

As stated earlier, there are differing views, whether environmental performance and environmental collaboration actually have a positive impact on economic performance. Research by De Giovanni and Esposito Vinzi (2012) suggests that both internal and external environmental collaboration would have a positive impact on economic performance. Although they did not find support for the connection between environmental performance and economic performance, most other authors suggest such a relationship (e.g. Klassen & McLaughlin 1996; Russo & Fouts 1997; King & Lenox 2001).

With regard to intra-firm supply chain performance, Töyli et al. (2008, 73) assert that its relationship to economic performance has not been studied thoroughly. They did not find a statistically significant relationship between logistics performance and financial performance, but concluded that intuitively e.g. lower logistics costs and shorter cash-to-cash cycles could be expected to improve economic performance. The same logic is followed in the framework, hence the positive relationship between intra-firm supply chain performance and economic performance.

This chapter concentrated on presenting a potential approaches to analyse the connection between environmental collaboration and firm performance. In order to summarise the key constructs and their relationships, a research framework was built together with hypotheses to test the proposed framework. Naturally there are also other approaches than the presented mixed method approach consisting here of survey research and multiple case studies. Finland State of Logistics 2012 survey data was used as an example of potential survey data (Appendix 1). Moreover, the advantages and disadvantages of survey and case methods were discussed. The actual analysis of the relationships suggested in framework is beyond the scope of this study. Therefore, besides summarising this thesis, the next chapter also discusses steps that could be taken in future research.

6 CONCLUSIONS AND FURTHER RESEARCH

6.1 Conclusions

This thesis aimed at developing a research framework for the connection between environmental collaboration in the supply chain and firm performance. Environmental collaboration is one approach of green supply chain management, emphasizing joint planning between suppliers and customers to reduce the environmental impact from production processes and products (Vachon & Klassen 2008, 301). Resulting from the focus on collaborative initiatives, monitoring and control oriented approaches usually included in green supply chain management were excluded. As presented in Chapter 2, collaboration is expected to bring several benefits for the alliance partners, such as improved efficiency and effectiveness, which in an optimum situation ultimately lead to sustained competitive advantage. However, in order to realize these benefits, the partnering organisations need to integrate their supply chain processes, share information effectively, synchronize their decision-making, align their incentives, and implement joint performance metrics (Simatupang & Sridharan 2005a, 261).

Chapter 3 introduced institutional theory and resource-based view, both two major theories applied in environmental management research. Two extension of resource-based view are particularly useful when conducting research on environmental collaboration. The natural resource based view (NRBV) suggests that sustained competitive advantage can be built upon resources related to environmental management (Hart 1995, 988-991), while the relational view proposes that organisational capabilities can be developed by combining resources of different supply chain members (Dyer & Singh 1998, 675; Vachon & Klassen 2008, 300). In this thesis environmental collaboration was divided into internal (i.e. within the firm) and external (outside the firm) collaboration. According to Shi et al. (2012, 57) internal environmental practices are causally ambiguous resources, whereas external environmental practices are socially complex resources, both being prerequisites for sustained competitive advantage. The previous literature therefore would seem to suggest that environmental collaboration has a positive impact on firm performance.

Nevertheless, firm performance is a multifaceted concept that seems to be surprisingly difficult to define although it is widely used. Here firm performance is defined to consist of three constructs; economic performance, intra-firm supply chain performance and environmental performance. The first of these, economic performance is easy to define and measure, and is therefore widely used to operationalize firm performance. Intra-firm supply chain performance, or alternatively logistics performance, is a newer concept and less used to operationalize firm performance. It consists of logistics costs,

service performance, and asset utilisation (Lorentz et al. 2012, 613). The rise of the balanced scorecard approach (e.g. Kaplan & Norton 1992), has promoted the use of non-financial performance metrics. Due to increasing interest in environmental issues, environmental performance is monitored more and more often. According to a broader definition, environmental performance is not only the negative impacts on natural environment but also the organisation's efforts to influence those (Shaw et al. 2010, 326). All these constructs are included in the framework developed in this thesis and presented in Chapter 5.5. In summary, both internal and external collaboration are expected to positively impact on all three dimensions of firm performance. Moreover, the environmental performance and intra-firm performance are expected to contribute positively to economic performance. Thus, firms are suggested to benefit from environmental collaboration both within the firm, and with suppliers and customers.

However, the causality of the concepts was discussed in Chapter 5.4.1. For example De Giovanni and Esposito Vinzi (2012, 912) argue that environmental and economic performance are actually formative rather than reflective constructs. This view suggests that variables used to measure the construct, in this case economic, intra-firm supply chain, and environmental performance, are causing the constructs, and not vice versa. Hence, for example items used to measure logistics costs, service performance, and asset utilisation are causing intra-firm supply chain performance. This contrasts the traditional reflective view in which e.g. good intra-firm supply chain performance would be a latent construct causing lower logistics costs, and good service performance and asset utilisation. If formative measurement theory was used, it would imply the use of alternative analysis methods, such as discarding traditional covariance-based structural equation modelling (Petter et al. 2007, 643).

In Chapter 5, a two-phase follow-up explanation model was suggested to analyse the framework. It is a mixed methods research approach, starting from the collection and analysis of quantitative data, followed by the subsequent collection and analysis of qualitative data to explain and expand on the results of the quantitative phase. This thesis used Finland State of Logistics 2012 survey as an example of data that could be used for the quantitative phase. The fact that the data is collected for another purpose than studying the framework presented in this thesis presents a challenge for the validity of the analysis. Furthermore, the data does not contain information on environmental performance or the drivers of environmental collaboration. In order to overcome this problem, a follow-up survey is needed. Moreover, the method triangulation of the suggested mixed methods approach increases validity. Therefore, the qualitative part was suggested to be conducted through multiple case studies. The characteristics as well as advantages and disadvantages of survey research and case study research were discussed at a general level and with regard to analysing the suggested research framework on environmental collaboration and firm performance. Both survey studies and multiple

case studies are appropriate for theory testing purposes (Voss et al. 2002, 198), which is the next step after the development of the research framework.

Mixed methods research enables combining quantitative and qualitative data in order to form a more complete picture of the phenomenon than either approach alone (Creswell & Plano Clark 2007, 7). As explained in Chapter 5 survey methods lack the ability to understand the context of the phenomenon. Case study methods, on the other hand, can be biased by the researcher's perceptions of the topic, and the results are difficult to generalize. Combining these two methods offsets the weaknesses related to each approach. 'Why' and 'how' type of questions, being the strength of case study method, can be used to explain and expand findings of the survey research, such as statistical differences among groups. With regard to this study, these differences might exist e.g. among different company sizes. Therefore, choosing case companies of different sizes might reveal insights why these differences exist. In the case of environmental issues, it might also be fruitful to know how the case companies think these differences could be reduced. This, in turn, could be an important piece of information for the managers as well as policy makers. If the empirical results confirm the framework, managers would also benefit from understanding how they can improve their firm performance through environmental collaboration.

6.2 Opportunities for future research

Further research is needed to develop the research framework and the methods to confirm the connection between environmental collaboration and firm performance. Although the connection between environmental management and performance has been studied rather extensively in recent years, much research has focused solely on the economic aspect of performance. The connection between intra-firm supply chain performance and environmental practices has received scarce theoretical and empirical scrutiny. Moreover, the focus on more collaborative type environmental practices with supply chain partners has only recently received some attention. Since the main aim of this study was to develop a research framework for the connection between environmental collaboration and firm performance, the actual theory testing remains to be done. Finland State of Logistics 2012 survey data can be used for testing some relationships proposed in the framework but additional data collection and analysis are needed to test the entire framework.

Since this thesis has focused on manufacturing and trading companies, it might be worthwhile to investigate the connection between environmental collaboration and firm performance in service industry. One target group of Finland State of Logistics 2012 survey was logistics service providers who also responded to the same set of questions

regarding environmental collaboration (Appendix 2). Intra-firm supply chain performance as operationalized in this thesis cannot be used to measure the performance of logistics service providers but another operationalization of performance is needed.

As this study focused on the connection between environmental collaboration and firm performance, the drivers to green supply chain management practices received substantially less attention. Regulation has frequently been mentioned as the most important driver of environmental initiatives. Since environmental collaboration requires long-term commitment and a significant number of resources, it would intuitively make sense if its drivers are other than regulatory, such as seeking competitive advantage through development of environmental capabilities. Therefore identifying the drivers of environmental collaboration would be another interesting future research direction.

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APPENDICES

Appendix 1: An example of potential survey data: Finland State of Logistics 2012

This appendix discusses potential approaches to analyse the survey data of Finland State of Logistics 2012 collected by Solakivi et al. (2012) to test the hypotheses based on the research framework. The data was collected as an online questionnaire in January and February 2012. The target groups of the survey were manufacturing (incl. construction) companies, trading companies, and logistics service providers operating in Finland, as well as consultants and teaching and research staff specialised in logistics industry. The term main industry is used here to refer to these target groups. The data was collected with reference to TOL 2008 industry classification.

The invitation to participate in the survey was sent to 38 834 people and as can be seen in Table 8, in total 2 732 respondents answered to the survey, resulting in a response rate of 7 %. Of the respondents, 32 % (875) represented manufacturing and construction, 28.3 % (773) trading, 25 % (684) logistics service providers, 4.4 % (121) consulting services, and 10.2 % (279) educational services.

Table 8 Respondent companies by main sector of industry and size

Company size	Manufacturing and construction	Trading	Logistics service providers	Consulting	Teaching and research	N
Micro	648	576	474	94		1792
Small	116	128	108	10		362
Medium	52	36	41	8		137
Large	59	33	61	9		162
Size not asked					279	279
Total	875	773	684	121	279	2732

The division of companies by size reflects the European Commission's definition of the size of micro-companies and small and medium-sized companies in terms of their turnover, as is following:

- Large companies: over EUR 50 million
- Medium-sized companies EUR 10 - 50 million
- Small companies: EUR 2 - 10 million
- Micro-companies: EUR 0 - 2 million

Environmental collaboration was addressed in Finland State of Logistics 2012 survey in three sets of questions regarding internal collaboration, collaboration with key suppliers, and collaboration with key customers. The questions regarding collaboration with suppliers and customers were similar to those of Vachon and Klassen (2008),

while questions regarding internal collaboration were formulated by the research group as Vachon and Klassen (2008) did not study internal aspect of collaboration. (Appendix 2) Of the other constructs of the theoretical framework, Finland State of Logistics 2012 data covers all three dimensions of intra-firm supply chain performance (Appendix 2), therefore enabling the analysis of the hypothesized positive impact of environmental collaboration. Moreover, respondents were asked to give the name of the company they were representing. Therefore, it is possible to combine the responses of unique responses with publicly available financial-reporting-based data, such as metrics of profitability (e.g. ROA, ROCE).

On the other hand, the survey data does neither contain any items regarding the drivers of environmental collaboration nor environmental performance. Although the respondents were asked to assess environmental collaboration in three sets of questions, they were not asked to give any the reasons for collaboration. It is possible to find connections between background variables which might affect the degree of collaboration but if the study would also aim at explaining why the firms collaborate, other research methods and new data collection would be needed. The impact of previous supply chain collaboration can be studied by forming a panel data of Finland State of Logistics surveys 2012 and 2010. Finland State of Logistics 2010 questionnaire had two sets of questions on collaboration within the firm and with suppliers and customers, respectively. Panel data would consist of firms that have responded to both surveys. Thus it is possible to analyse whether supply chain collaboration and environmental collaboration correlate with each other. A positive correlation could imply that environmental collaboration would be an extension of more traditional type of collaboration in the supply chain. However, other drivers, such as ethical values of the management and investors, and regulatory and competitive drivers remain uncovered as does the actual environmental performance

Furthermore, Finland State of Logistics 2012 survey covers also a number of other themes in addition to environmental collaboration. The fact that the data is not originally collected specifically for studying environmental collaboration limits its use for other research purposes. Construct validity is essential for theory testing, and refers to whether the instrument is actually measuring what is it supposed to (Malhotra & Grover 1998, 413). Empirical assessment of construct validity focuses on convergence between measures of the same construct and separation between measures of different constructs (Forza 2002, 178). Tests for convergence across measurement items for the same construct and tests for separation across measurement items of different constructs should also be performed with Finland State of Logistics survey data. Tests for convergence can be performed with factor analysis (Flynn et al. 1990, 267). Test for separation can also be performed through confirmatory factor analysis in which the number of factors and list of factors should be specified a priori (Forza 2002, 178).

Finland State of Logistics 2012 survey data forms a large sample. By far the largest group of respondents represents micro-sized companies but a sufficient number of larger firms have also responded, if measured in terms of industry turnovers. However, the survey is only conducted in a single country, Finland, which can reduce the generalizability of findings. The survey questionnaire had mostly multi-item questions, which enables forming multi-item variables as well. The reliability of such variables can be tested by e.g. Cronbach's alpha. (Malhotra & Grover 1998, 412.) Many scales are developed based on previous research, such as Vachon and Klassen (2008) in regards to environmental collaboration and Töyli et al. (2008) for intra-firm supply chain performance, thereby increasing content validity.

Appendix 2: Excerpt from the Finland State of Logistics 2012 questionnaire

T15. Please estimate the following logistics costs of your firm expressed as percentages of firm turnover:

- a) Transportation and cargo handling (incl. transport packing) costs
- b) Warehousing costs
- c) Inventory carrying costs
- d) Logistics administration costs
- e) Other logistics costs

Q15 for manufacturing, Q14 for trading

T17. Please estimate your firm's logistics performance in terms of the following key figures in 2011:

- a) How many % of your customer orders are delivered on time, at the right place, with correct documentation, in right quantity, and without damage?
- b) How many days is your customer order fulfillment cycle time (order-delivery)?
- c) What is the average number of your firm's days of sales outstanding?
- d) What is the average number of your firm's inventory days of supply?
- e) How many % of the orders you received were delivered complete in the right place and time ?
- f) How many days was your supplier's order fulfillment cycle time (order-delivery)?
- g) What is the average number of your firm's days of payables outstanding?
- h) How many suppliers have you used in the last 12 months?

Q17 for manufacturing, Q16 for trading

T24. Please assess the following statements regarding environmental collaboration within your company in the last two years: 1) totally disagree, 2) partly disagree, 3) not agree or disagree, 4) partly agree, 5) totally agree)

- a) We have set environmental goals to ourselves
- b) There is a mutual understanding of responsibilities regarding environmental performance
- c) We have worked together to reduce environmental impact of our activities
- d) We have conducted joint planning to anticipate and solve environmental-related problems
- e) We have worked together to reduce environmental impact of our products

Q24 for manufacturing, Q21 for trading, Q22 for logistics service providers

T25. Please assess the following statements regarding environmental collaboration with your key suppliers in the last two years: 1) totally disagree, 2) partly disagree, 3) not agree or disagree, 4) partly agree, 5) totally agree)

- a) We have goals to achieve environmental goals collectively with our key suppliers
- b) There is a mutual understanding of responsibilities regarding environmental performance
- c) We have worked together to reduce environmental impact of our activities
- d) We have conducted joint planning to anticipate and solve environmental-related problems
- e) We have worked together to reduce environmental impact of our products

Q25 for manufacturing, Q22 for trading, Q23 for logistics service providers

T26. Please assess the following statements regarding environmental collaboration with your key customers in the last two years: 1) totally disagree, 2) partly disagree, 3) not agree or disagree, 4) partly agree, 5) totally agree)

- a) We have goals to achieve environmental goals collectively with our key customers
- b) There is a mutual understanding of responsibilities regarding environmental performance
- c) We have worked together to reduce environmental impact of our activities
- d) We have conducted joint planning to anticipate and solve environmental-related problems
- e) We have worked together to reduce environmental impact of our products

Q26 for manufacturing, Q23 for trading, Q24 for logistics service providers