ENVIRONMENTAL INNOVATION IN CHAINS AND NETWORKS

ASSESSING DETERMINANTS AND PERFORMANCE IMPLICATIONS IN DUTCH FOOD AND BEVERAGE FIRMS

KATJA GREKOVA

Thesis committee

Promoter

Prof. Dr S.W.F. Omta
Professor of Management Studies
Wageningen University

Co-promoters

Dr H.J. Bremmers
Associate professor, Law and Governance Group
Wageningen University

Prof. Dr J.H. Trienekens
Personal professor at the Management Studies Group
Wageningen University

Other members

Prof. Dr J. Bloemhof-Ruwaard, Wageningen University
Dr C.S.A. van Koppen, Wageningen University
Prof. Dr W.J.M Heijman, Wageningen University
Prof. Dr S. Bröring, University of Bonn, Germany

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KATJA GREKOVA

Thesis

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CHAPTER ONE

INTRODUCTION

1.1. Introduction

Dynamic economic activity of the growing world population is increasingly leading to environmental degradation. A wide range of interconnected environmental issues ranges from resource depletion, waste and pollution to ozone layer depletion and the climate change. The challenge of meeting the needs of the present generation without compromising the right of the future generations to satisfy their needs is formulated as a sustainability challenge (WCED, 1987). Societal concern regarding environmental sustainability of production and distribution stimulates the development of public environmental policy to constrain the environmental impact of economic activities. The policy intends that the cost of environmental degradation caused by economic activity are internalized by the industry so that society does not have to carry them. The social responsibility of business nowadays is not only to increase profit (Friedman, 1973). To remain competitive and keep the "license to operate", the industry has to strive also for environmental targets (Gunningham et al., 2004).

Most companies have already made their first steps towards greening the operations. However, this is a long and challenging path. Stepping on this path and moving forward is not a matter of choice any more. A lot of issues and questions arise around the ways firms deal with environmental sustainability. In particular, how to leverage knowledge and resources for in-house environmental innovation? What are the implications of this innovation for corporate profitability? Should firms consider not only in-house environmental impact but also the impact of inputs and outputs throughout the supply chain? What factors accelerate environmental management (EM) beyond organisational boundaries? In terms of corporate profitability and internal operations, to what leads the involvement of supply chain into EM?

Answering these questions is essential for future progress in environmental and economic sustainability. Environmental sustainability of business is not an independent issue any more as academics, practitioners, and policy makers become more aware of the implications of environmental sustainability for corporate profitability (they are outlined in detail in Sections 1.2 and 1.3). When environmental and economic issues are so interconnected, reduction of environmental impact becomes an important aspect of corporate strategy. This draws managerial attention to the development of organizational capabilities for an effective EM.

The challenge of environmental sustainability was formulated relatively recently. Therefore, the understanding of its impact on the firm performance is still evolving. Although originally the internalization of environmental costs was perceived as contradictory to profit maximization targets, from the middle of 1990-s firms increasingly report opportunities to derive economic benefits from their efforts to reduce environmental impact (Carter and Rogers, 2008; Christmann, 2000; Hart, 1995; Klassen and McLaughlin, 1996; Porter and Van der Linde, 1995). For instance, search for cleaner energy sources and opportunities to decrease energy usage resulted in technologies with cost saving potential. This potential can be realized through reduced costs of inputs and reduced dependency on the inputs prices fluctuations. Efforts in waste reuse or recycling can be reimbursed through material and energy recovery, lower purchasing and waste disposal cost. An opportunity to harvest return on environmental investments can also stem from their appeal to environmentally conscious consumers (Dangelico and Pontrandolfo, 2013; Molina-Azorín et al., 2009a). However, firms' opportunities to gain a market share or a price premium from the efforts to reduce environmental impact vary per country, product, etc. (Carlsson et al., 2012; Thøgersen, 2010).

Urged to bridge economic interests of primary commercial stakeholders and environmental sustainability demands from non-commercial stakeholder groups, firms are increasingly integrating environmental concerns into their operations and into the relationships with external partners (Gold et al., 2010; Grekova et al., 2013). As business is gaining experience in in-house environmental innovations, the focus is shifting towards the integration of environmental concerns into supply chain and network relationships (Pagell and Wu, 2009; Sarkis et al., 2011). Efforts in the reduction of environmental impact span organizational boundaries as firms approach external actors to reduce environmental impact throughout the product's lifecycle, to leverage each other's resources, and to exploit learning and knowledge sharing opportunities. EM that involves external partners has a promising potential to induce sustainable growth in the industry as recent studies increasingly connect it not only to improved environmental but also economic performance (Gimenez and Tachizawa, 2012). Therefore, the current research agenda focuses on internal organizational capabilities and on external factors (such as the roles of public policies, consumer demand, and other stakeholder pressures) that support the development of supply chain-oriented EM as well as on its implications for firm performance (Beske, 2012). Having access to knowledge and resources of the partners in the supply chain and network does not imply that the firm can appropriate (i.e. capture) corresponding benefits (Cao and Zhang, 2010; Lavie, 2006) and tap external knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002) to enhance environmental sustainability of in-house operations. In this context, current literature is oriented towards the investigation of the roles of external partners, external knowledge exploitation, and capabilities to tap external knowledge for technological environmental innovation. Figure 1.2 graphically summarizes the above mentioned relationships that construct the research agenda. Taking these considerations into account, the present dissertation aims:

Figure 1.1. Research aim.

1. To analyse how firms address the challenge of obtaining environmental sustainability through environmental innovation and supply chain-oriented environmental management (EM);
2. To get insight in the performance implications of these EM practices.

Therefore, the main **objective** of this dissertation is:

- ***To investigate determinants of environmental innovation and of supply chain-oriented EM and their impact on firm performance.***

These two themes are interrelated. Supply chain-oriented EM can be used as a source of external knowledge that is expected to spur environmental innovation. Figure 1.2 provides a general overview of addressed concepts and the relationships between them. From the figure, it can be seen that we adopt primarily the resource based-view (RBV) (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984) and its spin-offs (Dyer and Singh, 1998; Hart, 1995; Lavie, 2006) to provide insights into organizational capabilities for in-house environmental innovation and supply chain-oriented EM as well as to address the interrelationships between them and their performance implications.

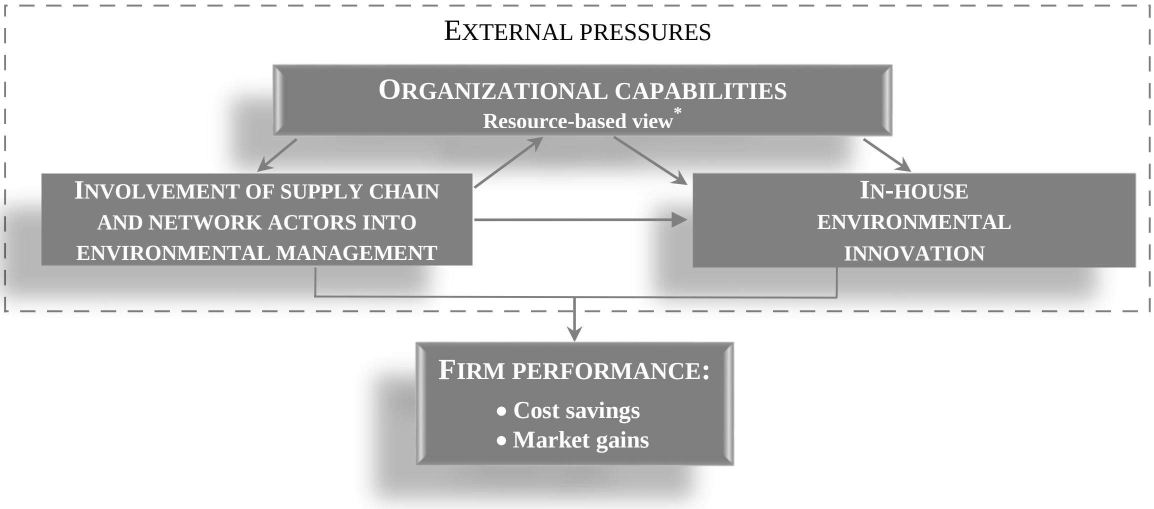

Figure 1.2. Overall framework of the dissertation.
Note: * Resource based view (RBV) including its spin-offs (Natural RBV, relational view, extended RBV)

The findings of this dissertation can serve as input for decision makers on the industry and policy levels. Knowledge about organizational capabilities required to support environmental innovation and supply chain-oriented EM can be used by managers to successfully implement these practices. Understanding the mechanisms behind environmental innovation and supply chain-oriented EM can provide insights into more efficient management of innovation and relationships with external actors. The findings of this dissertation can assist managers in their decision making regarding economic efficiency of investments in environmental innovation and in EM in supply chains. Understanding the impact of existing external pressures (including various policy instruments) on the firms' environmental behaviour can assist policy makers in the assessment of the effectiveness of current environmental policy and in the design of future policy directions aiming to stimulate sustainable industry growth. From an academic standpoint, our study provides a contribution to environmental innovation and EM literature by conducting an in-depth investigation of external pressures and internal organizational capabilities required for the development of in-house environmental innovation and supply chain-oriented EM as well as by exploring their impact on business performance.

The approach to address the challenge of environmental sustainability depends on the industry. Industries differ with respect to R&D capabilities, the level of pollution and associated with it external pressures, opportunities to modify processes as well as available inputs to reduce the environmental impact. *The present dissertation focuses on environmental innovation and supply chain-oriented EM as means of promoting sustainable industry growth,* ***using the Dutch food and beverage (F&B) processing industry as a subject of the study***.

The food industry is the largest EU manufacturing sector in terms of turnover, one of the leading sectors in terms of employment and share in household expenditures. The Dutch food industry is one of the leading industries not only in the EU, but also in the world. The Netherlands is the world's second largest exporter of agricultural products (7.5% of the world export, broad definition) (Hart et al., 2011). Four of the top 25 world F&B companies are Dutch. Given the industry size and the operations intensity in the context of the densely populated country, it is not surprising that food firms are responsible for a significant environmental impact in the Netherlands (Statistics Netherlands, 2012). The Netherlands falls in the top 10 of the world countries with the highest ecological foot-print per capita (WWF et al., 2012). Therefore, environmental sustainability of food production and distribution attracts a lot of attention from public authorities, consumers, and other stakeholders. Consumers' preference for food products and production include not only low environmental impact but also affordable prices. Dutch consumers enjoy one of the lowest food prices in Western Europe due to intensive supply chain cooperation for efficiency and increasing up-scaling (ING, 2012). While staying economically efficient, the Dutch food processing industry has been progressively reducing its environmental impact during the last decade through the use of efficient and sustainable production systems and processes to reduce environmental impact in an efficient manner.

During the last years an increasing number of chain initiatives to improve efficiency and environmental sustainability is reported in the Dutch F&B industry (Ministry of Economic Affairs, 2011). For instance, Dutch-based multinational Unilever works with their tomato suppliers to reduce the water usage in the chain by introducing drip irrigation. Coffee processor Douwe Egberts cooperates with technology suppliers to develop energy saving coffee machines and advices customers on the usage of these coffee machines to save energy. Meat processor VION provides farmers with information regarding technical characteristics of the slaughtered animals via a web-based information system (farmingnet) so that farmers can adjust to the optimal level of feeding and reduce inputs. Also public environmental policy is increasingly shifting focus from individual enterprises towards the supply chain (Vermeulen and Kok, 2012). For example, long-run public-private agreements on the reduction of environmental impact nowadays address supply chain level (e.g. Energy covenant MJA3). Taking into account above mentioned arguments, the food processing industry in the Netherlands can provide rich insights into how an industry can successfully address the environmental sustainability challenge.

1.2. Management of environmental innovation

Environmental innovation is defined by OECD (2010) as "*the implementation of new, or significantly improved, products (goods and services), processes, marketing methods, organizational structures and institutional arrangements which, with or without intent, lead to environmental improvements compared to relevant alternatives*". From this definition it follows that environmental innovation can take many forms: product, process, marketing, organizational, and institutional. The focus of practitioners and researchers is on technological environmental innovation that enables modifications of processes and products associated with the reduction of environmental impact (Frondel et al., 2007). In practice, environmental process and product innovations are interconnected (Utterback and Abernathy, 1975): environmental modifications in the product might require process changes and the process changes might bring about products with lower environmental footprint. As the distinction between environmental process and product innovation in industrial practice is not always clear, environmental literature is increasingly referring to environmental innovation as a whole (Bönte and Dienes, 2013) under the umbrella of technological environmental innovation. Technological environmental innovation (referred to as "environmental innovation" in this thesis) is also labelled as green innovation, eco innovation, or sustainable innovation. All these terms can be used interchangeably, except for sustainable innovation that also includes economic and social aspects (Schiederig et al., 2012).

Firms that engage into environmental innovation face challenges similar to those of the other innovators: risks of market failure, technology protection and knowledge spillovers associated with the regimes of appropriability, knowledge transfer within and beyond organizational boundaries, etc. *Environmental innovation also possesses distinctive features that set it apart from other innovation.* Other innovation generates knowledge spillovers at the stage of invention and market introduction.

These losses can be compensated by first mover advantages and intellectual property rights (IPR) protection instruments (e.g. patents) (Beise and Rennings, 2005). Unlike other innovations, environmental innovations generate knowledge spillovers also during the diffusion phase (Rennings, 2000). Environmental innovations not only internalize environmental costs but also cause less external costs compared to competing alternatives. Benefits created by environmental innovation at the cost of individual firms are appropriated by the society. This characteristic of environmental innovation is labelled as *"double externality"* (Rennings, 2000). Double externality increases the reluctance of the managers to invest in environmental innovation. Because the double externality problem makes technology development and market demand not sufficient to induce environmental innovation, the imposition of environmental regulation is essential to stimulate environmental innovation. In this way, the double externality problem brings about another peculiarity of environmental innovation: the necessity of *regulatory push/pull* to promote it (Rennings, 2000). An in-depth investigation into the determinants and business performance implications of environmental innovation began with Porter's hypothesis: properly designed environmental regulation can stimulate environmental innovation that in turn induces cost savings (Porter and Van der Linde, 1995). The role of regulation in environmental innovation is not clear-cut: although environmental regulation induces technological changes, it provides firms with little incentives to innovate beyond compliance. Therefore, the investigation of external determinants of environmental innovation as a form of proactive EM is increasingly considering the roles and pressures of a wider range of external actors.

Measures to reduce environmental impact might stem from the need to maintain the competitive position and keep the "license-to-operate" (Gunningham et al., 2004). External actors such as competitors, local communities, environmental organizations, supply chain partners, NGOs, etc. can be considered not only as a source of pressure but also as a source of new information and resources to reduce environmental impact. Case studies of Wu and Pagell (2011) show that sustainability leaders engage in collaboration with external actors such as NGOs, competitors, and regulators instead of considering them as opponents. Except new external knowledge, external partners are attractive due to an opportunity to access their capabilities, improve capabilities of the focal firm by learning, build synergy and access complementary technological resources (e.g. skill sharing) and through this complementarity to accelerate innovations, induce economies of scope and scale, share cost and risks, and gain market access (de Faria et al., 2010). Therefore, De Marchi (2012) suggested the third peculiarity of environmental innovation: *environmental innovation requires cooperation with external actors to much greater extent than other innovations*. This is because knowledge and skills for environmental innovation often fall outside the usual scope. Environmental innovations are "complex and systemic" so that the firms require external partners to achieve environmental sustainability of their processes and products and to ensure their environmental conformity (De Marchi, 2012). This third peculiarity of environmental innovation is widely debated in the literature (cf. Bönte and Dienes (2013), Triguero et al. (2014)). In particular, Bönte and Dienes (2013) point out that external knowledge transfer in case of environmental innovation might be not efficient due to complexity and the firm-specific character of this knowledge. Therefore, the findings regarding the roles of external actors in environmental innovation are still not clear-cut.

Access to external partners, their knowledge and resources can be an important determinant of environmental innovation. But is external knowledge able to substitute a lack of internal organizational capabilities like internal knowledge generation as suggested by findings of De Marchi (2012)? Or is there a complementarity of external knowledge sources for environmental innovation suggested by de Faria et al. (2010), Ketata et al. (2014) and del Río et al. (2013)? These questions are crucial for managers involved in environmental innovation development. The research into organizational capabilities required to support environmental innovation as well into the knowledge sources for this innovation should provide them with information for decision making.

Managers are also concerned about the existence of the business case for environmental innovation: can environmental innovation induce business performance improvements and justify investments into the development of the corresponding capabilities? In the literature, this question is formulated as *"does it pay to be green?"* (Hart and Ahuja, 1996). Multiple opportunities for cost savings are reported by researchers and practitioners (e.g. Hart (1995), Shrivastava (1995), Christmann (2000), Ambec and Lanoie (2008)). Nevertheless, it is not clear whether the cost saving potential of environmental innovation can overshadow the associated cost of this innovation development. Environmental innovation appealing to consumers' environmental consciousness can also generate other types of benefits: higher product price, market share, turnover, firm image, etc. The appropriation of these benefits can be obstructed by multiple factors. For instance, by the credence qualities (Darby and Karni, 1973). This is a disadvantage assigned to environmental process innovations (Grekova et al., 2013). Credence qualities refer to the fact that environmental innovations that improve environmental sustainability of the product might often be invisible to the customer. Otherwise, collection of additional costly and often unavailable information might be required to identify these innovations. Another example of the factors obstructing the market advantage from environmental innovation is the timing of the introduction of the innovation at the market segment (Chen et al., 2006; Nehrt, 1996). First movers were shown to be more likely to realize the market gains from environmental innovation. As the potential of environmental innovation to induce corporate profitability is still not clear, further investigation into the relationships between environmental innovation and firm performance is required.

1.3. Supply chain-oriented environmental management

Recognizing the potential of knowledge and resources available in supply chains and networks for individual firms in their quest to improve environmental sustainability of their operations, an increasing number of firms is involving their supply chain and network partners into environmental impact reduction. Although the involvement of the network is still novel (Pagell and Wu, 2009), supply chain collaboration to reduce environmental impact is becoming more common. The involvement of the supply chain in environmental impact reduction has been referred to as green (environmental) purchasing (Min and Galle, 2001), green supply chain management (GSCM) (Srivastava, 2007), sustainable supply chain management (Gold et al., 2010), externally-oriented EM (Bremmers et al., 2007), environmental collaboration (Vachon and Klassen, 2008), external EM (De Giovanni, 2012), and environmental supply chain cooperation (Zhu et al., 2010), depending on the focus of the research. These terms vary in the scope of the supply chain involved and the content of involvement. Some firms choose an arm's-length approach to influence the activities of supply chain partners. This approach is based on the collection and analysis of information about partners' environmental activities or on the evaluation of the inputs against the set of environmental requirements. Other firms opt for cooperation-based relationships with interactions and participation to reduce joint environmental impact (Hines and Johns, 2001; Lee, 2008; Vachon and Klassen, 2006). Therefore, we observe that *the boundaries of the involvement of supply chain partners into EM and terminology vary depending on the focus of the study and its problem area (Zhu et al., 2008b).* In Chapters 1 and 6, we label the involvement of the supply chain into the reduction of environmental impact as supply chain-oriented EM. In subsequent Chapters 2-4, we will use different terminology to shed the light on specific aspects of the concepts in the context of different research questions. In Chapter 2, externally-oriented EM will be used; in Chapter 3 – GSCM, in Chapter 4 – environmental collaboration.

Supply-chain oriented EM is considered as an "effective management tool and philosophy" to manage environmental impact throughout the product life cycle (Zhu et al., 2008b). As the focus of competition is increasingly shifting towards supply chains and networks (Gold et al., 2010; Hall, 2000; Zhu et al., 2008a), the involvement of the supply chain into EM becomes important to maintain also economic sustainability. To stimulate further development of environmental collaboration in the industry, managers and policy makers should be aware of internal organizational and external determinants of supply chain-oriented EM. Organizational behaviour is determined by the context (Hoffman, 2001a; Scott, 2001) and internal resources and capabilities (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). *The current research agenda concerns the roles of internal organizational capabilities and external pressures for supply chain-oriented EM*.

Investment in development of organizational capabilities to support supply chain-oriented EM should be justified. Prior research established that supply chain-oriented EM results in the improvement of environmental performance (Gimenez and Tachizawa, 2012). The question is whether these investment can be justified not only in terms of environmental but also economic sustainability. Just like environmental innovation, supply chain-oriented EM can induce cost savings and market gains (Carter et al., 2000; De Giovanni, 2012; Zhu et al., 2013). However, *supply chain-oriented EM might not automatically lead to firm performance improvements* (Green et al., 2012). Lavie (2006) distinguished three groups of factors that define the appropriation of the benefits generated through supply chain-oriented EM: actors' absorptive capacity, opportunistic behaviour, and bargaining power. In this context, actors' characteristics are important for the outcome of supply chain-oriented EM (Hall, 2000).

1.4. Theoretical perspectives

In this dissertation, we rely on different theoretical perspectives to analyse determinants and business performance implications of environmental innovation and of supply chain-oriented EM. In this section, we will outline the use of theories from the historical perspective on the industry's approach to environmental sustainability challenge.

When the challenge of environmental sustainability emerged on the industry agenda, the first measures to reduce environmental impact undertaken by firms were usually in-house measures (Hart, 1995). Two approaches to in-house environmental measures were distinguished (Sarkis and Cordeiro, 2001): pollution control (i.e. end-of-pipe) and prevention (also referred to as clean technology and source reduction (Christmann, 2000)). Pollution control measures do not assume changing the production process. Rather, installation of extra equipment or plants at the end of the process to modify emissions so that they can be handled easier (del Río González, 2005). For example, pollution can be treated with end-of-pipe measures through filters, scrubbers, treating polluting substances with other chemicals before releasing them into water, clean-up of contamination, etc. From the economic perspective, these actions are often associated with an installation of expensive pollution control equipment (Sharma and Henriques, 2005). From an environmental sustainability standpoint, end-of-pipe measures are of limited efficiency as they enable the progress in environmental impact reduction only up till a certain level. Because of arguable limited eco-efficiency of pollution control, manufacturing firms started to consider technologies that prevent waste and pollution during the production process. Pollution prevention came to the top of the industry agenda. In-house environmental innovations, like pollution prevention, required the development of specific in-house resources and capabilities. Resource-based view (RBV) and its spin-off Natural RBV described further in Section 1.4 focus on (internal) resources and capabilities required for (environmental) innovation and supply chain-oriented EM to gain a competitive advantage or to frame this advantage within the scope of social legitimacy. Further, we will discuss the foundations of these theories because in Section 1.5 our research questions will be framed within the scope of these theories.

When the opportunities of picking "low hanging fruit" (Hart and Ahuja, 1996) are exhausted, firms engage into more sophisticated environmental measures. In particular, the environmental impact of the processes and products of the individual firm depends on its inputs, machinery, distribution channels, etc. Therefore, EM of individual firms is increasingly spanning organizational boundaries (e.g. life cycle assessment (LCA), eco-design, reverse logistics) and involves supply chains and networks. The theory with the focus on internal resources and capabilities can be applied to the practices that involve the supply chain, but has some limitations like the lack of attention to the roles of external partners in the creation of competitive advantage. Therefore, the RBV's spin-offs (i.e. Natural RBV, relational view, extended RBV) that recognize this flaw in the original RBV would also serve the analysis of supply chain-oriented EM.

RESOURCE-BASED VIEW (RBV)

RBV originated as an attempt to look for factors that explain firm's performance inside the firm as opposed to the Porterian approach. RBV relies on a premise that resources and capabilities that are controlled by the firms are heterogeneous across the firms and imperfectly mobile. *In order to generate above-normal rents and provide a sustained competitive advantage, resources and capabilities must be VRIN*: (1) ***v**aluable* in order to exploit opportunities and avoid the threats, (2) ***r**are* among current and anticipated competitors, (3) difficult or impossible to ***i**mitate* and (4) ***n**on-substitutable* by the resources and capabilities that are also valuable but do not satisfy the conditions of rareness and imperfect imitability (Barney, 1991). The rents can be generated due to the differences in the revenue compared to the opportunity costs of production (quasi-rents) in combination with the rents caused by the scarcity of production factors (ricardian rents) or deliberate restriction of the output (monopoly rents) (Mahoney and Pandian, 1992; Peteraf, 1993). The RBV only considers these types of rent generated by an individual firm as a unit of analysis in accordance with the competitive paradigm (Lado et al., 1997). In this context, the rule of ownership or control of resources and capabilities by a single firm is crucial for sustained competitive advantage.

Especially in EM, the research focus is shifting for over a decade from the individual firm level towards collaboration in supply chains and networks (Reed, 2008; Sarkis et al., 2011). Although the RBV is widely used in environmental collaboration literature (Sarkis et al., 2011), *RBV's application is limited by its embeddedness in the competitive paradigm that disregards cooperation benefits*. This led to an increasing popularity of RBV spin-offs that rest on the cooperative paradigm (e.g. Vachon and Klassen (2008), Cheng and Sheu (2012)) with the premise that competitive advantage can be derived from collaboration with external actors.

Natural RBV

The Natural RBV does not explicitly address the rents created in cooperation. Nevertheless, it recognizes the benefits of cooperation for both environmental and economic sustainability. The RBV spin-off, Natural RBV of Hart (1995), does not suggest any additional sources of rent. Instead, the Natural RBV justifies the necessity to *"create competitive advantage within the broader scope of social legitimacy"*. According to the Natural RBV, framing the business within the social legitimacy scope should not risk competitive advantage but should rather induce differentiation benefits through improved corporate reputation. The Natural RBV suggests that firms follow three generic environmental strategies: pollution prevention, product stewardship, and sustainable development. The pollution prevention strategy relies on the core capability of continuous improvement (Hart and Dowell, 2010). When firms take into account the environmental impact of their inputs and outputs, environmental activities begin to span organizational boundaries towards organised cooperation with external stakeholders. This illustrates how pollution prevention evolves into product stewardship. Product stewardship relies on the core capability of stakeholder integration (Hart, 1995). Firms experienced in product stewardship are more likely to engage into the sustainable development strategy. The latter takes into account the environmental impact also in developing countries. Sustainable development relies on the core capability of shared vision and is expected to generate long-term competitive advantage by securing firm's future position. Environmental strategies are path dependent and embedded. Embeddedness refers to the fact that capabilities required by these strategies stimulate and accelerate each other. As we mentioned, Natural RBV does not introduce any new rents; it pertains to the rents suggested by RBV but frames them within the environmental sustainability scope. For example, stakeholders integration is expected to pre-empt the critical resources (Hart, 1995) associated with the ricardian rents spanning from the resource scarcity. Continuous improvement leads to cost savings by better extraction of the rent from the resources compared to competitors reflecting the essence of quasi-rents. Chapters 2 and 3 rely on the Natural RBV in the investigation of capabilities that support supply chain-oriented EM.

Relational view

The relational view (Dyer and Singh, 1998) *conceptualizes inter-firm relationships as a source of competitive advantage and of a new type of rents (relational rents) created by the dyad in collaboration*. Relational rents are derived through e.g. combining complementary and related resources and capabilities, learning, and knowledge sharing. Collaborative (joint competitive) advantage, created by partners in collaboration, has the following dimensions: innovation, quality, process efficiency, flexibility, and other business synergies (Cao and Zhang, 2012). However, the relational view considers collaboration benefits as joint for a dyad. It is not clear to what extent an individual firm can appropriate these benefits and enhance individual firm-level performance. The extended RBV addresses this gap. Through the prism of the relational view, Chapters 4 discusses the potential of supply chain-oriented EM to improve firm performance.

Extended RBV

RBV and relational view differ regarding the treatment of VRIN resource and capabilities by the firm. RBV claims the necessity to protect firm's VRIN resources and capabilities to maintain competitive advantage. Concurrently, the relational view suggests that sharing VRIN resources and capabilities can create common benefits and induce competitive advantage. Extended RBV (Lavie, 2006) resolves this paradox. Extended RBV offers the framework of competitive advantage of collaborating firm thereby addressing the shortcomings of RBV and relational view. First, it relaxes the assumption of ownership and control of VRIN resources by a single firm and replaces it with the assumption of accessibility. The firm in a dyad does not need to purchase resources or try to imitate them, because collaboration can provide the firm with the benefits generated by partners' resources without any need to possess the resources themselves. In this context, causal ambiguity and social complexity, the corner stones of imperfect imitability condition according to the RBV, are not crucial. The nature of the dyadic relationships rather than the nature of resources determines imitability. Second, *extended RBV redefines the rents of collaborating firms taking into account the problem of rent appropriation by collaborating partners*. The rent of collaborating firm includes, among others, the share of relational rent the focal firm could appropriate and (un)intended involuntary gains from (non)shared partner's resources due to bargaining power, opportunism, and absorptive capacity. In Chapter 4, we discuss the problem of appropriation of rents created in supply chain-oriented EM. Furthermore, we explore what appropriation problem implies for the outcomes of supply chain-oriented EM.

1.4.1. Central concept based on RBV: absorptive capacity

The research on absorptive capacity stems theoretically from the RBV and its spin-off – the knowledge based view (Grant, 1996b). According to the RBV, *absorptive capacity is a strategic organizational capability that can be employed to achieve sustained competitive advantage from external knowledge* (Zahra and George, 2002) as it is path-dependent, firm specific, and socially embedded (Lane et al., 2002). Absorptive capacity is a capability to "recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990). The role of absorptive capacity in the rent generation is seen as twofold. On the one hand, absorptive capacity induces ricardian rents originating from knowledge scarcity. On the other hand, absorptive capacity can lead to quasi-rents because absorptive capacity enables knowledge creation through the combination of new and existing resources and capabilities (Lane et al., 2006). Absorptive capacity has four dimensions: knowledge acquisition, assimilation, transformation, and exploitation (Zahra and George, 2002). Firms that manage four dimensions of absorptive capacity can benefit in two ways. First, acquisition and assimilation of external knowledge assists updating knowledge stock and avoiding myopia towards new external developments and breakthrough innovations (Ahuja and Lampert, 2001; Jansen et al., 2005). Second, developed transformation and exploitation enable firms to benefits from knowledge application and to achieve short-term profits. Zahra and George (2002) emphasize especially "the efficiency of creating value from external knowledge" in absorptive capacity, while Lane et al. (2006) view absorptive capacity as a mechanism to "search broadly for knowledge that can help meet its [firms] specific needs". The role of absorptive capacity in environmental innovation as a mechanism to tap external knowledge available in the networks is discussed in Chapter 5.

1.5. Thesis setup

Subsequent Chapters 2-5 present empirical studies into internal capabilities and external pressures that support environmental innovation and supply chain-oriented EM as well as their impact on firm performance. The analysis is conducted through the lenses of organizational theories discussed in the Section 1.4. Chapters 2-5 focus on different aspects of environmental innovation and supply chain-oriented EM. Figure 1.3 provides an overview of subsequent chapters.

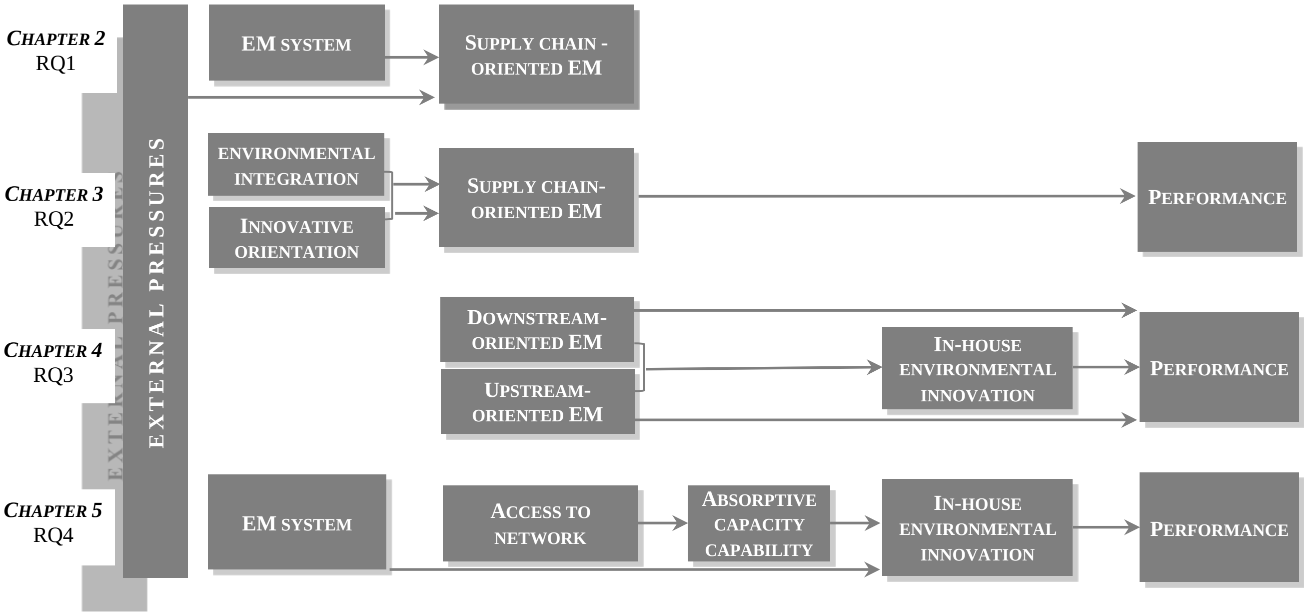

Figure 1.3. Overview of the thesis research questions and chapters.

Chapter 2 expands in a multi-period setting the understanding of the roles of internal organizational determinants and external institutional pressures in supply chain-oriented EM. Understanding the factors that influence managers to develop supply chain-oriented EM helps to design environmentally and economically sustainable food chains. We address the effects of external institutional pressures and the level of in-company EM system on the development of cooperation and information exchange in food chains to reduce joint environmental impact, i.e. supply chain-oriented EM. The development of E-EM in organizations is explained from two perspectives. The role of institutional pressures is drawn from the neo-institutional theory (DiMaggio and Powell, 1983; Hoffman, 2001a) and the role of the EM system is underpinned by the Natural RBV (Hart, 1995).

We did not come across any quantitative studies that analyse the factors that influence the implementation of supply chain-oriented EM in a multi-period setting. Carter and Rogers (2008) call for a longitudinal research to get insight into the evolution and the implementation of supply chain-oriented EM. Zhu et al. (2008a) notice that early stage of adoption and dynamic nature of supply chain-oriented EM require a longitudinal research. Within the last decade, when supply chain-oriented EM came to the research agenda, changes in environmental governance, institutional pressures, and firms' experience with EM may have affected the relative importance of the factors that influence the adoption of supply chain-oriented EM. Addressing these research gaps, Chapter 2 investigates the determinants of supply chain-oriented EM in food supply chains in a multi-period setting.

The Natural RBV (Hart, 1995) views environmental practices as path dependent from internal environmental practices towards environmental practices involving external partners such as supply chain actors. Therefore, the implementation of supply chain-oriented EM is expected to be influenced by the extent of adoption of an EM system (Darnall et al., 2008). The presence of an EM system alone might not be sufficient to progress to supply chain-oriented EM, because the EM system does not explicitly prescribe the evaluation of environmental impact of the whole supply chain. External pressures might be required to make the step from internal EM system towards supply chain-oriented EM. Prior research from the perspective of neo-institutional economics (DiMaggio and Powell, 1983; Hoffman, 2001b) identified external institutional pressures from public authorities, supply chain partners, and societal groups as one of major drivers for the adoption of supply chain-oriented EM (Bremmers et al., 2007; Walker et al., 2008; Wu et al., 2012; Zhu and Sarkis, 2007). However, little empirical research investigated the relative contribution of external institutional pressures and internal factors to supply chain-oriented EM (Wu et al., 2012). We analysed survey data of 255 and 96 Dutch F&B processors collected in 2002 and 2010 respectively to answer the following research question:

Research Question 1 (RQ1): *How do the relationships between external institutional pressures, adoption of in-company EM, and supply chain-oriented EM evolve over time?*

Prior research that integrated both organizational determinants and business performance implications of proactive environmental practices is scarce (Chan et al., 2012). Chapter 3 aims to explain what organizational capabilities support the development of supply chain-oriented EM and how supply chain-oriented EM influences business performance. In particular, we investigate the interplay between general organizational capabilities that are not constraint to a specific organizational function and are developed within the scope of the core business strategy (i.e. innovative orientation) and organizational capabilities developed within the scope of environmental strategy (i.e. integration of environmental concerns within the organization) for supply chain-oriented EM. Past research, represented mostly by the case studies, suggest that firms should be both innovative and able to embed environmental concerns into the firm structure for proactive EM like supply chain-oriented EM (Pagell and Wu, 2009; Sharma and Vredenburg, 1998). However, corresponding empirical quantitative evidence is missing. Investigating this issue might provide valuable managerial insights. Can only innovative firms be successful in proactive environmental practices that involve their supply chains? Or is the integration of environmental concerns within the firm more important than having a strong innovative orientation? In other words, can environmental integration lead to the development of more advanced forms of EM alone of it requires complementary capabilities developed within the core organizational strategy, such as innovative orientation? Furthermore, Chapter 2 explores the potential of supply chain-oriented EM to induce firm performance. Compared to the previous studies, Chapter 2 considers supply chain-oriented EM as a capability to integrate supply chain partners into the reduction of environmental impact rather than a set of environmental practices on supply chain level. From the RBV perspective, such operationalization can provide new insights into performance implications of supply chain-oriented EM.

Research Question 2 (RQ2): *What organizational capabilities support the development of supply chain-oriented EM and how does supply chain-oriented EM influence firm performance?*

To answer the research question 2 and the following research questions, we used survey data of Dutch F&B processors collected in 2013.

In Chapter 4, we conduct an in-depth investigation into the impact of supply chain-oriented EM on environmental sustainability of internal organizational processes and firm performance. Prior research on supply chain-oriented EM focused on its determinants and performance implications (e.g. Diabat and Govindan (2011), Zhu et al. (2013)). However, quantitative research that investigates what changes in business processes and technologies are induced by supply chain-oriented EM is scarce. Only Chiou et al. (2011) examined how environmental collaboration with suppliers induces improvements in environmental sustainability of internal processes. However, their research only considered collaboration with suppliers. Case studies of Hall (2000) showed that improvements in environmental sustainability of internal processes might occur primarily for one of the two parties and depend on the party's buyer/seller position in the dyad and characteristics of the relationship. Therefore, we examined supply chain-oriented EM within the context of two types of dyads: focal firm - supplier and focal firm-customer. The goal of the Chapter 4 is to explore the potential of supply chain-oriented EM to stimulate changes in internal processes to address external sustainability pressures and to improve business performance.

Another gap addressed in Chapter 4 concerns potential indirect relationships between environmental collaboration and firm performance. Most studies on environmental collaboration examined a direct impact of inter-firm linkages on firm-level performance (see i.e. Zhu et al. (2007), De Giovanni (2012), Gimenez and Tachizawa (2012)). However, two resource-based view (RBV) spin-offs, the relational view (Dyer and Singh, 1998) and the extended RBV (Lavie, 2006), suggest that environmental collaboration can influence firm performance indirectly: it creates joint collaborative advantage for both parties and the share appropriated by each party contributes to firm-level performance. Innovation is one of the corner stones of (joint) collaborative advantage (Cao and Zhang, 2012). Considering environmentally sustainable process improvements introduced by the focal firm as an appropriated part of collaborative advantage, we investigate the indirect effect of environmental collaboration on firm performance via environmentally sustainable process improvements.

Research Question 3 (RQ3): *What is the potential of supply chain-oriented EM to improve environmental sustainability of internal processes and firm performance?*

Chapter 5 extends the findings of Chapter 4 regarding the role of external actors in environmental innovation. Discussing the use of external knowledge in environmental innovation, environmental literature rarely considers that having access to external knowledge is not sufficient in order to progress with environmental innovation. Firms should possess the capabilities to "recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990) known as absorptive capacity. Although the network possesses knowledge that could be used to generate new ways to reduce environmental impact, the successful conversion of this knowledge into environmental innovations relies on the firm's absorptive capacity (del Río González, 2005, 2009). Empirical environmental literature addressing the role of absorptive capacity is scarce. This is especially interesting given the growing body of literature on green collaboration and the use of external knowledge in EM and innovation (see e.g. Vachon and Klassen (2007), Gimenez and Tachizawa (2012), De Marchi and Grandinetti (2013)). Although conventional innovation and knowledge management literature recognizes absorptive capacity as one of the major innovation determinants (Crossan and Apaydin, 2010), environmental innovation literature in this respect is scarce. Chapter 5 aims to address this gap by investigating the role of absorptive capacity as a mechanism for external knowledge appropriation to foster environmental innovation. By connecting innovation management and EM literature, we make a step towards an integrative framework of environmental innovation and its contribution to firm performance. The latter is extensively addressed in the "whether it pays to be green" debate (e.g. Blanco et al. (2009) for an overview).

Next to the role of external knowledge in environmental innovation, Chapter 5 considers the impact of the EM system on environmental innovation as the EM system reflects the development and accumulation of internal environmental knowledge within the firm. In this way, the study pertains to the debate on the relative roles of internal and external knowledge in environmental innovation. One group of studies suggest that access to information from the broader range of external sources induces environmental innovations because knowledge and skills for environmental innovation often fall outside the usual scope (De Marchi, 2012; Ketata et al., 2014). The opponents suggest that external knowledge transfer in case of environmental innovation might be not efficient due to complexity and the firm-specific character of this knowledge (Bönte and Dienes, 2013). Therefore, internal knowledge development is supposed to be crucial for environmental innovation (Bönte and Dienes, 2013; Cuerva et al., 2014; Triguero et al., 2014). Chapter 5 considers the validity of both arguments, when the role of absorptive capacity is taken into account.

Research Question 4 (RQ4): *What is the impact of capabilities to tap external knowledge and of capabilities to develop and accumulate internal knowledge on environmental innovation?*

Chapter 6 discusses the contributions provided by answering these research questions to the academic literature, acknowledges limitations of the research, and suggests avenues for future research. Furthermore, the implications of our findings for the industry practitioners and policy makers are indicated. Figure 1.4 summarizes the outline of the dissertation.

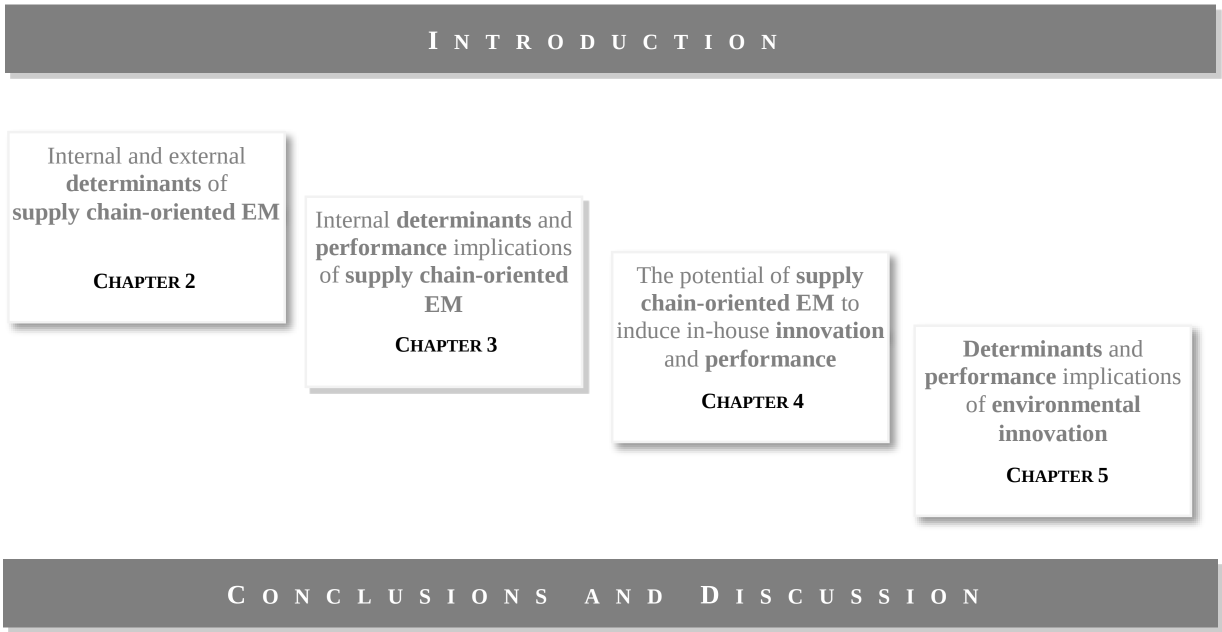

Figure 1.4. Dissertation setup.

CHAPTER TWO

DETERMINANTS OF SUPPLY CHAIN-ORIENTED ENVIRONMENTAL MANAGEMENT

Chapter Two answers the Research Question 1:

How do the relationships between external institutional pressures, adoption of in-company EM, and supply chain-oriented EM evolve over time?

This Chapter is based on:

K. Grekova, H.J. Bremmers, J.H. Trienekens, R.G.M. Kemp, S.W.F. Omta, 2014. Extending environmental management beyond the firm boundaries: An empirical study of Dutch food and beverage firms. *International journal of production economics* 152, 157-187.

2.1. Introduction

Nowadays the food industry is confronting two major challenges: environmental and economic sustainability (Vermeulen et al., 2012). Urged by the current state of the natural environment, food processors are increasingly pressured to reduce environmental impact by societal groups, by tightening environmental regulation, and by customers and consumers down the supply chain. At the same time, consumers demand food chains to deliver products at affordable prices. Consequently, food processors are challenged to increase the environmental sustainability of their operations without compromising the costs or ideally even gaining cost savings.

Environmental impact of the final product depends on the whole supply chain and calls for cooperation and information exchange with supply chain partners to reduce their joint environmental impact. The latter is defined and labelled in this Chapter as externally-oriented environmental management (E-EM)[1]. Prior research refers to different practices associated with E-EM such as joint environmental planning, working together with supply chain partners to reduce environmental impact, and developing the shared understanding of responsibilities (De Giovanni and Esposito Vinzi, 2012), the assessment of suppliers' environmental performance (Testa and Iraldo, 2010), collaboration with customers to change product specifications, for green packaging, green transportation channels, and reverse logistics (Ageron et al., 2012; Azevedo et al., 2011; Manzini and Accorsi, 2013; Zhu et al., 2008a). Cooperation in the supply chain for environmental management is considered "an effective management tool and philosophy" (Zhu et al., 2008b) for manufacturing organisations. This is due to its potential to improve environmental performance via reduction of waste, emissions, and decrease in the use of natural resources (Azevedo et al., 2011; De Giovanni and Esposito Vinzi, 2012; Testa and Iraldo, 2010) and to benefit operational performance (Zhu et al., 2005), especially in terms of higher product quality (Azevedo et al., 2011; Vachon and Klassen, 2008). There is a growing body of evidence in favour of E-EM's contribution to business performance indicated by cost savings, higher profit and market share (see e.g. De Giovanni and Esposito Vinzi (2012); Gimenez and Tachizawa (2012); Testa and Iraldo (2010); Zhu et al. (2010)). These findings evidence the promising potential of E-EM as a tool to design food supply chains that are both environmentally and economically sustainable. Therefore, it is particularly important to investigate the factors that influence managers to develop E-EM.

In this Chapter, we investigate the joint effects of external institutional pressures (from public authorities, local communities and environmental organisations, supply chain partners, branch organisations, and environmental covenants) and the level of internal environmental management development on the implementation of E-EM in Dutch food processing firms. Our findings regarding E-EM determinants can support managerial decision making with respect to the implementation of E-EM practices, which require information exchange in the supply chain as well as cooperation with customers and suppliers. By cooperation, they can improve environmental and economic sustainability in food chains and make these chains more competitive.

Prior research regarding the factors that drive firms to extend environmental management towards the supply chain is not exhaustive. We noticed two substantial gaps and will address them in the

[1] The boundaries of the involvement of supply chain partners into environmental management and terminology used in this dissertation vary depending on the focus of the study and its problem area (Zhu et al., 2008b). To shed the light on specific aspects of the concepts in the context of different research questions we use the following terminology: in the present Chapter - externally-oriented EM; in Chapter 3 – GSCM, and in Chapter 4 – environmental collaboration. In Chapters 1 and 6, we label the involvement of the supply chain into the reduction of environmental impact as supply chain-oriented EM. Supply chain-oriented EM serves as a generic constructs that covers externally-oriented EM, GSCM, and environmental collaboration.

present Chapter. First, little empirical research investigated the relative contribution of external institutional pressures and internal factors to E-EM (Wu et al., 2012). Among internal factors, according to the Natural RBV of (Hart, 1995), there is a path dependency of environmental practices from internal environmental practices towards environmental practices involving external partners such as supply chain actors. This implies that E-EM implementation is influenced by the extent of adoption of the in-company EM (I-EM)[2] (Bremmers et al., 2007; Darnall et al., 2008). I-EM is based on the Deming cycle of continuous improvement (Deming, 1986) and targets environmental impact reduction of a specific manufacturing location. The presence of I-EM alone might not be sufficient to progress to E-EM, because I-EM does not explicitly prescribe the evaluation of environmental impact of whole supply chain. External pressures might be required to make the step from I-EM towards E-EM. Prior research from the perspective of neo-institutional economics (DiMaggio and Powell, 1983; Hoffman, 2001b) identified external institutional pressures from public authorities, supply chain partners, and societal groups as one of major drivers for E-EM adoption (see e.g. Walker et al. (2008), Zhu and Sarkis (2007), Wu et al. (2012)). Therefore, our first contribution rests in adopting an integrative approach to investigate the joint effects of external institutional pressures and the level of I-EM development on the implementation of E-EM in food supply chains.

Second, a need for multi-period research is recognised by earlier studies. For instance, Carter and Rogers (2008) call for a longitudinal research to get insight into the evolution and the implementation of E-EM. Also Zhu et al. (2008a) notice that E-EM's early stage of adoption and dynamic nature require a longitudinal research. Within the last decade, when E-EM came to the research agenda, changes in environmental governance, institutional pressures, and firms' experience with EM may have affected the relative importance of the factors that influence E-EM adoption. We did not come across any quantitative studies that analyse the factors that influence the implementation of E-EM in a multi-period setting. Consequently, such research is necessary. To narrow this gap, the present Chapter investigates the factors that influence the implementation of E-EM by analysing empirical data collected in 2002 and 2010 from Dutch F&B processors.

The Dutch F&B industry can provide an instructive example how to increase environmental and economic sustainability in food chains for F&B firms in other countries. This is because the Netherlands falls in the top 10 of the world countries with the highest ecological foot-print per capita (WWF et al., 2012). The F&B industry is one of the largest industries in the Netherlands in terms of employment and turnover. This is also one of the most polluting industries (Statistics Netherlands, 2012). However, F&B processors have been progressively reducing their environmental impact during the last decade (Statistics Netherlands, 2012) and contribute to environmental sustainability of food chains.

The Chapter proceeds as follows. In the next section, we provide a theoretical foundation of the study: an overview of the E-EM concept, a literature review, and formulation of hypotheses linking external institutional pressures and internal factors to E-EM through the lens of neo-institutional economics and the Natural RBV. The research method and survey design are presented in Section 2.3. In Section 2.4 the hypotheses are discussed through empirical analysis of survey results. The last section is devoted to a discussion of theoretical contributions, the conclusions, and managerial implications.

[2] I-EM is referred to as EM system in Chapters 1, 4, and 5.

2.2. Theoretical framework

2.2.1. Externally-oriented environmental management (E-EM) concept

During the last decade, E-EM emerged as a complex and integrative approach to the design of sustainable supply chains by involving upstream and downstream supply chain partners in the reduction of environmental impact. The analysis of prior research regarding the factors that influence managerial decisions to develop E-EM is complicated by differences in definition, measurement, and theoretical perspective. These differences make the interpretation and comparison of scientific results difficult.

Extension of environmental management beyond the boundaries of the individual firm towards the supply chain is not expressed in a single concept. It has been referred to as green (environmental) purchasing (Min and Galle, 2001), green supply chain management (Srivastava, 2007), sustainable supply chain management (Gold et al., 2010), externally-oriented EM (Bremmers et al., 2007), environmental collaboration (Vachon and Klassen, 2008), external environmental management (De Giovanni, 2012), and environmental supply chain cooperation (Zhu et al., 2010), depending on the focus of the research. Though these terms are often used as interchangeable, this is not always justified.

For instance, some studies consider I-EM as an E-EM facilitator (e.g. Arimura et al. (2011), Vachon and Klassen (2008), Darnall et al. (2008)), whereas others consider I-EM as a part of E-EM (e.g. Zhu et al. (2005)). I-EM requires manufacturers to develop an environmental policy or strategy, to set environmental impact reduction targets and objectives, to establish an implementation and operation system (including, among others, training and education of employees and procedures for control of environmental impact) and a system of checking and corrective action, as well as to assure a management review process on the level of individual firm (Rondinelli and Vastag, 2000). I-EM does not particularly address environmental impact reduction in supply chain. Joining E-EM and I-EM in one construct can provide a misleading picture of the factors that influence firm's responsiveness to the implementation of E-EM. It does not allow for tracing the development of environmental management from one stage to another. Moreover, E-EM is a more proactive form of environmental management compared to I-EM (Vachon and Klassen, 2008). Proactive environmental management means going beyond merely compliance to legal requirements (Aragon-Correa and Sharma, 2003). Legal requirements do not explicitly prescribe collaboration in the supply chain to reduce environmental impact. Prior research (see e.g. Buysse and Verbeke (2003)) revealed that drivers to compliance-oriented environmental management and to proactive environmental management differ. We view environmental management of a firm as a total of in-company activities to reduce a firm's environmental impact (I-EM) and collaborative activities with supply chain actors to reduce environmental impact in the chain (E-EM). So we do not consider I-EM as a part of E-EM.

Approaches to E-EM vary also on the breadth of the chain involvement. Testa and Iraldo (2010), Paulraj (2009), Arimura et al. (2011) consider E-EM as a one-tiered collaboration between the buyer and the supplier. This is because in many cases the environmental impact of the buyer's output depends on the supplier's input. The measurements provided by Azevedo et al. (2011), Zhu et al. (2005), and Zhu et al. (2010) indicate that environmental collaboration with suppliers and customers is based on different practices. Most of the authors, like Vachon and Klassen (2008) and Zhu et al. (2010), include the focal firm's collaboration with both the upstream and downstream supply chain partners in the concept of E-EM. Following this literature stream, we take into account the focal firm's collaboration with both suppliers and customers as part of E-EM.

2.2.2. External institutional pressures

We apply neo-institutional theory to investigate the influence of external institutional pressures on the E-EM. Manufacturing firms' behaviour with respect to environmental management is not purely defined by internal decisions, but is shaped by the institutional pressures from the actors (constituents) in their organisational fields (Hoffman, 2001a). An organisational field is a set of complex social structures and linked relationships among organisational actors. The interests and values of the field's constituents converge in institutions, which give a certain value and meaning to the firm's action. Firms seek social legitimacy by confirming with predominant social norms, traditions and influences (Oliver, 1997). Hence, institutions affect the firm's decisions and priorities regarding E-EM.

Managers may reallocate firm's scarce resources and may shift the internal power balance between organisational functions towards E-EM as a result of the interaction and negotiation with organisational fields' constituents such as supply chain partners, public authorities, and intermediaries. For instance, firms invest in E-EM to comply with the requirements of environmental covenants, to keep a "license-to-produce" from local communities and environmental organisations, to remain being a supplier of the customers with environmental demands or to keep up with the rest of the industry. Neo-institutional theory enables to explore how the changes in the institutional pressures from constituents of organisational fields drive firms to implement E-EM in course of time.

According to Hoffman (2001a) and Scott (2001), aggregated institutional pressure is present at three levels: regulative, normative, and culturally-cognitive. Regulative pressure is legally sanctioned and focuses on manufacturers' compliance with established rules and laws (Hoffman, 2001a). While compliance to regulative institutions is based on expedience, compliance to normative institutional pressure is based on social obligation. Culturally-cognitive pressure is routed in culture and beliefs and, therefore, is least deliberately shaped. Under culturally-cognitive pressure, firms (unconsciously) reach conformity to the other firms they believe to be successful by mimicking them. In practice, all three pressures are rarely seen in isolation (Scott, 2012).

In Sections 2.2.2.1-2.2.2.5, we consider the respective influences of external institutional pressures from organisational fields' constituents on managerial decisions to implement E-EM in order to increase environmental sustainability of food supply chains. In line with previous studies, the following constituents are most important from an environmental perspective: public authorities, local communities and environmental organisations, supply chain partners, branch organisations, and environmental covenants. For every constituent we investigate its potential to contribute to E-EM implementation in 2002 and 2010, given their levels of institutional pressures (regulative, normative or culturally-cognitive).

2.2.2.1. Public authorities

The pressure from public authorities that is expressed via regulation, legislation or licensing requirements can be placed at the regulative level (Tate et al., 2011). Regulative pressure is mentioned as a driver for E-EM implementation by some scholars (see e.g. Min and Galle (2001)), while others state that regulative pressure does not necessarily target E-EM (Hall, 2000). Environmental regulation aims at the reduction of the focal firm's environmental impact. In many countries, like in the Netherlands, public authorities do not coercively impose E-EM. E-EM goes beyond regulatory compliance, what implies that E-EM is a more proactive approach to EM. Thus E-EM can be primarily stimulated by others than public authorities (Buysse and Verbeke, 2003). For voluntary and proactive environmental measures, regulative pressure (in spite of its great potential) is less important compared to normative and culturally-cognitive pressures.

Regulative pressure might *indirectly* affect E-EM by promoting I-EM. In this respect, Arimura et al. (2011) found an indirect effect of participation in voluntary governmental environmental programmes on ISO 14001 "Environmental management systems" certification by Japanese medium-sized and large manufacturing facilities. ISO 14001 certified facilities were more likely to adopt E-EM. Nevertheless, we do not expect that Dutch F&B processors perceive public authorities' directly steering E-EM.

Drawing conclusions based on the prior studies, it is important to notice that, even within a specific country, public authorities can play a different role in different time periods. For instance, Dutch environmental policy in relation to E-EM in supply chains undergoes significant changes as more and more power is being left to non-state actors (Vermeulen and Kok, 2012) and more attention is being devoted to the development of a 'responsibility culture' in the industry. Driessen et al. (2012) distinguish three periods in the history of Dutch environmental policy. Before 1990s, environmental management was initiated by public authorities who also set environmental impact reduction targets and implementation strategies for firms.

During the second period (1990-2000), after facing implementation problems, public authorities left the implementation strategy to the industry to decide upon. Public authorities limit themselves to setting long term goals for environmental impact reduction. Hybrid forms of public-private environmental collaboration, such as branch organisations and covenants, appeared to balance environmental impact reduction targets and firm implementation strategies. The results of the second period affect the outcomes of the survey that we conducted in 2002.

The third period began after 2000. Front runners in business and civil society were increasingly showing a tendency towards self-regulation by initiating proactive environmental strategies in the area of E-EM. Environmental organisations became more active in collaboration with business front-runners and in the discussions on environmental issues in media, raising public awareness and demand for environmental management. The survey that we conducted in 2010 corresponds to third period. Because E-EM is a relatively new concept, the third period is the most important for E-EM. During the third period, regulative pressure from public authorities is not strong anymore, while normative and cognitive pressures have strengthened.

Every subsequent period as defined by Driessen et al. (2012) does not substitute but complements the previous one. Because more and more actors are increasing their influence on food processors to reduce environmental impact, the relative influence of the public authorities compared to all the other actors is expected to decrease in course of time.

Hypothesis 1. *Over time, pressure from public authorities is associated with a lower propensity of food processors to develop E-EM in supply chains.*

2.2.2.2. Local communities and environmental organisations

Food processors can work on implementation of E-EM due to a perceived social obligation to reduce environmental impact, which is expressed via normative pressure from local communities and environmental organisations. Local communities and environmental organisations can - via media or any other public means - discredit producers that do not demonstrate sufficient effort to reduce their environmental impact. The reputation of the whole industry can be damaged because of a few firms (Tate et al., 2011). In this way, firms face normative pressure from local communities and environmental organisations. Although the influence of local communities and environmental organisations is not legally enforced, firms cannot ignore their social obligation if they wish to keep a “licence-to-produce” (Gunningham et al., 2004). That is why institutional pressures from local communities and environmental organisations can be described as “normative with a savour of regulative”.

E-EM can be developed as a response to the desire to reduce environmental impact expressed by local communities and environmental organisations because E-EM is perceived to contribute to better environmental performance (Vachon and Klassen, 2008). However, local communities and environmental organisations might not demand explicitly E-EM, rather environmental management as such. Especially because local communities are affected by environmental impact of a specific manufacturing location rather than the whole supply chain, they might lack incentive to demand environmental cooperation in the supply chain.

Hypothesis 2. *Over time, pressure from local communities and environmental organisations is not associated with a higher propensity of food processors to develop E-EM in supply chains.*

2.2.2.3. Supply chain partners

The influence of supply-chain partners on the implementation of E-EM by food processors is difficult to qualify in terms of levels of institutional pressures. This influence is not legally enforced. Hence, it is not regulative. It is more likely that managers observe E-EM among their supply chain partners as a successful strategy and adopt E-EM themselves. Such an adoption is a result of unintentional or deliberate mimicry associated with culturally-cognitive pressure. E-EM will also be developed due to normative pressure to satisfy the expectations of environmentally conscious suppliers and customers (Wu et al., 2012; Ye et al., 2013; Zhu and Geng, 2013). In case of an uneven power balance, requirements of supply chain partners may become an obligation to safeguard the continuity of the business. Nevertheless, we don’t consider the pressure from supply chain partners as regulative because the pressure from supply chain partners is not instrumented by the laws. The pressure from supply chain partners is seen as both culturally-cognitive and normative.

The pressure from supply chain partners is expected to be positively associated with the implementation of E-EM by food processors. Supply chain partners can be interested in facilitating E-EM due to its potential to improve operational efficiency (Azevedo et al., 2011; Vachon and Klassen, 2008) in the food chains, which is necessary to maintain competitiveness at the inter-supply chain level (Hult et al., 2007) and to respond to consumers’ demand for both environmentally sustainable and affordable food. Because supply chain partners are taking more and more initiatives in proactive environmental management (Section 2.2.1), we expect their pressure to have a higher influence on the implementation of E-EM in 2010 compared to 2002.

Hypothesis 3. *Over time, the pressure from supply chain partners is associated with a higher propensity of food processors to develop E-EM in supply chains.*

2.2.2.4. Branch organisations

Branch organisations have potential to exploit the culturally-cognitive institutional level to stimulate E-EM in food chains. According to Geels (2004), branch organisations facilitate learning of groups rather than of individuals (so-called “social learning”) via imitation and experience exchange. Branch organisations facilitate information exchange between their members and other constituents (Lepoutre and Heene, 2006). They contribute to the development and diffusion of new knowledge and technology (Johannsen, 2002). By bringing food processors together, branch organisations induce isomorphism of their actions and provide opportunities for both deliberate and unintentional mimicry. Mimicry is an attribute of culturally-cognitive institutional pressure.

Compliance with environmental aims of the branch organisations might be partly attributed to the pressure of the regulative institutional level. Dutch public authorities work together with branch organisations to introduce their requirements in the food industry (Farla and Blok, 2002; Lepoutre and Heene, 2006). Public authorities enter into contracts with the industry via branch organisations that act as intermediaries on behalf of their member firms.

Being a member of a branch organisation exerts a normative influence on firms. The firm will be inclined to adopt a level of environmental management that is perceived as common for the members (Miemczyk, 2008). Otherwise, they would experience peers’ pressure (Tate et al., 2011). This type of searching for appropriateness or match between the firm’s position in a certain community on the one hand and the expectations and requirements to this position on the other typically occurs due to the normative pressure (Qian et al., 2009).

Branch organisations are expected to facilitate I-EM, but we do not expect them to stimulate E-EM directly. The members of branch organisations do not typically represent different stages of the food chain, but are localised at the same stage. It is more “natural” for branch organisations to act “horizontally” rather than “vertically”. We do not expect that the role of branch organisations in E-EM development in 2002 is different compared to 2010.

Hypothesis 4. *Over time, the pressure from branch organisations is not associated with a higher propensity of food processors to develop E-EM in supply chains.*

2.2.2.5. Environmental agreements (covenants)

Branch organisations in the F&B industry often negotiate environmental covenants on behalf of their members. Environmental covenants represent agreements between public authorities and market parties by which the firms voluntarily commit themselves to certain environmental targets under the guidance of public authorities (Van Tatenhove and Leroy, 2003). Environmental covenants typically target the reduction of the environmental burden of processes and products (Kemp, 2000). They can contribute to operational efficiency, like in the case with the Dutch energy covenant (reduced energy consumption) and the packaging covenant (reduced waste).

Like branch organisations, covenants provide food processors opportunities for mimicry via information and experience exchange among members. By providing opportunities for mimicry, environmental covenants exercise culturally-cognitive pressure. Next to the culturally-cognitive influence, covenants also have a normative influence. Compliance to environmental covenants is not legally sanctioned, so firms may refuse to participate. If doing so, firms would be negatively perceived by other firms in the sector (Bressers et al., 2011). The latter demonstrates that covenants exert normative pressure on their members.

The affiliation of environmental covenants with the regulative level of institutional pressure is not direct. Participation of public authorities in the covenants' negotiation process makes covenants being implemented in the "shadow of the law" (Huppes et al., 2009). Also in case of refusal to participate in (voluntary) covenants or non-compliance to their targets, public authorities might impose an alternative: stringent regulation as a way to reach environmental impact reduction targets (Bressers et al., 2005). That is why environmental covenants contain an element of regulative institutional pressure. The regulative institutional pressure from covenants is minor compared to the culturally-cognitive and the normative pressures, because (as mentioned) covenants exist only in the "shadow of the law".

We expect that environmental covenants would have a higher effect on the implementation of E-EM in 2010 rather than in 2002. This expectation follows from the history of the Dutch environmental covenants for the last two decades. Around 2002, many covenants (like long-term energy efficiency agreements) ended the first agreements dated back to the end of 1980-s or the beginning of 1990-s. It was decided to proceed with the next round of covenants and to broaden their scope. New covenants went beyond picking "low hanging fruit". They included the goal to reduce environmental impact of the supply chain as a whole. Another explanation to the expected growing impact of covenants can be the content of agreements. For example, according to the energy efficiency covenant, firms have to reach an annual target for energy efficiency improvement. When is not possible any more to achieve such a saving internally, collaboration with supply chain partners is the next logical step.

Hypothesis 5. *Over time, the pressure from environmental covenants is associated with a higher propensity of food processors to develop E-EM in supply chains.*

2.2.3. Internal factors

Institutional theory alone cannot explain the heterogeneity in the food processors' adoption of E-EM driven by isomorphic institutional pressures lead to isomorphic policies (Sarkis et al., 2011) because of internal factors that also influence the implementation of E-EM (Walker et al., 2008). Sarkis et al. (2011) mention a gap in the understanding of the interaction between institutional and internal factors to promote E-EM. This gap will be addressed in this Chapter by considering the relative effects of internal and external factors on E-EM.

In this section, we rely on the Natural RBV (Hart, 1995) to address in a multi-period setting the impact of internal factors, namely the impact of the level of I-EM adoption, on the implementation of E-EM by F&B processors. Multi-period analysis within the Natural RBV theoretical framework is particularly necessary because the relationship between I-EM and E-EM is expected to change over time. The latter is due to path dependency of environmental strategies, as addressed by the Natural RBV. Path dependency can hardly be investigated by cross-sectional analysis and calls for a multi-period research.

2.2.3.1. In-company environmental management (I-EM)

The Natural RBV was introduced by Hart (1995) to incorporate opportunities and challenges imposed by sustainable development into the resource based view. The essence of the Natural RBV is in three strategies (pollution prevention, product stewardship, and sustainable development), their driving forces, core resources and capabilities, and competitive advantage. For the purpose of this Chapter we will focus on the shift from pollution prevention to product stewardship to explain how the level of I-EM adoption influences the development of E-EM.

The pollution prevention strategy links I-EM to the core capability of continuous improvement (Hart and Dowell, 2010). Taking into account the environmental impact of the focal firm's inputs and outputs, F&B processors in course of time begin to extend their environmental management from internal organisational activities towards organised cooperation with external stakeholders. In this way pollution prevention evolves into product stewardship. The core capability of the product stewardship strategy is stakeholder integration (Hart, 1995). Integration of the stakeholders' environmental interests requires information exchange and working together on environmental impact reduction, like in the case with E-EM. Environmental strategies of pollution prevention and product stewardship are path dependent and embedded. Path dependency means that product stewardship, which has the core capability of stakeholders integration, is dependent on pollution prevention, which has the core capability of continuous improvement. Embeddedness refers to the fact that capabilities required by these strategies stimulate and accelerate each other.

We apply the Natural RBV to explain the relationship between the level of I-EM and the development of E-EM in food supply chains. Based on path dependency of environmental strategies, we expect those F&B firms that have already implemented I-EM to make more progress in E-EM compared to those that have just started with I-EM. Firms need to accumulate knowledge and experience about I-EM first before expanding their environmental practices beyond the firms' boundaries towards the food chain (De Giovanni, 2012). Because the F&B industry is expected to accumulate more experience and knowledge in I-EM by 2010, we expect I-EM to be a stronger predictor of E-EM in 2010 compared to 2002.

Hypothesis 6. *Over time, the implementation of I-EM is associated with a higher propensity of food processors to develop E-EM in supply chains.*

2.2.3.2. Constraints on E-EM

The study considers two constraints to E-EM: the size of the food processor and the environmental budget. Prior research rarely included small firms in the study sample. Firms of different size groups are typically considered as being different in terms of resources, time, and knowledge that is available for environmental management, stakeholder pressures, and institutional environment (Lepoutre and Heene, 2006). Although larger firms are thought to have more resources available for environmental management, a small firm size does not always constrain environmental management (Lepoutre and Heene, 2006). Aragón-Correa et al. (2008) found that Spanish SMEs can adopt proactive environmental management practices due to their distinctive characteristics such as shared vision, shorter communication lines, entrepreneurial orientation, and flexibility in managing external relationships. Small firms might develop E-EM due to the requirements of powerful supply chain partners. We will compare small, medium-sized, and large firms to investigate if indeed the firm's size constrains E-EM development.

The lack of financial resources is one of the most important barriers to environmental management development not only for SMEs (Palmer, 2000) but also for large firms, given the low profit margins in the F&B industry. Hence, availability of environmental budget is another potential constraint also on E-EM implementation in food chains.

2.2.4. Theoretical framework

Figure 2.1 presents the theoretical framework with references to hypotheses, which indicate proposed relationships between the research variables. Neo-institutional economics (DiMaggio and Powell, 1983; Hoffman, 2001b; Scott, 2001) was used as a theoretical lens to investigate the effects of external institutional pressures on E-EM. The Natural RBV (Hart, 1995) provided a perspective on the influence of the I-EM level on the E-EM.

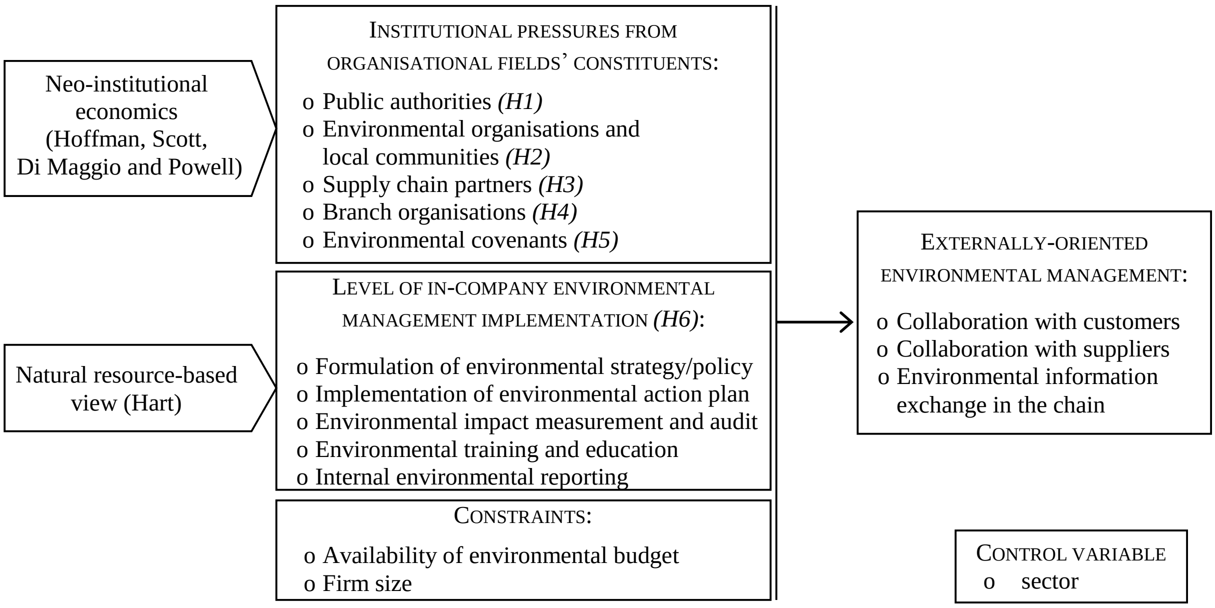

Figure 2.1. Theoretical framework relating I-EM, institutional pressures, and E-EM as well as theory streams used to explain proposed relationships.

2.3. Material and methods

2.3.1. Data collection and response

In 2002 and 2010, two research projects conducted the surveys to investigate environmental management in Dutch F&B industry. Due to the similarities between the projects, it is possible to compare them in a multi-period setting. Firm addresses, industry classification codes, and number of employees were acquired from the Dutch Chamber of Commerce. In 2002, 1348 and in 2010, 1781 randomly selected F&B firms with at least 10 employees were addressed through postal mail. To increase the response rate the cover letter promised anonymity to respondents.

In 2002, 328 usable responses were received, a response rate of 24.3%. In 2010, 113 responses were received, what constitutes a response rate of 6.3 %. After list-wise deletion of missing values 255 firms remained in 2002 and 89 firms in 2010. The difference in the response rates can be explained by the following factors. First, the surveys were conducted on behalf of different organisations. The survey, which was focused on environmental information flows, was sent out in 2002 by Wageningen University on behalf of the Ministry of Housing, Spatial Planning, and the Environment. The survey also addressed the administrative load of environmental regulation that could enhance the willingness to respond. In 2010, the research focused on environmental innovation and strategy. The survey questionnaire was sent out on behalf of Wageningen University only. Second, the 2010 survey came after the 2008 financial crisis and subsequent recession. Under these circumstances, firms might perceive environmental management as costly and diverting resources from their core value-creating activities. The latter might be reflected in a lower willingness to participate in environmental management surveys.

2.3.2. Research variables operationalization and measurements

In this section, we will describe the operationalization and construction of the main research variables. The research variables and their measures are presented in Table 2.1. E-EM was measured as a formative construct as an average of three items: environmental collaboration with customers, with suppliers, and environmental information exchange in the food supply chain. Most studies that addressed the influence of I-EM on E-EM measured I-EM with one statement. In particular, whether the firm implemented (and certified) ISO 14001 "Environmental management systems" (Arimura et al., 2011) or another environmental management system (Testa and Iraldo, 2010), or not. The absence of a certified ISO 14001 system does not imply that a firm did not adopt I-EM practices (King et al., 2005) or that a firm is not in the process of I-EM implementation. We therefore use a measure of I-EM calculated as the sum of five binary statements. They include measures of Darnall et al. (2008) such as the design of an environmental policy, environmental training and education for employees, environmental audit, and impact measurement. To address fully the Deming cycle of continuous improvement, we also include internal environmental reporting and implementation of an environmental action plan in the I-EM measure. Other research variables were not measured on multi-item scale (Table 2.1).

Because the research variables were measured on a 7-point Likert scales in 2010 and on a 5-point and binary scales in 2002, we rescaled the scores for comparability (see Table 2.2)[3].

Table 2.2.
Rescaling.

Scale 2002	Scale 2010	Rescaling	Applied to statements (Table 2.1)
0 = No 1 = Yes	1 = Not implemented 4 = 50% implemented 7 = Fully implemented	1-2 = 0 (No); 3-7 = 1 (Yes).	1-5
0 = No 1 = Yes	1 = Not implemented 4 = 50% implemented 7 = Fully implemented	2002: 0=0 (Totally disagree); 1=3 (Mostly agree). 2010: {(score-1)/6}*4	6
1 = Totally disagree 2 = Mostly disagree 3 = Neither agree nor disagree 4 = Mostly agree 5 = Fully agree	1 = Not at all, 4 = Average, 7 = Very much	2002: (score-1) 2010: {(score-1)/6}*4	7-8
1 = No influence, 2 = Little influence, 3 = Reasonable influence, 4 = Much influence, 5 = Very much influence	1 = Not at all, 4 = Average, 7 = Very much	2002: (score-1) 2010: {(score-1)/6}*4	9-11
0 = No 1 = Yes	1 = Not at all, 4 = Average, 7 = Very much	1-2 = 0 (No); 3-7 = 1 (Yes).	12-13
1 = Totally disagree 2 = Little agreement 3 = Reasonable agreement 4 = Mostly agree 5 = Fully agree	1 = Not at all, 7 = Very much	2002: (score-1) 2010: {(score-1)/6}*4	14

[3] To examine how rescaling may have influenced our ordinary linear regression results (OLS) (Table 2.6), a sensitivity analysis was conducted. While changing the way of conversion from one scale to another, we compared OLS regression coefficients and statistical significance (as reported in Table 2.6). The results showed that almost all coefficients and statistical significance levels remained the same under different rescaling schemes. Therefore we assume that OLS regression results were not affected by the authors' choice of rescaling.

Table 2.1.
Research variables operationalization.

	Operationalization
	In-company environmental management:
1	2010 and 2002: Formulation of an environmental strategy / policy
2	2010 and 2002: Environmental training and education of the staff
3	2010: Implementation of an environmental action plan 2002: Formulation of an environmental action plan
4	2010: Regular measurements and audit 2002: Implementation of a baseline measurement (environmental audit) Regular environmental measurements
5	2010: Regular internal reports on environmental issues in business operation 2002: Periodic internal environmental reporting
	Externally-oriented environmental management:
6	2010: Information exchange on environmental issues in the chain. 2002: For what reason (s), environmental information collected by your company? For information exchange with our suppliers and customers
7	2010 and 2002: We work together with our suppliers to reduce environmental impact
8	2010 and 2002: We work together with our customers to reduce environmental impact
	External pressures:
	Public authorities' pressure
9	2010: Motive for environmental measures: imminent legislation and tightening licensing requirements. 2002: To what extent does the government affect environmental care in your firm?
	Environmental organisations' and local communities' pressure:
10	2010: Motive for environmental measures: pressure from non-profit stakeholders (such as environmental organisations and local communities) 2002: To what extent do environmental organisations affect environmental care in your firm? To what extent do the local communities affect environmental care in your firm?
	Supply chain partners' pressure
11	2010: Motive for environmental measures: pressure from commercial stakeholders (such as customers or shareholders and banks)? 2002: To what extent do the customers affect environmental care in your firm? To what extent do the suppliers affect environmental care in your firm?
	Branch organisations' pressure
12	2010: In our sector branch organisations are involved in environmental measures 2002: Is there a branch organization within your industry, which pursues the field of environment?
	Environmental agreements' (covenants) pressure
13	2010: We are involved in the implementation of environmental agreements (such as packaging or MJA2) 2002: Do you have signed an agreement (covenant) that targets environmental impact reduction?
	Constraint: environmental budget availability
14	2010 and 2002: Availability of budget for environmental measures
15	Firm size: Log (number of employees)
16	F&B sector: Based on industry classification codes

The content (face) validity of the constructs was assured by a literature review, adequate research design, and questionnaire evaluation by experts of the advisory committee of the research project. Moreover, the 2002 questionnaire was pretested in 5 selected firms. As mentioned, we had one multi-item scale that was a formative construct measuring E-EM. Reliability of a formative construct is similar to the content validity and, therefore, is assessed in the same ways. Nomological validity of E-EM is assessed in the context of statistical model testing.

2.3.3. Methods

Possible non-response bias was checked by comparison of early respondents with late respondents. Late respondents were used to approximate non-respondents (see Miller and Smith (1983)). Because 2002 data were received in one batch, non-response analysis was only possible for 2010 data. No statistically significant differences were found between early and late respondents. Hence, non-response bias is not a severe problem for the present research. The representativeness of the sample for the population with respect to demographical indicators (firm sizes and F&B sectors) was checked with Chi-square statistics.

Because the data distributions show deviations from normality, non-parametric tests were applied, such as the Mann-Whitney test for differences between two group medians and the Kruskal-Wallis test for more than two groups. Ordinary least squares (OLS) regression was carried out to investigate the effects of I-EM, as well as of institutional drivers and constraints on E-EM. Residuals appeared to be normally distributed. Variance inflation factor values were calculated to identify potential multicollinearity problems. A White test checked the presence of heteroscedasticity. Both do not give rise to concern.

2.4. Results

2.4.1. Sample characteristics and baseline statistics

Tables 2.3 and 2.4 show that the samples collected in 2002 and 2010 are comparable in terms of firm size groups (χ^2=1.434, df=2, p=0.488) and industry sectors (χ^2=1.613, df=5, p=0.900). Compared to the population both samples are skewed towards larger firms and contain more medium–sized and large firms (2002: $\chi^{2=}$7.463, df=2, p=0.024; 2010: χ^2=6.861, df=2, p=0.032). The underrepresentation of the small firms in the survey samples is common and often unavoidable (Wagner, 2007). The sample is representative in terms of firms distribution over F&B sectors, both in 2002 (χ^2=1.820, df=4, p=0.769[4]) and in 2010 (χ^2=7.672, df=5, p=0.175).

Table 2.3.
Distribution of firms over the firm size groups in 2002 and 2010.

	2002 sample		2002 population		2010 sample		2010 population	
Small (10-49 employees)	147	57.6%	992	73.6%	56	58.3%	1361	76.4%
Medium (50-249 employees)	78	30.6%	302	22.4%	33	34.4%	353	19.8%
Large (≥ 250 employees)	30	11.8%	54	4.0%	7	7.3%	67	3.8%
Total	255	100.0%	1348	100.0%	96	100.0%	1781	100.0%

[4] Dairy firms are included in the Others category because expected count for χ^2 calculation was less than 5.

Table 2.4.
Distribution of firms over F&B sectors in 2002 and 2010.

	2002 sample		2002 population		2010 sample		2010 population	
Meat	41	16.1%	251	18.6%	14	14.6%	198	11.1%
Fruit and vegetables	22	8.6%	73	5.4%	9	9.4%	80	4.5%
Dairy	12	4.7%	40	3.0%	8	8.3%	93	5.2%
Feed	19	7.5%	92	6.8%	10	10.4%	99	5.6%
Bakeries	99	38.8%	578	42.9%	33	34.4%	938	52.7%
Others	62	24.3%	314	23.3%	22	22.9%	373	20.9%
Total	255	100.0%	1348	100.0%	96	100.0%	1781	100.0%

Figure 2.2 evidences significant progress of Dutch F&B processors with respect to I-EM implementation. Medium-sized and large firms have fully or almost fully implemented I-EM by 2010. In other words, their managerial and operational structures are adjusted for setting environmental targets, introducing implementation and control systems, systems for checking and for corrective action. This is to guarantee continuous improvement of environmental performance and environmentally sustainable food production (Iraldo et al., 2009). By 2010, small firms reached a level of I-EM adoption (2.80 SD=2.08 on a 0-5 scale) that is comparable to the level of I-EM observed among medium-sized and large firms in 2002. This means that small firms introduced a number of elements of I-EM that contribute to the reduction of environmental impact in the food processing location. However, they did not develop continuous improvement capabilities yet.

The progress in the development of E-EM is also considerable, but can be attributed almost entirely to improvement made by and medium-sized firms (Figure 2.3). Small food processors made almost no steps forward. We observe that particularly large firms have started to extend their environmental management towards the food supply chain. Interestingly, large food processors also nearly reached the maximum level of I-EM adoption by 2010, as can be observed in Figure 2.2. Section 2.4.2 further elaborates upon this subject.

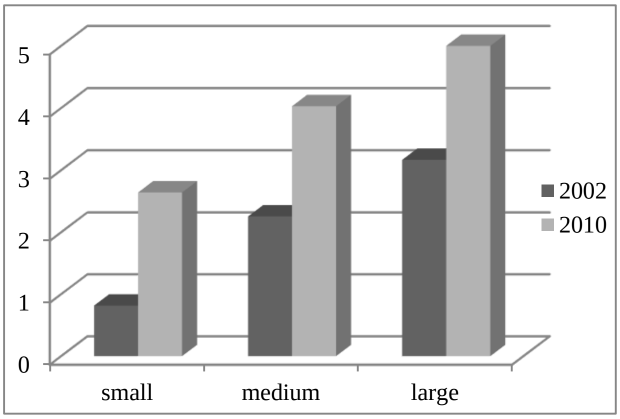

Figure 2.2. Implementation of in-company environmental management in small, medium-sized, and large Dutch F&B firms in 2002 and 2010 (0-5 scale).

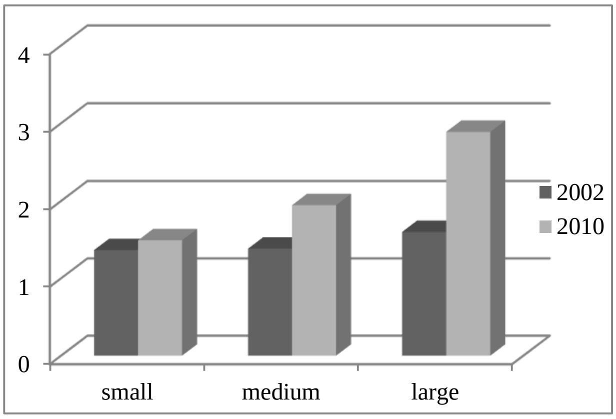

Figure 2.3. Implementation of externally-oriented environmental management in small, medium-sized, and large Dutch F&B firms in 2002 and 2010 (0-4 scale).

As shown in Figure 2.4, implementation of I-EM differs across F&B sectors. All F&B sectors improved their I-EM in 2010 compared to 2002. However, meat processors improved I-EM more than the others. During the last years, the meat sector has faced a number of food safety crises (such as dioxin, Avian influenza). Increasing institutional pressure might have urged Dutch meat firms to not only take care of food safety, but also of environmental issues that draw increasingly the attention of consumers, local communities, and environmental organisations. This might explain why meat firms have drastically improved their mean I-EM score almost till the maximum level in 2010. Active participation of Dutch meat firms in energy covenants in 2001-2007 could also have facilitated I-EM implementation (Productschap Vee en Vlees [PVV], 2007).

Like meat processors, fruit and vegetable processors took more care of safety and environmental issues in 2010 than in 2002. Environmental management has become an essential part of fruit and vegetable firms' food safety and quality agenda. This is because the use of pesticides, nitrogen and phosphate concentration in water are concerns for both food safety and for environmental management (Van Plaggenhoef, 2007). Fruit and vegetable firms almost fully implemented I-EM by 2010. However, their starting level (in 2002) was higher compared to the meat sector.

While dairy processors had the highest level of I-EM implementation in 2002, their improvement by 2010 is very modest, especially compared to the meat sector. This result is consistent with similar research in France (Grolleau et al., 2007). Feed sector and bakeries have made a considerable progress by 2010. However, the level of I-EM implementation among bakeries is still very low (Figure 2.4).

Figure 2.5 evidences that meat processors made the most considerable progress in E-EM implementation among all sectors by 2010, while also reaching the maximum level of I-EM on the individual firm level. The E-EM progress by 2010 cannot only be explained by the high starting level of E-EM in 2002. To compare: the fruit and vegetable sector had almost the same starting level of E-EM in 2002 but showed very little progress by 2010. The reason for an especially high progress of meat firms in E-EM implementation could be that most Dutch meat firms (95% of pig slaughterhouses (Theuvsen et al., 2007), 95% of the poultry meat chain (Van Plaggenhoef, 2007)) apply the sector-wide quality assurance system "Integraal Keten Beheer" (IKB, 'Integrated Chain Control" in English). As follows from its name, IKB is a chain-oriented quality management system. It could facilitate the development of other chain-oriented practices, like E-EM. The other sectors have made less progress. Bakeries did not improve at all.

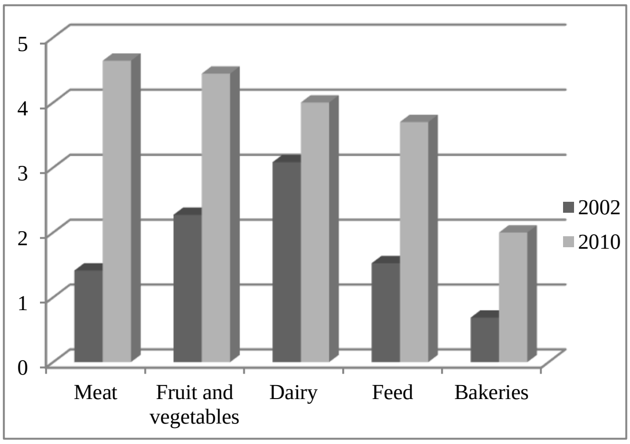

Figure 2.4. Implementation of in-company environmental management in Dutch F&B sectors in 2002 and 2010 (0-5 scale).

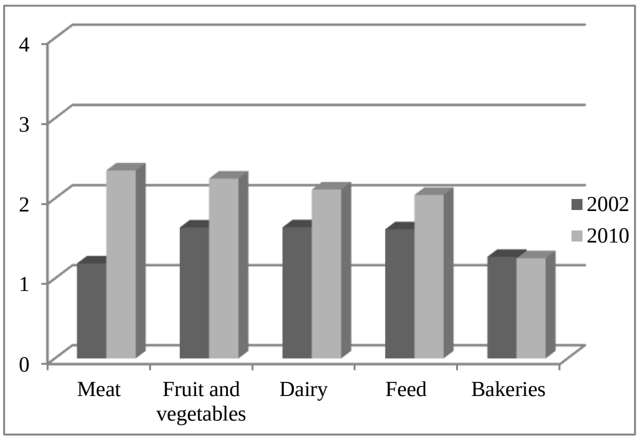

Figure 2.5. Implementation of externally-oriented environmental management in Dutch F&B sectors in 2002 and 2010 (0-4 scale).

Data presented in Table 2.5 show an interesting pattern. Overall, the institutional pressures from all constituents strengthened by 2010 ($p<0.01$), except the pressure from public authorities. Nevertheless, public authorities' pressure remains relatively high in both years. Two explanations can be put forward for the fact that perceived pressure from public authorities has not increased over time. First, F&B firms were less experienced in environmental management in 2002 than in 2010. Second, public authorities might not have strongly promoted advances in environmental management beyond minimum regulatory requirements, so that the other constituents filled in the gap in institutional pressure towards beyond-compliance behaviour. Indeed, Table 2.5 shows an increase in pressures from other constituents than public authorities.

The difference in managerial perception of regulative pressure from public authorities and the other institutional pressures is especially large for small food processors. Managers in small firms perceive the pressure from public authorities as very strong, because these are considered as “distant” and difficult to manage. Pressure from public authorities remains strong but does not change for small firms.

Small firms are close to immediate stakeholders like supply chain partners, whose influence is increasing. Small firms and their supply chain partners, especially customers, are often embedded in local communities so that managing the relationship with local communities is crucial (Lepoutre and Heene, 2006). Local communities and environmental organisations strengthened their pressure by 2010 mostly towards small firms.

Perception of branch organisations being active in environmental management and involvement in covenants has increased by 2010. While in 2002 only 47% of food processors acknowledged that branch organisations are active in environmental management, this figure has increased to 74% in 2010. In course of the same period their involvement in environmental covenants has increased from 65% to 76%.

Table 2.5 shows that the environmental budget has grown by 2010 compared to 2002, especially among SMEs. Financial resources supported their progress in I-EM (Figure 2.2).

Table 2.5.

Means and standard deviations (between parentheses) of small, medium-sized, and large Dutch F&B firms in 2002 and 2010.

Variable	Scale	Small			Medium			Large			Overall		
		2002	2010	Sig	2002	2010	Sig	2002	2010	Sig	2002	2010	Sig
Public authorities	0-4	2.59	2.67		3.05	2.93		2.80	3.52	**	2.76	2.82	
		(1.07)	(0.97)		(0.82)	(0.91)		(0.85)	(0.74)		(0.99)	(0.96)	
Local communities and environmental organisations	0-4	1.24	1.77	***	1.46	1.66		1.67	2.29		1.35	1.77	***
		(0.88)	(1.22)		(0.85)	(1.06)		(0.78)	(1.01)		(0.87)	(1.15)	
Supply chain partners	0-4	1.17	2.00	***	1.38	2.28	***	1.47	2.95	***	1.27	2.17	***
		(0.96)	(1.14)		(0.91)	(0.94)		(0.81)	(1.48)		(0.94)	(1.12)	
Branch organisations	0-1[1]	0.39	0.68	***	0.58	0.79	*	0.57	1.00	*	0.47	0.74	***
		(0.49)	(0.47)		(0.50)	(0.42)		(0.50)	(0.00)		(0.50)	(0.44)	
Involvement in environmental covenants	0-1[1]	0.54	0.70	*	0.79	0.82		0.83	1.00		0.65	0.76	***
		(0.50)	(0.46)		(0.41)	(0.39)		(0.38)	(0.00)		(0.48)	(0.43)	
Environmental budget	0-4	0.90	1.85	***	1.56	2.42	***	2.97	3.14		2.23	2.86	***
		(0.99)	(1.20)		(0.83)	(1.01)		(0.89)	(1.07)		(1.01)	(1.02)	

Significance ***= $p < 0.01$; **= $p < 0.05$; * = $p < 0.10$.
[1] 1=100%

2.4.2. The effect of external institutional and internal organisational factors on E-EM

OLS analysis was applied to test the hypotheses. Table 2.6 reports that different factors had an impact in 2002 and in 2010 on the implementation of E-EM in food supply chains. In 2002, E-EM was primarily influenced by external institutional pressure on normative and culturally-cognitive level from supply chain partners. By 2010, the implementation of I-EM became a major determinant of E-EM development, followed by external institutional factors like involvement in environmental covenants and pressure from supply chain partners.

Pressure from local communities and environmental organisations did not increase its influence on E-EM adoption in food supply chains by 2010. This is in line with Hypothesis 2. In fact, primarily normative pressure from local communities and environmental organisations had no impact on E-EM, neither in 2002 nor in 2010. The same holds for regulative pressure from public authorities. Their pressure did not increase their influence on the implementation of E-EM in 2010 compared to 2002. Consequently, we cannot confirm Hypothesis 1 that indicates an association between the pressure from public authorities and lower propensity of food processors to develop E-EM in supply chains. Nevertheless, as discussed in Section 2.2.2.1, Dutch public authorities also rely on indirect influence instruments such as covenants.

In 2010, involvement in environmental covenants had the strongest institutional influence on E-EM implementation, while in 2002 there was no impact of covenants on E-EM. The strengthening of the normative and culturally-cognitive impact of environmental covenants on E-EM in the food chains is in line with Hypothesis 5. Unlike covenants, branch organisations did not influence E-EM implementation significantly and did not increase their impact in course of time. This confirms Hypothesis 4. The influence of branch organisations might vary depending on the F&B sector. In some sectors branch organisations are very small and have only a few employees, while in the other F&B sectors branch organisations are large and influential. This might make negligible an aggregated impact for the whole group of F&B respondents.

In 2002, institutional pressure from supply chain partners had a strong, positive, and significant effect on E-EM. This effect is lower but still significant at the 10% level in 2010. Consequently, we cannot support Hypothesis 3 regarding the strengthening influence of supply chain partners on food processors' responsiveness to extend their environmental management towards the supply chain. The changes in the impact of supply chain partners on E-EM might also be attributed to the difference in the measures used in 2002 and 2010 surveys.

The results show the changes in the relative influence of internal factors on E-EM development in food chains. Whereas the availability of environmental budget played a key role in 2002, implemented I-EM became important in 2010. This is not surprising because firms have to divert financial resources to environmental management first in order to reach a progress in I-EM adoption. In the course of time firms invested in environmental care (see Table 2.3) and improved their environmental sustainability by increasing the level of I-EM adoption (Figure 2.2, Figure 2.4). Consequently, we observe that the availability of financial resources became less important for food processors' decisions regarding E-EM development, compared to the importance of I-EM implementation. Increasing importance of I-EM implementation for the firm's inclination to extend environmental management towards greening the entire supply chain confirms Hypothesis 6.

Table 2.6.
OLS: the effect of institutional pressures, in-company environmental management, and constraints on externally-oriented environmental management.

	Regression coefficient	
	2002	2010
Public authorities	-0.07	-0.07
Local communities and environmental organisations	0.03	0.04
Supply chain partners	**0.36*****	**0.16***
Branch organisations	-0.03	0.07
Environmental covenants	-0.07	**0.23***
In-company environmental management	0.13	**0.44*****
Environmental budget	**0.18****	0.12
Firm size:		
- Medium	-0.09	-0.02
- Large	-0.04	0.09
Sector:		
- **Meat**	-0.08	**0.15***
- Fruit and vegetables	0.01	0.05
- Dairy	0.00	0.06
- Feed	0.07	0.08
- Bakeries	0.01	0.02
R^2, %	22.8	60.2
F-statistics	5.053***	8.765***

Significance ***= p < 0.01; **= p < 0.05; * = p < 0.10.

2.5. Discussion and conclusions

Because the demand for environmental sustainability and for affordable prices in the F&B industry is increasing, F&B firms have to design proper relationships in the supply chain. Collaboration of primary food producers, processors, and retailers has a promising potential to improve environmental, operational, and business performance and to respond to consumer demands more efficiently. In order to stimulate the development of sustainable food chains, a good understanding of the factors that influence managerial decisions to engage into E-EM is required. The present Chapter investigates the influence of external institutional and internal factors on the implementation of E-EM in supply chains. We base our empirical analysis on data from Dutch F&D industry that is characterised by a high level of innovation, supply chain cooperation, and experience in efforts to reduce environmental impact. Theoretical implications and contributions of this study, a discussion regarding the place of our findings in existing literature, implications for the managers, limitations, and avenues for future research are discussed below.

2.5.1. Linking the findings to existing literature and theoretical implications

2.5.1.1. External institutional pressures

The first contribution of this Chapter lies in investigating in a dynamic perspective external institutional and internal organisational factors that influence food processors' decisions to implement E-EM. We analysed the changes that occur over time in the factors that affect managers in their decisions to extend environmental management beyond the individual firm's boundaries in order to build a sustainable supply chain. To our knowledge, this is the first multi-period quantitative study that addresses this issue.

Also research on the role of institutional factors in supply chain cooperation is scarce (Miemczyk, 2008). A number of studies in the past addressed the adoption of specific practices within the scope of E-EM under external pressures. In particular, Kroon and Vrijens (1995) investigated from the reverse logistics perspective the reuse of secondary packaging material in the context of Dutch and German packaging regulative initiatives. Later Listeş and Dekker (2005) examined the use of sand originating from construction waste under restrictive regulation forbidding sand land filling in the Netherlands. Many similar studies in other countries considered the implementation of the specific practices within E-EM scope and in the context of particular regularity initiatives (see e.g. Barros et al. (1998), Gamberini et al. (2008), Hu et al. (2002), Louwers et al. (1999), Shih (2001), Spengler et al. (1997)). However, these studies lack an integrative approach as they considered only specific practices within the scope of E-EM and addressed external pressure primarily from the regulative institutional level. The present study provides empirical evidence that institutional pressures from various institutional levels exerted by different constituents of organizational fields are an important factor to explain the increasing implementation of E-EM by Dutch food processors.

However, institutional pressures from various levels are not equally important to adopt E-EM. Our empirical results indicate the influence of institutional pressures from supply chain partners and increasingly also from environmental covenants at normative and culturally-cognitive levels. We also found that regulative institutional pressure from public authorities had no impact on E-EM, both in 2002 and in 2010. These results confirm the theoretical classification of Driessen et al. (2012) discussed in Section 2.2.1 as it pertains to public authorities relying less on regulative institutional pressure (direct steering), leaving more power to the industry, stimulating front-runners as well as responsibility culture and self-organisation (like in case of covenants) among firms. The latter refers to normative and culturally-cognitive pressures. It was confirmed in an interview with a policy officer that Dutch public policy focuses at building responsibility and initiative of the industry. As the level of the E-EM implementation is increasing in 2010, it becomes clearer that E-EM's "rules and logic" are getting institutionalised and "becoming themselves institutional rules" in the food industry (cf. Sarkis et al. (2011)). This implies for food processors that environmental collaboration with customers, suppliers, and environmental information exchange in the supply chain are increasingly considered as "appropriate behaviour".

Although mean scores indicate that primarily normative pressure from local communities and environmental organisations is strengthening, it does not influence food processors' decisions regarding E-EM in contrast with findings of e.g. to Driessen et al. (2012). This could be explained by the fact that local communities do not distinguish between I-EM and E-EM. Instead, they demand results with respect to environmental impact reduction and leave the decisions how to meet their demand to the firms. As for environmental organisations, they might cooperate only with front runner firms. If this is the case, such cooperation will not be reflected in the aggregated results that we have presented.

Although we observed strengthening institutional pressure to adopt E-EM on normative and culturally-cognitive levels, the progress of food processors in E-EM could have been greater. Mimetic institutional pressure on the culturally-cognitive level and normative pressure (attributed to e.g. covenants and supply chain partners) could be associated with food processors willing to meet a certain common level of E-EM rather than to exceed it (Bansal and Roth, 2000). Firms might not wish to bear risks associated with first movers' strategies and just want to be in line with industry peers. Although this provides an incentive for firms to work on E-EM, it does not stimulate fast progress.

The strength of institutional pressures exerted by various constituents varies over time. In accordance with Goodrick and Salancik (1996) and Delmas and Toffel (2008), we found institutional pressures to be especially influential during the period of uncertainty when practices are less institutionalised. Indeed, in 2002 institutional pressure from supply chain partners was most influential for E-EM and internal organisational factors had a weaker impact. Eight years later, E-EM practices became more institutionalized as evidenced e.g. by increasing orientation of public-private covenants towards supply chain cooperation promoting this behaviour in the industry. So internal organisational factors primarily determined E-EM and institutional pressures played a secondary role in 2002. In 2002, managers faced high institutional pressure due to uncertainty of what constitutes an appropriate behaviour to achieve environmental impact reduction. In course of time, a knowledge base regarding the efficiency of E-EM is accumulated. As a result the uncertainty regarding the appropriateness of E-EM is diminishing. The question "Should we implement E-EM?" might be replaced with another question: "How do we implement E-EM?" For managers to decide upon the latter, internal organisational factors such as the level of I-EM might be more pronounced compared to external institutional pressures.

The finding that regulative pressure from public authorities have no significant *direct* impact on E-EM is consistent with Buysse and Verbeke (2003) and Qian et al. (2009). These authors state that other constituents than public authorities influence firms that undertake proactive environmental measures, like E-EM. In this context, our study contributes also to the more general discussion regarding the role of regulative institutional pressures promoting proactive environmental management. Our findings correspond to the findings of Miemczyk (2008) that regulative pressure does not stimulate and might even hinder specific novel environmental practices by diminishing their competitive value. This conflicts with the arguments of Sarkis et al. (2011) that environmental regulations in developed countries, like the Netherlands, increase environmental awareness and thus stimulate proactive EM. However, the described effects are *indirect*. Our study shows that when factors concerning environmental awareness are taken into account (e.g. environmental pressure of local communities, environmental organisations, customers), the direct effect of regulative pressure from the public authorities is not significant. If public authorities support "beyond compliance" behaviour explicitly, like in the study of Rivera (2004), the level of their regulative pressure is strengthening and a *direct* positive relation between regulative pressure from public authorities and "beyond-compliance" environmental behaviour is found. In line with Rivera (2004), Zhu et al. (2005) identified regulative pressure from the central government as the most important factor for E-EM development analysing data from Chinese manufacturing and processing industries. However, both Chinese public authorities and enterprises have an economic incentive to develop E-EM: satisfying environmental requirements of foreign importers. Interestingly, Sharfman et al. (2009) even found a negative effect of environmental regulation on E-EM among US firms; firms might be too busy working on complying with I-EM regulations to look for proactive environmental management solutions like E-EM.

As we saw in Section 2, a number of other studies also applied neo-institutional theory to E-EM implementation (Tate et al., 2011; Wu et al., 2012; Zhu and Sarkis, 2007). However, in these studies the investigation of external institutional pressures to develop E-EM was not combined with addressing the impact of I-EM as an internal organisational factor. The next section will elaborate upon our findings in this respect.

2.5.1.2. Internal organisational factors and constraints

While the Natural RBV lacks empirical support (Shi et al., 2012), this Chapter provides a second contribution as an empirical argument in favour of path dependency of environmental management from I-EM to E-EM. The overall results support the application of the Natural RBV to E-EM implementation. Food processors that made considerable progress with I-EM are also likely to develop E-EM. The absence of progress among small firms suggests that it is better to reach a sufficient level of I-EM first before proceeding with E-EM. This difference in development of E-EM is in line with our Hypothesis 6, which is based on the path dependency of environmental strategies, as discussed in Section 2.3.1. On the contrary, a study of Darnall et al. (2008) found that it is not important for the development of E-EM for how long I-EM had been implemented. Only a positive association between E-EM and I-EM was identified. In this context it should be noted that Darnall et al. (2008) considered firms that were already working on I-EM for 2.4 to 4.0 years. Perhaps a longer time period is required to progress from I-EM to E-EM. Also their empirical analysis did not consider institutional pressures.

In 2002, the availability of environmental budget appeared to be the most important internal factor that explains E-EM implementation. Also the level of I-EM adoption was low in 2002. When the level of I-EM was improved by 2010, environmental budget availability became less important for further progress in E-EM. Prior research referred to environmental budget availability as a concern for E-EM development. However, environmental budget availability was not measured as a separate construct but used to justify the effect of the firm size (Zhu et al., 2008a). We found that, indeed, smaller firms appeared to have smaller environmental budgets. As expected, smaller firm size hampers also F&B firms' progress towards E-EM as well as their perception of external pressures. This is in line with e.g. Min and Galle (2001) and Rivera (2004).

While prior studies focused solely on large firms or solely on SMEs, our study addresses both. Within SMEs a distinction was made between small and medium-sized firms. This appeared appropriate: our results show that medium-sized food processors are different from the small ones. In fact, their level and progress in E-EM development and I-EM implementation is more comparable to large rather than small firms.

2.5.2. Managerial implications: increasing E-EM adoption to improve environmental and economic sustainability in food chains

Because research simultaneously addressing internal organisational and institutional factors is scarce (Wu et al., 2012), our results provide important implications for F&B firms' managers and can support their decision making regarding investments in E-EM. Our findings show that external institutional pressures and internal organisational factors such as the level of I-EM implementation have a strong influence on the implementation of E-EM. Before extending environmental management towards the supply chain, managers first have to make sure that they have mastered I-EM in all its aspects. The philosophy of continuous improvement for environmental sustainability should be integrated in operational and managerial structures. When food processors are only in the process of I-EM implementation and when they address only a part of I-EM requirements, their propensity to work on E-EM together with supply chain partners is much lower.

When environmental practices are very novel and the institutional pressure regarding an appropriate behaviour is uncertain, managers perceive institutional pressures to be especially strong. So in 2002 we observed that the institutional pressure of supply chain partners was essential to motivate food processors in their E-EM development. By 2010, E-EM became more institutionalised. So that internal organisational factors like I-EM that can facilitate E-EM implementation became of primary importance. External institutional pressure from supply chain partners diminished its importance. Although the pressure from environmental covenants increased its influence on E-EM, it still played a secondary role compared to I-EM.

In our sample, we observed that mainly medium-sized and large F&B firms have reached sufficiently high levels of I-EM by 2010 and progress towards E-EM. While the progress of medium-sized and large firms is obvious, the level of E-EM among small firms was and remains low. Larger and more powerful partners in the food chain can use their power to involve small firms in E-EM, even if small firms have not yet mastered I-EM. In this case, I-EM implementation will be accelerated by E-EM in accordance with embeddedness of environmental strategies as discussed by Hart (1995). We did not empirically test embeddedness of E-EM and I-EM, but it provides an interesting opportunity for future empirical research.

2.5.3. Limitations and directions for future research

A limitation of this study is a relatively low response rate in 2010. This implies that the findings might not adequately reflect the targeted population. Nevertheless, non-response bias investigation and comparison of 2002 (when the response rate was sufficient) and 2010 samples on their demographical characteristics revealed no severe concerns. Consequently, we can consider the 2010 results acceptable if no unjustifiable population claims are made. Another limitation is that some measurements used in 2002 and 2010 are comparable, but not exactly the same. Although the differences in the measurements might have influenced the results, we base our conclusions on those empirical evidences that can be substituted one for another in 2002 and 2010. Moreover, sensitivity analysis suggests that scale differences do not jeopardize our findings. In particular, changing the way of conversion from one scale to another, we observe a stable sign of regression coefficients, a very small magnitude in the coefficient size change, and no changes in the level of significance that would affect the interpretation of the results. Despite these limitations, this research provided a unique opportunity to address E-EM development in a multi-period setting.

We see two potential avenues for future research. First, our research model can be extended by linking E-EM to perceived performance outcomes on the level of the individual firm but also on the food supply chain level. Performance outcomes could also be connected with the factors that influence E-EM development. For instance, firms actuated to develop E-EM by supply chain partners might be more positive about the contribution of E-EM to performance than firms developing E-EM due to normative pressure (e.g. from local communities and environmental organisations). Second, we found that the majority of F&B respondents did not reach a very high level of E-EM implementation. We identified that to be able to respond to external pressures of E-EM adoption it is important to achieve a certain level of I-EM first. Because many Dutch F&B respondents did not reach a sufficient level of I-EM yet, they also could not advance their E-EM. Nevertheless, even among firms with a high level of I-EM, the level of E-EM development is not high. Thus, we advise an in-depth qualitative investigation of success and failure examples of E-EM adoption in food supply chains.

CHAPTER THREE

CAPABILITIES FOR SUPPLY CHAIN-ORIENTED ENVIRONMENTAL MANAGEMENT.

Chapter Three answers the Research Question 2:

What organizational capabilities support the development of supply chain-oriented EM and how does supply chain-oriented EM influence firm performance?

This Chapter is based on:

K. Grekova, H.J. Bremmers, J.H. Trienekens, R.G.M. Kemp, S.W.F. Omta. Greening supply chains: capabilities and performance effects in Dutch food and beverage processors. To be submitted.

3.1. Introduction

During the last decade, the interests of manufacturing managers, policy makers, and researchers in environmental protection are increasingly shifting from the level of an individual firm towards the level of supply chains (SCs) and even networks (Pagell and Wu, 2009).

From a managerial perspective, it is getting more obvious that nowadays environmental impact cannot be managed by a focal firm acting in isolation. This is because the environmental impact of inputs, in- and outbound logistics, packaging, waste management, all depend on actions and the information of SC partners. Therefore, green supply chain management (GSCM)[5] emerged as a managerial tool to improve environmental sustainability of operations in collaboration with SC partners. GSCM refers to the integration of environmental concerns into the relationships with SC partners to take into account environmental impact beyond organizational boundaries (Darnall et al., 2008; Sarkis et al., 2011; Zhu et al., 2008b). As the focus of competition is shifting towards the SC and network level (Gold et al., 2010; Hall, 2000; Zhu et al., 2008a), GSCM practices have become increasingly important to maintain and enhance economic sustainability. Based on the growing empirical evidence, it is believed that GSCM has a potential to contribute to both environmental sustainability and firm performance (Chan et al., 2012; De Giovanni, 2012; Zhu et al., 2010). Alternative practices, such as outsourcing of polluting activities (Gavronski et al., 2011), can only be seen a short-run solution because they facilitate environmental degradation, undermine a firm's reputation, and jeopardize the "license to operate".

Our objective is *to provide a testable framework that explains what organizational capabilities support the development of GSCM as well as to get insight into its business performance implications*. Prior research suggests that this theme is largely unexplored (Chan et al., 2012). The proposed theoretical framework is grounded in the resource-based view (RBV) (Barney, 1991; Peteraf, 1993; Prahalad and Hamel, 1990; Wernerfelt, 1984) and in its extension the Natural RBV (Hart, 1995).

From an academic standpoint, the present study extends the understanding of GSCM impact on firm performance by analysing GSCM as a capability to integrate environmental concerns into the relationships with SC partners. We focus on three aspects of GSCM (Zhu et al., 2008c): green purchasing, environmental collaboration with customers, and eco-design. Prior research is increasingly converging in recognizing GSCM's potential to contribute to firm performance (Carter and Rogers, 2008; Gimenez and Tachizawa, 2012). However, empirical research is not consistent regarding the value-creating potential of the separate practices that construct GSCM (cf. e.g. Azevedo et al. (2011); Carter et al. (2000); Green et al. (2012); Hall (2000); Zhu et al. (2007)). Zhu et al. (2008b) show that the practices constructing GSCM are interconnected and can be united by the overarching factor. Through the implementation of green purchasing, environmental collaboration with customers, and eco-design, firms learn to integrate environmental concerns into their relationships with stakeholders, such as SC partners (Hart, 1995). Therefore, we consider how green purchasing, environmental collaboration with customers, and eco-design practices induce the development of the capability to integrate SC partners into the reduction of environmental impact, i.e. GSCM. From the RBV and Natural RBV perspectives, it can be advocated that proactive environmental management (green purchasing, environmental collaboration with customers, and eco-design) leads to the development of competitively valuable organizational capabilities (such GSCM with its the capability to integrate SC partners into environmental impact reduction) that induce firm performance (Aragón-Correa et al., 2008; Sharma and Vredenburg, 1998).

[5] See pp. 14-15 regarding the relationships between GSCM and supply chain-oriented EM.

Consequently, we explore the potential of the GSCM to improve firm performance, while treating GSCM as a *capability* to integrate environmental concerns into SC relationships.

Furthermore, the present study provides new insights into the capabilities required to develop GSCM. Prior research suggests that mostly innovative firms are likely to extend their environmental management towards SC level (Pagell and Wu, 2009). However, possessing innovative orientation capabilities does not imply that the firm can apply them not only to achieve core business objectives but also to reduce the environmental impact. The objective to reduce environmental impact should be embedded in the minds of the employees in order to be taken into account while they perform their functions. From the Natural RBV perspective, the firms with developed cross-functional cooperation can faster integrate environmental concerns into their relationships with SC partners (Hart, 1995). Therefore, integration of functions and efforts within the firm can ease the integration of stakeholders outside organizational boundaries. The efforts and expertise of the specialists working in different functions (purchasing, marketing and sales, R&D, quality, etc.) and support from all organizational layers are required if the firm wants to leverage the efforts of SC to minimize environmental impact of the product throughout its life cycle (Reuter et al., 2010; Walton et al., 1998; Zhu et al., 2008a). The present study contributes to existing literature by exploring how firms leverage their existing organizational capabilities (i.e. innovative orientation) to bring their capabilities to pursue the environmental strategy (i.e. integration of environmental concerns within organization) to the next level: towards the integration of environmental concerns into SC relationships. Our study proposes that innovative orientation is complementary to the integration of environmental concerns within the firm. Together, they can provide an additional impetus to the development of GSCM.

The present Chapter relies on empirical analysis of the survey data collected among Dutch F&B processors in 2013. This context is interesting from a theoretical prospective. Prior studies refer to the differences caused by industry variables that explain the variation in embracing GSCM practices (Zhu et al., 2011; Zhu et al., 2008c). Nowadays research addressing the implementation of GSCM practices in the food industry is still rather scarce (Manzini and Accorsi, 2013). Consequently, research in the food industry is also theoretically desirable to provoke a further discussion on the role the industry in the content and the scope of GSCM implementation.

The remainder of the Chapter is structured as follows. Section 3.2 is dedicated to the development of hypotheses linking organizational capabilities, GSCM, and firm performance. Data collection process, research variables operationalization and the research method are presented in Section 3.3. Section 3.4 presents the data analysis and the results of hypotheses testing. Finally, Section 3.5 discusses managerial and theoretical implications as well as limitations of the present study and directions for future research.

3.2. Theoretical framework

The RBV serves as the theoretical foundation to advocate the impact of innovative orientation, environmental integration, and their interaction effect on GSCM as well as to assess the impact of GSCM on firm performance. The RBV rests on the assumption that the firm's competitive advantage can be derived from and sustained due to organizational resources and capabilities. Unique bundles of resources that are rare, valuable, difficult to imitate and to substitute can provide competitive advantage (Barney, 1991; Wernerfelt, 1984). Organizational capabilities refer to the capacity to deploy the resources or their combination in the context of organizational processes to achieve the firm's objective (Amit and Schoemaker, 1993). The RBV is increasingly used to investigate the relationships between organizational capabilities, environmental management, and firm performance, not only in the field of strategic management, but also in the field of production, operations, and SC management (Schoenherr, 2012). From the RBV perspective, by implementing environmental practices that involve supply chain partners (such as green purchasing, environmental collaboration with customers, and eco-design), the firms induce the development of rare, socially-complex and difficult to imitate capabilities to integrate SC partners into the reduction of environmental impact. These capabilities can be leveraged to improve firm performance.

Hart (1995) extends the RBV to address opportunities and threats posed by the rise of environmental sustainability concerns. The Natural RBV discusses interdependencies between resources and capabilities that underpin proactive environmental management. Notably, Hart (1995) suggests that the presence of in-house internal integrative capabilities, associated with an internal cross-functional approach to environmental management, stimulates the development of an integration capability on SC level, associated with the stakeholders engagement in environmental management. The use of existing organizational capabilities developed within the core business strategy, such as innovative orientation, and capabilities to pursue environmental strategy, such as environmental integration, for GSCM is hardly explored in the literature. In the context of the RBV, Christmann (2000) shows that organizational capabilities developed to pursue environmental strategy need to be complemented by general organizational capabilities, developed within the core business strategy, to generate actual business improvements. Also recent studies propose the necessity of both types of capabilities for the development of GSCM (Beske, 2012; Pagell and Wu, 2009), but corresponding empirical research is scarce.

The theoretical framework presented in Figure 3.1 depicts the proposed relationships between organizational capabilities, GSCM, and firm performance. We suggest that environmental integration capability, innovative orientation, and their interaction stimulate the development of GSCM. GSCM can contribute to firm performance in terms of cost savings and market gains.

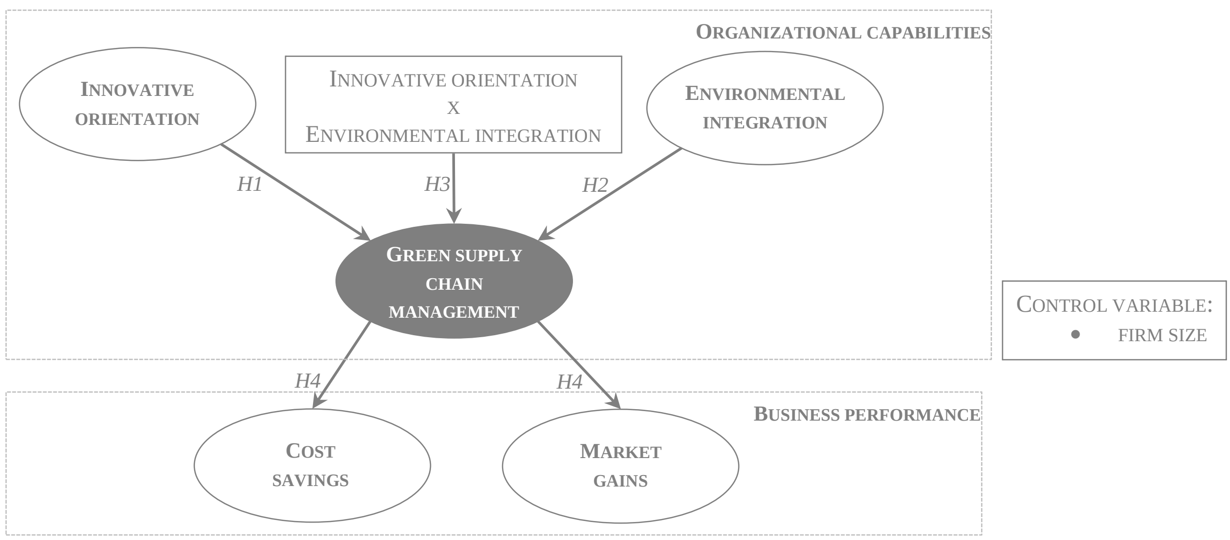

Figure 3.1. Theoretical framework.

3.2.1. Innovative orientation

Innovative orientation refers to a firm's willingness to explore new opportunities rather than only focusing on the exploitation of its existing strong aspects (Menguc and Auh, 2006). Moreover, innovative orientation pertains to the flexibility and responsiveness to anticipate and react on changes in the market demands (Wong, 2013a). Learning and market orientation are important aspects of the firm's innovative orientation that make this capability especially valuable for the firms (Hult et al., 2004; Menguc and Auh, 2006). Any innovation should be market-oriented. This is because the firm can achieve and sustain a competitive advantage in the targeted markets only if it can better understand and meet customer needs (Narver et al., 2004). Innovative orientation of the firm is associated with a continuous search for innovative solutions that take advantage of new available information. When an innovation occurs, it generates positive innovation spillovers that can be (temporarily) compensated by first mover advantages or patents. First mover advantages and patents prolong the advantages achieved from innovation. However, not all environmental improvements can be patented and imitators can access them (Wagner, 2007). Consequently, innovative orientation is important in order to ensure that the firm continuously updates existing practices, stays in search for performance optimization, and keeps up with the market and competition.

Sharma and Vredenburg (1998) illustrate that the capability of innovative orientation in environmentally proactive firms is a part of organizational culture and is *not* restrained to a specific organizational function (e.g. R&D). Consequently, innovative orientation is a general organizational capability developed within the core business strategy.

Sharma and Vredenburg (1998) suggest a positive association between innovative orientation and proactive environmental strategies. Wong (2013a) found that more innovative firms are more likely to generate solutions that benefit both environmental and firm performance. For instance, general capabilities to continuously update or develop new technologies complement pollution prevention practices and provide firms with additional competitive advantage (Christmann, 2000). Past research linking innovative orientation to proactive environmental management on SC and network level is scarce. The review of Cantor et al. (2012) concludes that innovative orientation capability needs to be continuously enlarged through the co-production of knowledge and development of new competences together with SC and network partners. According to the case studies of Pagell and Wu (2009), innovative organizations are the leaders in sustainability when it comes to the implementation of GSCM practices and seeking for novel partners to take advantage of new knowledge and opportunities. However, their empirical analysis relied on data only from the case studies among sustainability leaders and requires further investigation.

Hypothesis 1. Innovative orientation of a firm is positively related to GSCM.

3.2.2. Environmental integration

To ensure sustainable production and distribution, managers have to integrate environmental concerns within the organization. Environmental sustainability cannot be achieved by the efforts of the environmental function alone. It must be a part of the job of employees at different organizational layers and of employees operating in different functions (e.g. quality, R&D, production, procurement, etc.) (Pagell and Wu, 2009). Commitment to environmental impact reduction should first penetrate the organization in order to generate spillovers to the SC and ultimately to stimulate GSCM. Therefore, the capability to integrate environmental concerns within the organizations should rely on cross-functional mechanisms as well as the mechanisms that span organizational layers. So Christmann (2000) expects that cross-functional management within the firm complements the capabilities associated with stakeholders integration beyond firm's boundaries.

In the present Chapter, we refer to environmental integration as the integration of environmental concerns into decision making of employees working in different organizational functions and at different organizational layers. Environmental integration has to be achieved on both the strategic and operational level. On the strategic level, values and behaviour of the top management with respect to environmental sustainability are essential for the implementation of green projects in the firm (Gavronski et al., 2011; Handfield et al., 2005) and beyond the boundaries of an individual firm (Waddock et al., 2002). Top management commitment to the reduction of environmental impact is important for employees' commitment to environmentally responsible behaviour (Cantor et al., 2012) and for the development and the implementation of creative environmental ideas by employees (Ramus and Steger, 2000). Integration of environmental concerns at the strategic level stimulates building an internal responsibility culture with a positive self-regulation and an environmental mindfulness of the employees in the firm (Thomas et al., 2004). These examples show how strategic integration of environmental concerns within the firm stimulates proactive environmental stance. Proactive environmental stance implies being open for new solutions for reducing environmental impact (Sharma, 2000). These solutions can cover also environmental cooperation with SC partners and engaging with a wider range of non-commercial stakeholders. Based on the evidence that especially cross-functional programs call for managerial support, Zhu et al. (2008a) hypothesize and prove that GSCM, as a cross-functional initiative, relies on strategic commitment to the reduction of environmental impact.

On the operational level, integration of environmental concerns in different functions and organizational levels within the firm is essential for the integration of environmental concerns in SC relationships. GSCM practices require cooperation in the SC. SC cooperation calls for the in-depth involvement in environmental management of the specialists in procurement, logistics, marketing and sales, operations, quality management, etc. For example, cross-functional cooperation facilitates eco-design. This is because efforts in different functional areas need to be joint to reduce environmental impact of the product throughout its life cycle (Wong, 2013a). Pagell and Wu (2009) found that when environmental management is concentrated in the hands of a single person/department, employees in the other functional areas are not likely to include environmental concerns in their decision making. When environmental concerns are integrated in the organization, employees are likely to cooperate with a wider range of actors to integrate their knowledge and interests. Together, they can improve environmental sustainability of processes and products. For instance, Reuter et al. (2010) suggest and provide a case study evidence that firms that manage to integrate environmental concerns within the organization can develop sustainable SC environmental management capabilities at lower cost and in less time than competitors. Sharma and Vredenburg (1998) report that proactive firms in the Canadian oil and gas industry engage with concerned stakeholders groups for plant design, site location, new exploration and developments, including new product development, and recycling. Therefore, although past studies point to the potential of environmental integration to induce the involvement of SC actors in the reduction of environmental impact, corresponding empirical research is scarce and largely presented by case studies.

Hypothesis 2. Environmental integration within the firm is positively related to GSCM.

3.2.3. Synergy from innovative orientation and environmental integration capabilities

Embeddedness in the organizational culture (Sharma and Vredenburg, 1998) suggests that innovative orientation capability can be hard to imitate and that it can serve as a causally ambiguous and valuable capability to gain competitive advantage. Innovative orientation is a general organizational capability that is developed as an important part of the overall business strategy, not environmental strategy (Christmann, 2000). However, when the firm recognizes on a strategic and operational level the importance of environmental strategy for the overall business continuity, competitiveness, and profitability, the firm can apply innovative orientation capability to advance environmental strategy. When innovative orientation is combined with environmental integration in the firm, it should stimulate employees on all organizational levels and functions to search for novel environmental solutions, such as GSCM. Christmann (2000) suggests that innovative orientation can be of assistance to capture potential benefits from the capabilities associated with environmental impact reduction. We expect that synergy can be realized as an interaction effect between innovative orientation and the firm's capability to integrate environmental concerns within the organization. This synergy contributes to overall organizational objectives by stimulating environmental management beyond organizational boundaries that has a potential to induce performance and competitiveness. Environmental integration capability makes sure that continuous search for innovation in the firm takes into account its commitment to the reduction of the environmental impact. Firms with embedded innovativeness and environmental concern will be more likely to implement proactive environmental practices, such as GSCM. Innovative orientation combined with environmental integration stimulates employees in different organizational functions and layers to search for new solutions to the reduction of environmental impact, such as GSCM.

Hypothesis 3. The higher a firm's innovative orientation, the higher the contribution of environmental integration to the development of GSCM

3.2.4. GSCM and firm performance

Prior research is not conclusive regarding the sign of the relationship between GSCM practices and firm performance. This relationship requires further investigation (see e.g. Chan et al. (2012), De Giovanni (2012), Seuring and Müller (2008), Zhu et al. (2012)). Firms might not be able to derive benefits from GSCM initiatives because of the costs and resource commitments that are necessary for the realization of GSCM projects. For instance, Zhu et al. (2005), studying a sample of manufacturing and processing firms in China, conclude that extra costs associated with GSCM practices (e.g. costs of purchasing of environmentally friendly materials, additional investments and operational costs, costs of training and education) exceed the cost savings realized due to GSCM initiatives. However, it must be noted that Zhu et al. (2005) do not cover other benefits from GSCM initiatives such as a potential increase in product price, higher market share, and improved corporate reputation (De Giovanni, 2012; Eltayeb et al., 2011). Also Green et al. (2012), based on the survey of US manufacturing managers, provide mixed findings regarding the relationship between GSCM practices and firm performance. Although some practices, like green purchasing, lead to overall performance improvement, eco-design appears to have a negative impact on firm performance. Concurrently, there are also evidences of eco-design potential to induce firm performance. Firms that cooperate with SC partners can (re)design products with lower life-cycle costs and reduce their own liability. Resulting from this cooperation superior products and improved efficiency can contribute to firm performance (Paulraj, 2011).

Previous studies addressing the relationships between GSCM and firm performance are not conclusive. Yet, the number of studies that evidence GSCM contribution to firm performance is increasing. The industry example of Unilever shows the potential of GSCM practices to improve corporate profitability. A sustainable sourcing strategy helps Unilever to secure supply, reduce costs, protect scarce resources, and meet consumer demands while at the same improving farmers' welfare (Unilever, 2012b). Different theoretical perspectives can be applied to justify positive relationships between GSCM and firm performance.

First, proactive environmental practices (green purchasing, eco-design, environmental collaboration with customers) lead to GSCM development. Therefore, GSCM can be linked to firm performance within the scope of the discussion “whether proactive environmental management pays” (Blanco et al., 2009; Molina-Azorín et al., 2009a). Sharma and Vredenburg (1998) found that adoption of proactive environmental management stimulates the development of valuable organizational capabilities, such as the capability of stakeholder integration, of higher-order learning, and of continuous innovation. These capabilities can contribute to the firm’s competitiveness and performance as indicated by cost savings, improvements in productivity and quality (Sharma and Vredenburg, 1998). Also Russo and Fouts (1997) suggest that proactive environmental strategies can be used by the firm to attract environmentally conscious customers. The study of Rivera (2002) provides empirical evidence that proactive environmental management can be leveraged by firms to increase product prices and sales. Therefore, although individual practices that construct GSCM do not necessary lead to improved firm performance, they induce higher order capabilities of stakeholders integration that are expected to be beneficial for firms.

Second, the Natural RBV of Hart (1995) suggests that environmental practices can bring sustained competitive advantage if they are associated with building resources and capabilities that are tacit, socially complex, and rare (i.e., company specific). GSCM relied on the capability of stakeholders integration that is socially complex (Shi et al., 2012), rare, and difficult to imitate (Pagell et al., 2010).

Third, also from the perspective of a relational view (Dyer and Singh, 1998) it is suggested that GSCM stimulates the development of trust and reputation-based relationships between the partners and ultimately leads to inter-organizational knowledge sharing (Cheng et al., 2008; Tencati and Zsolnai, 2009). The latter is one of the determinants of relational rents (Dyer and Singh, 1998). GSCM requires an exchange of technical information about each other’s product and operations and mutual willingness to learn to reduce environmental impact of those products and operations (Vachon and Klassen, 2008). GSCM stimulates the development of relational capabilities with SC partners. These can lead to other than environmental improvements, for instance, product quality improvements (Azevedo et al., 2011; Vachon and Klassen, 2008). Through GSCM practices SC partners can leverage each other’s resources, exploit resource complementarities, and create superior resource bundles to provide competitive advantage and improve performance (Lee et al., 2012).

Hypothesis 4. GSCM is positively related to firm performance

3.3. Material and methods

3.3.1. Sample and data collection

The research model presented in Figure 3.1 was empirically tested based on the data from a survey among Dutch F&B processors conducted in 2013. Addresses and telephone numbers of F&B processors with at least 10 employees were acquired from the Dutch Chamber of Commerce. The firms were telephoned to communicate the research background and to ask for contact details of the employee responsible for environmental issues. This employee was telephoned to explain the research objective. After the respondent agreed to participate in the research, they received an email with the cover letter and link to the online questionnaire. A total of 606 contacted firms resulted in

131 usable responses that correspond to the response rate of 22%[6]. This is comparable to prior studies addressing the similar subject (see e.g. Wong (2013a), Gavronski et al. (2011)).

The presence of a non-response bias can threaten external validity and, therefore, was examined by comparing respondents with the firms that did not complete the questionnaire on the first items that open the questionnaire. Firms that did not complete the questionnaire were assumed to be comparable to non-respondents. We concluded that non-response bias is not a severe problem for our research because no statistically significant differences between respondents and non-respondents were revealed.

Common method bias (CMB) can arise because all data were collected from one source (one respondent) at one point of time. To avoid the inflation of structural parameters estimates in case of CMB's presence (Gefen et al., 2011), we used the marker-variable technique with competitive intensity in the industry as a marker variable (Leonidou et al., 2013) to check for the presence of the CMB. The outcome shows not potential concern for the CMB.

3.3.2. Measurement development

The scale items were constructed based on the measures developed in the past research. The questionnaire was evaluated by the representatives of the industry and branch organizations. This resulted in minor adjustments of the scales to better capture the context of the F&B industry. The scale items are reported in Table 3.1. The survey questionnaire offered respondents the statements to be assessed on a 7-point Likert scale ranging from "Not at all" = 1 to "Very much" = 7.

To measure innovative orientation we adapted four items from the construct of Wong (2013a) that is based on the study of Gold et al. (2001). These items express firm's flexibility in recognizing opportunities posed by market and competition and adjusting business to exploit these opportunities. Environmental integration capabilities on a strategic level were measured with three items adjusted from Gattiker and Carter (2010). The measure reflects top management support and involvement into the development and implementation of environmental projects. Four items addressing integration capabilities on operational level were adopted from the measures of Branzei et al. (2004) and Pujari et al. (2003). Items used to measure environmental integration pertain to the capabilities to integrate environmental concerns of employees working in different functions and at different organizational layers.

The present study adapted the measures suggested by Zhu et al. (2008b) to assess three key aspects of GSCM: green purchasing, cooperation with customers, and eco-design. Business performance implications of GSCM include cost savings and market gains. Achieved for the past 3 years cost savings were measured as a three-item concept based on Zhu et al. (2005). The literature suggests also other than cost savings firm performance improvements: higher market share, sales, and product quality (Azevedo et al., 2011; De Giovanni, 2012; Eltayeb et al., 2011). Consequently, a three-item construct was formulated to capture market value gains.

[6] In total, 143 responses were received but 12 of them had missing values on the variables included in the research model.

Table 3.1.
Survey constructs and measures used to test the research model.

		Loadings	T-values
Organizational capabilities			
Innovative orientation (CR=0.918, AVE=0.738)			
New opportunities to serve our clients are quickly understood	IO1	0.89	35.45**
We quickly analyse and interpret changing market demand	IO2	0.91	58.53**
We are among the first to recognize the changes in competition	IO3	0.89	35.39**
We have difficulties to adjust our business to meet the customer demand (reverse-coded)	IO4	0.73	13.07**
Environmental integration (CR=0.934, AVE=0.670)			
• ***On strategic level*** (CR=0.956, AVE=0.879)			
The top management actively supports the reduction of environmental impact of the firm	SI1	0.96	111.91**
The top management actively supports environmental project initiatives	SI2	0.95	60.61**
The top management is personally and actively involved in environmental projects implementation	SI3	0.90	39.25**
• ***On operational level*** (CR=0.935, AVE=0.782)			
There is a regular dialog on environmental issues between people working in different functions	OI1	0.86	31.81**
Functional specialists are encouraged to take environmental initiatives	OI2	0.92	63.26**
Most our employees are aware of what we are doing for the environment	OI3	0.87	36.22**
Employees on the working floor come up with suggestions how to reduce environmental impact	OI4	0.89	46.47**
Green Supply Chain Management (CR=0.909, AVE=0.560)			
• ***Green purchasing*** (CR=0.937, AVE=0.833)			
Awareness of what suppliers do to reduce environmental impact	GP1	0.90	46.77**
Provision of suppliers with environmental requirements	GP2	0.93	56.77**
Cooperation with suppliers for solutions to reduce environmental impact	GP3	0.91	46.24**
• ***Environmental collaboration with customers*** (CR=0.928, AVE=0.811)			
Cooperation with customers for reduction, reuse or recycling of the packaging	CC1	0.87	32.83**
Cooperation with customers for less energy usage during the product transportation	CC2	0.91	53.70**
Cooperation with customers for solutions to reduce environmental impact	CC3	0.92	57.53**
• ***Eco-design*** (CR=0.824, AVE=0.701)			
Implementation of improvements to reduce, reuse or recycle the packaging of the final product	ED1	0.87	28.08**
Implementation of improvements to use more natural materials and less synthetic/hazardous materials	ED2	0.80	15.23**
Business performance			
Cost savings *realized due to undertaken environmental measures for the last three years* (CR=0.905, AVE=0.761)			
Energy cost have decreased	CA1	0.90	46.40**
Water and waste water cost have decreased	CA2	0.79	64.32**
Savings on waste and waste treatment have been realized	CA3	0.92	15.75**
Market gains *realized due to undertaken environmental measures for the last three years* (CR=0.914, AVE=0.781)			
Product price has increased	MA1	0.81	16.16**
The turnover has increased	MA2	0.93	45.93**
Product quality has improved	MA3	0.90	40.69**
Control variable:			
Firm size: log number of employees			

Note: CR [composite reliability], AVE [average variance extracted]
** = p<0.01

All above described constructs were treated as reflective. However, we operationalized two concepts (environmental integration and GSCM) as second order formative constructs. The hierarchical latent variables were modelled using the repeated indicator approach (Lohmöller, 1989; Wold, 1982) to the modelling of higher order latent variables as a construct that comprises all the manifest variables of the underlying first-order latent variables (Becker et al., 2012). GSCM construct is endogenous in a nomological network. Under this condition, an application of the repeated indicator approach does not yield the estimates of path coefficients, because first order constructs already explain all the variance of the second-order construct. Consequently, a two-stage approach (Henseler and Chin, 2010; Ringle et al., 2012) was applied to be able to estimate the impact of innovative orientation and environmental integration on GSCM.

3.3.3. Method of data analysis

Data analysis was conducted in two stages that include measurement model evaluation and testing the relationships between the constructs. The first stage of analysis aims to ensure that the constructs are strong enough to be used in the model. The second stage is dedicated to structural model testing. Both stages of analysis were carried out with the variance-based approach to structural equation modelling (SEM) Partial Least Squares (PLS), the Smart PLS 2.0 application (Ringle et al., 2005). Variance-based SEM with PLS was preferred over covariance-based SEM because we use formative constructs.

3.4. Results

3.4.1. Measurement model evaluation

The adequacy of measures was evaluated based on the output of the PLS analysis. The adequacy of reflective and formative measures is assessed in different ways due to different theoretical considerations behind the construct formation. Our study employs first order reflective constructs and a number of second order formative constructs. First, we evaluated the adequacy of reflective measures by addressing different aspects of measures' validity and reliability. Second, the quality of formative constructs was examined based on the significance of items' weights and multicollinearity statistics.

We assessed *content validity* to decide if our measures reflect a specific domain of a content (Carmines and Zeller, 1979). The loadings above the threshold of 0.7 (Table 3.1) evidence *item reliability*. This indicates that at least half of the variance of the indicator is captured by the latent construct. *Internal consistency reliability* refers to a strong association between the indicators assigned to the same construct to ensure the homogeneity and unidimensionality (Gerbing and Anderson, 1988). The values of composite reliability (Table 3.1) are in a range from 0.82 to 0.96, well above the threshold of 0.8 (Nunnally, 1978). They indicate that the items show a good internal consistency reliability in relation to their constructs. *Convergent validity* requires the latent construct to capture at least half of the items' variances. The values of Average Variance Extracted (AVE) (Table 3.1) well above 0.5 suggest an adequate convergent validity.

Discriminant validity was evaluated in two ways: relying on the Fornell-Larcker criterion (Fornell and Larcker, 1981) (Table 3.2) and examining the cross – loadings (Table 3.3). Both ways report that any latent construct is different from the other latent constructs in the model. In particular, the Fornell-Larcker criterion suggests that the AVE should be higher than the variance (squared correlations) between the construct and the other constructs. Alternatively, the square root of AVE should be greater than the correlation coefficient of the focal construct with any other construct in the model. Table 3.2 indicates that this condition is met. Therefore, items are distinct from each other, so that their discriminant validity is established. The same conclusion can be reached looking at the cross-loadings (Table 3.3). For every construct, the loadings of the corresponding manifest items are higher than the loadings of the manifest items belonging to the other constructs.

Table 3.2.

Correlation table for the examination of the Fornell-Larcker criterion for discriminant validity

		1	2	3	4	5	6	7	8	9
1	Innovative orientation	**0.86**								
2	Strategic integration	0.42	**0.94**							
3	Operational integration	0.58	0.63	**0.88**						
4	Green purchasing	0.52	0.59	0.63	**0.91**					
5	Collaboration with customers	0.45	0.52	0.49	0.64	**0.90**				
6	Eco-design	0.24	0.33	0.29	0.38	0.52	**0.84**			
7	Cost savings	0.37	0.50	0.47	0.46	0.41	0.28	**0.87**		
8	Market gains	0.30	0.31	0.47	0.37	0.32	0.43	0.38	**0.88**	
9	Firm size	0.46	0.33	0.47	0.44	0.37	0.06^{ns}	0.42	0.16^{ns}	**na**

Note: Bold numbers on the diagonal show the square root of AVE;
Off-diagonal numbers represent construct correlations.
All the correlations above are significant at $p<0.01$ level except those denoted with ^{ns} = not significant.

Table 3.3.

Cross-loadings for the evaluation of discriminant validity

	Innovative orientation	Strategic integration	Operational integration	Green purchasing	Collaboration with customers	Eco-design	Cost savings	Market gains
IO1	**0.89**	0.35	0.50	0.45	0.38	0.26	0.29	0.31
IO2	**0.91**	0.34	0.49	0.47	0.43	0.21	0.26	0.23
IO3	**0.89**	0.35	0.51	0.44	0.36	0.20	0.29	0.21
IO4	**0.73**	0.41	0.51	0.41	0.36	0.15	0.44	0.27
SI1	0.42	**0.96**	0.63	0.58	0.52	0.31	0.51	0.29
SI2	0.43	**0.95**	0.64	0.62	0.53	0.34	0.48	0.30
SI3	0.31	**0.90**	0.48	0.44	0.40	0.27	0.40	0.26
OI1	0.57	0.45	**0.86**	0.57	0.42	0.17	0.44	0.35
OI2	0.55	0.59	**0.92**	0.58	0.48	0.31	0.45	0.44
OI3	0.51	0.59	**0.87**	0.50	0.45	0.25	0.40	0.39
OI4	0.43	0.57	**0.89**	0.57	0.38	0.28	0.39	0.48
GP1	0.43	0.52	0.49	**0.90**	0.56	0.36	0.39	0.30
GP2	0.50	0.54	0.63	**0.93**	0.60	0.32	0.51	0.39
GP3	0.49	0.54	0.59	**0.91**	0.59	0.36	0.36	0.32
CC1	0.39	0.38	0.37	0.52	**0.87**	0.49	0.34	0.20
CC2	0.38	0.47	0.44	0.59	**0.91**	0.44	0.40	0.29
CC3	0.43	0.54	0.50	0.61	**0.92**	0.47	0.38	0.35
ED1	0.18	0.31	0.33	0.35	0.48	**0.87**	0.30	0.34
ED2	0.23	0.24	0.13	0.28	0.38	**0.80**	0.16	0.38
CA1	0.34	0.47	0.40	0.38	0.36	0.21	**0.90**	0.29
CA2	0.35	0.43	0.45	0.43	0.38	0.26	**0.92**	0.32
CA3	0.27	0.40	0.38	0.40	0.35	0.28	**0.79**	0.39
MA1	0.16	0.20	0.30	0.20	0.22	0.32	0.24	**0.81**
MA2	0.28	0.29	0.45	0.36	0.33	0.39	0.39	**0.93**
MA3	0.32	0.30	0.47	0.39	0.27	0.41	0.34	**0.90**

As stated in the Section 3.3.2, we developed two higher order constructs to capture the overarching capabilities related to environmental integration and GSCM. The results evidencing an adequate quality of the constructs are presented in Table 3.4. In case of two second-order formative constructs we relied on the examination of Variance inflation factors (VIF) and significance of the weight to judge upon the latent constructs' adequacy. Both criteria show no reason for concern: weights are significant while VIF's values do not show any serious multicollinearity concerns.

Table 3.4.
Assessment of the second-order constructs

	Environmental integration			GSCM		
Weights and VIFs of the 1st order constructs:	Weight	T-value	VIF	Weight	T-value	VIF
• Strategic integration	0.61	24.56**	4.39			
• Operational integration	0.50	30.80**	4.39			
• Green purchasing				0.49	20.30**	1.69
• Collaboration with customers				0.47	21.85**	1.97
• Eco-design				0.21	10.38**	1.37

3.4.2. Structural model analysis and evaluation

Figure 3.2 depicts the results of hypotheses testing. Table 3.5 summarizes the model parameters generated by PLS-SEM analysis. Bootstrapping provided the indicators of significance of the model parameters. Following the recommendation of Chin and Newsted (1999), 500 resamples were drawn from the original sample with 131 cases.

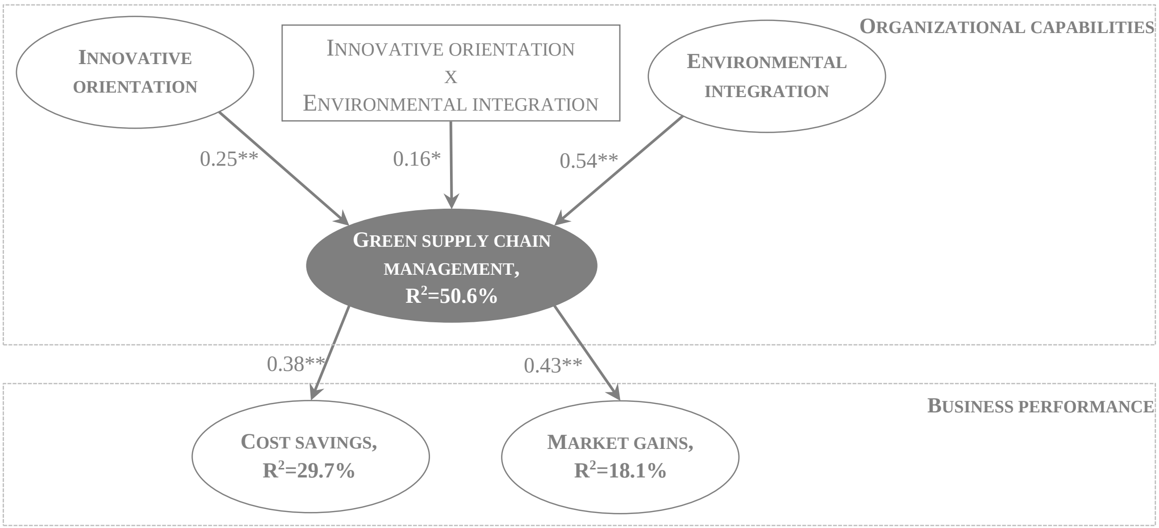

Figure 3.2. Model testing results.
(The control variable is not shown)

Table 3.5.
Structural model analysis.

Path to:	GSCM (R^2=50.6%)		Cost savings (R^2=29.7%)		Market gains (R^2=18.1%)	
Path from:	Path coef. ξ	t-value	Path coef. ξ	t-value	Path coef. ξ	t-value
Environmental integration	0.54	6.843**				
Innovative orientation	0.25	2.648**				
Environmental integration x Innovative orientation	0.16	2.249*				
GSCM			0.38	4.522**	0.43	5.553**
Firm size	0.05	0.637	0.27	3.544**	-0.01	0.158

Note: ** = p<0.01; * = p < 0.05

The factors included in the model explain 51% of GSCM's variance. The substantial amount of explanatory variance is attributed to the presence of environmental integration capabilities. In line with Hypothesis 2, capabilities to integrate environmental concerns in strategic and operational levels in the organization have a strong and positive impact ($p<0.01$) on the integration of environmental concerns into SC relationships, i.e. GSCM. To explain the implementation of GSCM, not only capabilities related to the organizational aspects of environmental management in the firm are required. Innovative orientation ($p<0.05$) is important to develop GSCM. This confirms Hypothesis 1. In combination, innovative orientation and environmental integration can provide an additional impetus to GSCM development. A positive and significant interaction term ($p<0.05$) indicates that the higher the firm's innovative orientation, the more environmental integration stimulates GSCM. This result supports Hypothesis 3.

The implementation of GSCM practices is positively and significantly related to firm performance improvements, both in terms of cost savings ($p<0.05$) and market gains ($p<0.01$). Consequently, we fail to reject Hypothesis 4. It should be noted that factors included in the model explain substantial proportions of variance of cost savings (36.7%) and market gains (33.0%).

Also the control variable plays an important role in the research model. The size of the firm is positively and strongly related ($p<0.01$) to GSCM: larger firms are much more likely to integrate their SC partners into the reduction of environmental impact.

3.5. Discussion and conclusions

This study was conducted in response to a call to analyse organizational capabilities required to stimulate GSCM (Chan et al., 2012; Darnall et al., 2008; Gavronski et al., 2011; Zhu et al., 2008a). In this context, we examined the potential of GSCM, as a capability of integrate SC partners into the reduction of environmental impact, to improve firm performance. The results indicate that GSCM is positively influenced by the innovative orientation of the firm and the integration of environmental concerns within the organization. These two capabilities accelerate each other, what provides an additional impetus to the development of GSCM. The level of GSCM appeared to be positively related to firm performance both in terms of market gains and cost savings on energy, water, and waste treatment.

3.5.1. Theoretical implications

Urged by an increasing shift of environmental management beyond organizational boundaries, a large number of studies investigated organizational factors that can support this shift. In addition, in the last years the potential of environmental management in SCs to enhance firm performance was considered. Although multiple studies examined determinants of GSCM, they mostly focused on the role of organizational capabilities developed within the scope of environmental strategy. Accordingly, we address the impact of the capability to integrate environmental concerns within the firm on GSCM. The present study also explores the influence of existing organizational capabilities, not restraint to environmental management, on GSCM. Innovative orientation of the firm, developed within the firm's core strategy, can be used to advance the environmental strategy towards GSCM. The present study offers a model that explains what organizational capabilities support the development of GSCM as well as addresses its performance implications.

We provide a first contribution by examining the interdependencies between organizational capabilities required for proactive environmental practices. Case studies of Pagell and Wu (2009) and mixed method study of Sharma and Vredenburg (1998) point out the importance of general organizational capabilities, such as innovative orientation for environmental management that spans organizational boundaries. Considering past empirical literature, the studies in SC context that analyse how the firms apply their capabilities developed within their core strategy to provide an additional impetus to the development of environmental strategy are very scarce. In case of GSCM, we not only found that capabilities related to environmental management are important, but also general organizational capabilities, such as innovative orientation, that are not restrained to specific organizational functions. The general organizational capability of continuous innovation appears to complement environmental integration. Their interaction was found to stimulate GSCM. In Section 3.2, we showed that innovative orientation and environmental integration are valuable organizational capabilities that could induce competitive advantage. In case of GSCM, it is shown that these organizational capabilities also stimulate more advanced environmental capabilities, such as GSCM, that in turn contribute to corporate profitability.

The capability to integrate environmental concerns within the organization appeared to be positively related to the integration of environmental concerns in SC relationships. This finding provides empirical support to the theoretical propositions of Hart (1995) and Christmann (2000): firms with a cross-functional approach are more likely to engage in environmental collaboration with external stakeholders. The way we build a statistical model enables not only to test the relationships between integration capabilities and GSCM practices (i.e. green purchasing, environmental collaboration with customers, and eco-design), but rather between in-house integration capabilities and GSCM capabilities (i.e. integration of environmental concerns into the relationships with SC partners). In particular, we operationalized GSCM as a second order reflective-formative construct. It implies that GSCM scores refer to overarching GSCM capabilities common for green purchasing, collaboration with customers, and eco-design. Such a model formation suits our objective to test interdependency between organizational capabilities and constitutes the second contribution of our study.

Green et al. (2012) illustrate how specific environmental practices in SC context, such as eco-design, might not be always beneficial for corporate performance, while the other practices, like green purchasing are more likely to induce firm performance. Our study shows that overarching capability of SC partners in environmental management is beneficial for firms. This finding provides additional support to the stream of studies that advocates profit-creating potential of GSCM, e.g. Zhu et al. (2010), De Giovanni (2012), Chan et al. (2012). We extend this stream by showing that overarching capability of integration of SC partners into the reduction of environmental impact is worth developing for firms. Although specific environmental practices that involve SC partners (green purchasing, eco-design, or environmental collaboration with customers) do not necessary contribute to firm performance, they are interdependent and together stimulate GSCM. The fact that in case of Dutch F&B processors GSCM is positively associated with firm performance provides evidence in favour of GSCM potential to improve environmental and economic sustainability in SCs.

3.5.2. Managerial implications

The results of this study have important implications for managers. Our empirical findings confirm the postulate that GSCM is a “managerial tool and philosophy” to enhance environmental and economic sustainability of SCs (Zhu et al., 2008b). First, GSCM is a *managerial tool*. Section 3.4 evidences the importance of internal organizational capabilities for GSCM. The fact that *internal* organizational capabilities explain a large proportion of GSCM variation indicates that a lot of power is concentrated in the hands of managers. By stimulating innovative orientation and the integration of environmental concerns within the organization, managers can enhance GSCM capabilities that ultimately lead to cost savings and market gains. Second, GSCM is indeed an *"organizational philosophy"*. This is because GSCM relies on rare, causally ambiguous, and valuable capabilities of innovative orientation and integration of environmental concerns within the organization. It is a real challenge for managers to develop a proactive and innovative organization with an environmentally concerned mind-set. Our findings indicate that top management commitment to environmental impact reduction, support of environmental projects and involvement in their implementation are the building blocks for integration of environmental concerns in the firm. Raising employees' environmental awareness, encouraging cross-functional and cross-layer environmental communication and initiatives are needed for environmental concerns to be able to penetrate the organization. Integration of environmental concerns within an innovative firm additionally stimulates the development of GSCM.

3.5.3. Limitations and directions for future research

Finally, the limitations of the study have to be acknowledged. First, we relied on self-reported data because, unfortunately, no actual data were available. It is a common practice in GSCM research. Nevertheless, empirical survey research based on the actual data is desirable to validate our findings. Second, our research is limited to the data from food processors. As it was established that industries vary significantly in their patterns of GSCM development (Zhu et al., 2008b), future studies can test the model in the context of different industries. Third, prior literature addressing the relationships between GSCM practices and firm performance suggests that this relationship might vary in the long- and short-run. In particular, Chan et al. (2012) and Zhu et al. (2012) are concerned that GSCM might not contribute to firm performance in the short run but rather provides long term benefits. We conducted a cross-sectional study examining the relationships between GSCM and firm performance. Future studies can test our model in a longitudinal setting.

CHAPTER FOUR

SUPPLY CHAIN-ORIENTED ENVIRONMENTAL MANAGEMENT AND FIRM PERFORMANCE.

Chapter Four answers the Research Question 3:

What is the potential of supply chain-oriented EM to improve environmental sustainability of internal processes and firm performance?

This Chapter is based on:

K. Grekova, H.J. Bremmers, J.H. Trienekens, R.J. Calantone, S.W.F. Omta. How environmental collaboration with suppliers and customers influences firm performance: evidence from Dutch food and beverage processors. Submitted.

4.1. Introduction

Urged by the current state of the natural environment, the dynamic evolution of stakeholders' requirements and changing methods to achieve environmental sustainability, manufacturing firms are continuously searching for practices and partnerships for sustainable growth. Embedding sustainability concerns in supply chain relationships is increasingly employed to reduce environmental impact of the product throughout its life cycle (i.e. FrieslandCampina (2012), Unilever (2012a)). In environmental collaboration, supply chain partners leverage each other's resources and exploit learning and knowledge sharing opportunities to enhance environmental sustainability.

Prior research on environmental collaboration with supply chain partners focused on its determinants and performance implications (i.e. Diabat and Govindan (2011), Zhu et al. (2013)). However, quantitative research that investigates what changes in business processes and technologies are induced by environmental collaboration is scarce. Only Chiou et al. (2011) examined how environmental collaboration with suppliers induces improvements in environmental sustainability of internal processes. However, their research only considered collaboration with suppliers. Case studies of Hall (2000) showed that improvements in environmental sustainability of internal processes might occur primarily for one of the two parties and depend on the party's buyer/seller position in the dyad and characteristics of the relationships. Therefore, we examined two types of dyads: environmental collaboration with suppliers and customers. The goal of the present Chapter is to explore the potential of environmental collaboration with suppliers and customers to change internal processes to address external sustainability pressures and to improve business performance.

Another gap we address concerns potential indirect relationships between environmental collaboration and firm performance. Most studies on environmental collaboration examined a *direct* impact of inter-firm linkages on firm-level performance (see i.e. Zhu et al. (2007), De Giovanni (2012), Gimenez and Tachizawa (2012)). However, two RBV spin-offs, the relational view (Dyer and Singh, 1998) and the extended RBV (Lavie, 2006), suggest that environmental collaboration can influence firm performance *indirectly*: it creates joint collaborative advantage for both parties and the share appropriated by each party contributes to firm-level performance. Innovation is one of the corner stones of (joint) collaborative advantage (Cao and Zhang, 2012). Considering environmentally sustainable process improvements introduced by the focal firm as an appropriated part of collaborative advantage, we investigate the indirect effect of environmental collaboration on firm performance via environmentally sustainable process improvements. Providing manufacturing managers with better understanding of direct and indirect relationships between environmental collaboration and firm performance can gain them more control over environmental collaboration outcomes.

The Chapter is organized as follows. Section 4.2 discusses the relationships between environmental collaboration, environmentally sustainable process improvements and firm performance in light of RBV spin-offs. Furthermore, the research model and hypotheses are presented. Then the approach to data collection and analysis is described, followed by analysis of collected data. Section 4.5 discusses our findings, implications and avenues for future research.

4.2. Theoretical framework

The theoretical framework of the present study is grounded in RBV spin-offs: relational view and extended RBV. Together they underpin hypotheses linking environmental collaboration, environmentally sustainable process improvements and firm performance.

The RBV originated as an attempt to look for factors that explain the firm's performance inside the firm as opposed to the Porterian approach. Resources and capabilities, which are heterogeneous across firms and imperfectly mobile, generate above-normal rents and a sustained competitive advantage if they are valuable, rare, imperfectly imitable and non-substitutable (Barney, 1991). The RBV considers only rents generated by an individual firm as a unit of analysis in accordance with the competitive paradigm (viz. quasi-rents, ricardian, monopoly rents (Peteraf, 1993)).

Especially in environmental management, the research focus is shifting for over a decade from the individual firm level towards collaboration in supply chains and networks (Reed, 2008; Sarkis et al., 2011). Among reasons for this increasing interest in environmental collaboration is the inability to reduce environmental impact of the final product without considering the contribution of preceding stages of the supply chain. Although the RBV is widely used in environmental collaboration literature (Sarkis et al., 2011), RBV's application is limited by its embeddedness in the competitive paradigm that disregards cooperation benefits. This led to an increasing popularity of RBV spin-offs that rest on the cooperative paradigm (i.e. Vachon and Klassen (2008), Cheng and Sheu (2012)) with the premise that competitive advantage can be derived from collaboration.

The relational view (Dyer and Singh, 1998) conceptualizes inter-firm relationships as a source of competitive advantage and of a new type of rents (*relational rents)* created by the dyad in collaboration. Relational rents are derived through e.g. combining complementary and related resources and capabilities, learning and knowledge sharing. Collaborative (joint competitive) advantage, created in collaboration, has following dimensions: innovation, quality, process efficiency, flexibility and other business synergies (Cao and Zhang, 2012). Consequently, innovation such as sustainable process improvements, is one of the benefits from environmental collaboration that can enhance firm performance. However, the relational view considers collaboration benefits as joint for a dyad. It is not clear to what extent an individual firm can appropriate these benefits and enhance individual firm-level performance. Extended RBV addresses this gap.

The extended RBV (Lavie, 2006) offers the framework of competitive advantage of collaborating firms that addresses the shortcomings of the RBV and the relational view. Extended RBV redefines the rents of collaborating firms taking into account the problem of appropriation. The rent of collaborating firm includes, among the others, the share of relational rent the focal firm could appropriate and (un)intended involuntary gains from (non)shared partner's resources due to i.e. bargaining power, absorptive capacity and opportunism.

Suggested by the extended RBV rent composition has an important implication for our research: environmental collaboration is not only directly related to the firm performance. There is an indirect link from collaboration to performance through a share of collaboration benefits that the firm could appropriate. Sustainable process improvements, as an example of innovation, are one of the building blocks of collaborative advantage (Cao and Zhang, 2012; Möller and Törrönen, 2003). Consequently, environmental collaboration can influence firm performance: (1) *indirectly* by appropriating a part of collaboration advantage, i.e. via environmentally sustainable process improvements achieved due to environmental collaboration and (2) *directly* by appropriating a part of collaborative advantage realized by partners, i.e. lower inputs prices as a result of internal process improvements achieved by partners.

Empirical work of Cao and Zhang (2011) reflected on these theoretical developments. They found that supply chain collaboration has a positive impact on collaborative advantage that subsequently contributes to firm's performance. However, collaborative advantage was operationalized as a common benefit from collaboration that partners gain together. Such an operationalization does not address the problem of appropriation. To address this gap, we consider part of the collaborative advantage that the firm could appropriate - environmentally sustainable process improvements realized by the focal firm due to environmental collaboration.

Environmental collaboration literature on the appropriation of collaborative benefits is scarce. Most studies consider only the *direct* effect of environmental collaboration on firm performance (i.e. Eltayeb et al. (2011), De Giovanni (2012)). The review of Gimenez and Tachizawa (2012) shows that the findings regarding the impact of environmental collaboration on firm performance are not conclusive and require further examination to address, among others, potential mediators or indirect effects. Also the literature on environmental collaboration with downstream partners reports conflicting evidences. Vachon and Klassen (2008) found that environmental collaboration with customers has no impact on cost savings while Rao and Holt (2005) report a positive effect. The presence of conflicting findings calls for deeper investigation of possible indirect effects in line with RBV's spin-offs. Otherwise, interpretation of direct paths from environmental collaboration to firm performance might be misleading. Another challenge is to examine the presence of any residual direct effect of environmental collaboration on firm performance when the indirect effect that occurs via environmentally sustainable process improvements is taken into account.

In the following, we will formulate hypotheses that link environmental collaboration with suppliers and customers, sustainable process improvements and firm performance. Figure 4.1 provides an overview of hypotheses that link environmental collaboration to sustainable process improvements and firm performance. The following sections will elaborate on proposed relationships.

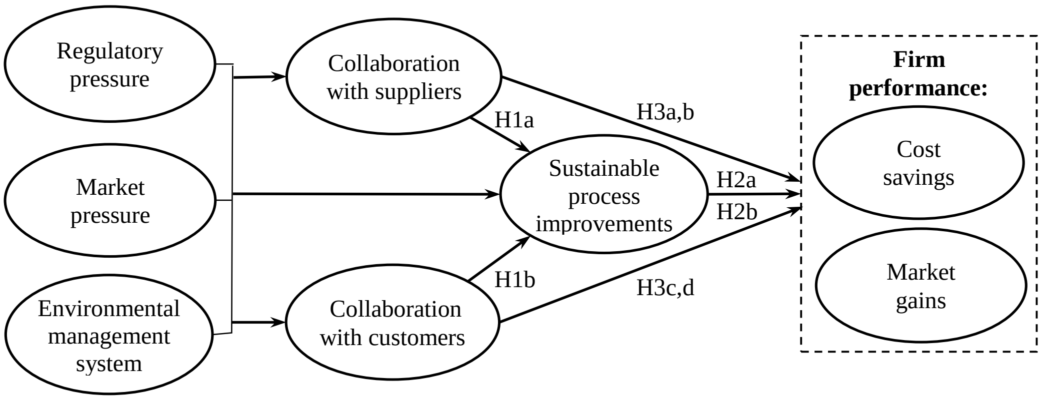

Figure 4.1. The research model.

4.2.1. Environmental collaboration and sustainable process improvements

The literature regarding the impact of environmental collaboration on sustainable process improvements is not clear-cut. Collaboration stimulates knowledge creation in the firm as it internalizes partner's knowledge or knowledge generated by partners in collaboration (Inkpen, 1996). In a sample of Corsten and Felde (2005), collaboration with suppliers has a positive impact on buyer's innovation. This is due to access to suppliers' knowledge of production and fulfilment, using suppliers' ideas to improve the end product and opportunity to share R&D costs. In environmental literature, according to theoretical developments of Hart (1995), firms engage in environmental collaboration with external stakeholders to minimize life-cycle costs of the product. Because environmental strategies are embedded, activities aiming to minimize life cycle costs facilitate internal changes in operations that prevent pollution. In empirical environmental research, case studies of Hall (2000) illustrated how, depending on external pressures, environmental collaboration of British and Japanese food retailers with their suppliers facilitated environmental innovations. Actual technological improvements were appropriated on the supplier side while the retailers could improve their performance directly, by selling better products. The study did not discuss any improvements induced by collaboration with suppliers on the retailers' side.

In the collaboration literature, an increasing attention is being paid to the characteristics of the suppliers due to their importance for the content and the outcome of collaboration (i.e. Kaufman et al. (2000), Schiele (2006)). In the context of F&B processors, suppliers have little opportunity to alter the nature of their outputs, but environmental collaboration with processors can help them to improve environmental sustainability of their own operations. The suppliers of F&B processors are often farmers of a smaller size and with lower R&D capabilities, market power and external pressures to reduce environmental impact. Therefore, they have little opportunities to induce environmentally sustainable process changes on their customers' side. Consequently, as opposed to many studies that blindly claim the necessity of environmental collaboration with suppliers in order to generate environmentally sustainable process improvements within the focal firm (i.e. De Marchi (2012)), we expect that in our context environmental collaboration with suppliers is likely to result in sustainable process improvements on suppliers side. Environmental collaboration with suppliers is not likely to induce sustainable process improvements among F&B processors.

Unlike environmental collaboration with suppliers, collaboration with customers has a strong potential to alter suppliers' environmental practices by means of learning and knowledge sharing, because the customers are one of suppliers' major financial stakeholders (Simpson et al., 2007). Collaboration with customers is crucial to increase the chance of success when bringing adapted, improved or new products to the market (Belderbos et al., 2004). However, the opportunities of F&B processors to modify their product in order to reduce environmental impact are often limited due to the nature of the product (Bremmers et al., 2009). Consequently, environmental challenges are primarily addressed through the process improvements stimulated by customers. F&B processors that seek to improve environmental sustainability of their processes are expected to reach it by environmental collaboration with customers.

Hypothesis 1a. *Environmental collaboration with suppliers is not associated with sustainable process improvements.*

Hypothesis 1b. *Environmental collaboration with customers is positively associated with sustainable process improvements.*

4.2.2. Sustainable process improvements and firm performance

Investments in environmental sustainability of business processes are promising to enhance also economic sustainability. Hart (1995) outlines cost saving opportunities. For instance, implementation of energy saving technologies can reduce the costs of inputs and firm's dependency on the energy price volatility. Waste reduction assumes more efficient usage of materials, lower purchasing and waste disposal costs. In addition, technologies that reduce pollution imply lower compliance and liability costs. Better environmental risk management leads to lower costs of equity and WACC (Sharfman and Fernando, 2008). Miles and Covin (2000) suggest also lower HRM cost due to safer and a higher quality/morale work environment. A firm initiating advanced sustainable process improvements can increase the costs of competitors as they would be challenged by external stakeholders to rise to a comparable level of environmental sustainability (Siegel, 2009).

Hypothesis 2a. *Sustainable process improvements are positively associated with cost savings.*

In theory, environmentally sustainable process improvements can serve as a differentiation basis to charge a higher product price or ensure a wider market coverage by pertaining to the requirements of environmentally conscious customers or consumers. Siegel and Vitaliano (2007) notice that in minds of consumers environmental characteristics of the product might be associated with a high product quality following the high quality-high price logic. Nevertheless, sustainable process improvements can induce actual quality improvements. Continuous improvement capabilities that support environmental improvements were shown to generate positive spillovers in terms of product quality (Melnyk et al., 2003).

Especially sustainable *process* improvements might be invisible to customers (consumers) due to their credence qualities (Darby and Karni, 1973). Such improvements cannot be detected by customers during the product use and require collection of additional costly information. The credence qualities of sustainable process improvements impede the appropriation of their potential economic benefits. However, branding and customer relationships can ease the monitoring of credence qualities (Darby and Karni, 1973). Sustainable process improvements can also be communicated to the customers as a part of the firm’s image. Consequently, there is a potential to realize market gains from sustainable process improvements, but it is difficult to conclude from the literature to what extend they can be realized in practice.

Hypothesis 2b. *Sustainable process improvements are positively associated with market gains.*

4.2.3. Environmental collaboration and firm performance: indirect and direct relationship

Building on the hypotheses in Sections 4.2.1 and 4.2.2, we can expect that environmental collaboration with customers facilitates the implementation of sustainable process improvements by F&B processors (H1b) that in turn contributes to F&B processors’ performance (H2a,b). Therefore, if these hypotheses are confirmed, *indirect* effects of environmental collaboration with customers on firm performance will be observed. As for environmental collaboration with suppliers, it is not expected to induce sustainable process improvements among F&B processors (H1b). Therefore, if Hypothesis 1a is confirmed, there will be no indirect effect of environmental collaboration with suppliers on firm performance through sustainable process improvements.

Environmental collaboration can also provide *direct* contributions to firm performance. Although we proposed that F&B processors do not benefit from environmental collaboration with suppliers through sustainable process improvements, F&B processors can receive direct benefits from engaging in business with eco-efficient suppliers. For instance, Carter (2005) found that socially responsible purchasing stimulates organizational learning that improves suppliers’ performance, while better supplier’s performance induces cost savings on the buyer’s side. In addition to indirect effects through environmental process improvements, environmental collaboration with customers can contribute to firm's performance directly. This is because customers rely on reward and incentive systems to encourage environmentally conscious supplier behaviour (Seuring and Müller, 2008).

The impact of collaboration on performance depends on the firm's role in the buyer-seller dyad (Spekman et al., 1998). In the up-stream collaboration, when the focal firm is a buyer, it emphasizes cost and lead time reduction as well as securing a reliable source of supply. In the up-stream collaboration, acting as a seller, the focus is on revenue enhancements, strategic market position, and customer satisfaction. Consequently, F&B processors are most likely to benefit from environmental collaboration with their suppliers in terms of cost savings and from environmental collaboration with customers – in terms of market gains.

Hypothesis 3a. *Environmental collaboration with suppliers is positively associated with cost savings*

Hypothesis 3b. *Environmental collaboration with suppliers is not associated with market gains*

Hypothesis 3c. *Environmental collaboration with customers is not associated with cost savings*

Hypothesis 3d. *Environmental collaboration with customers is positively associated with market gains*

4.2.4. Control variables

External stakeholders' pressures is one of the major determinants of any form of environmental management as it is associated with gaining social legitimacy and drawing differentiation advantage (Hart, 1995). We considered two major stakeholder forces, regulatory and market pressures, as external control variables that stimulate environmental collaboration and sustainable process improvements. Internally, continuous improvement capabilities underpinning the functioning environmental management system (EM system) facilitate environmental collaboration (Grekova et al., 2014) as well as sustainable process improvements.

4.3. Material and methods

4.3.1. Sample and data collection

Empirical data to test the research model were collected through a survey conducted among Dutch F&B processors that have at least 10 employees in 2013. Their contact information was acquired from the Dutch Chamber of Commerce. Managers responsible for environmental management were contacted by phone to explain the research objective. If willing to participate, they received an email with a cover letter and a link to the online-based questionnaire. The cover letter explained the purpose of the survey and ensured the anonymity of the respondents. If the firms were not interested in the research, they were asked for the reason of refusal. To increase the response rate, a reminder to complete the survey was sent in two weeks after initial mailing.

Out of 143 received questionnaires, 4 were incomplete. Contacting 606 firms resulted in 139 usable questionnaires. An effective response rate of 23% is fair in comparison with recent similar studies in the field (cf. Eltayeb et al. (2011), Wong et al. (2012)).

Among the most common reasons for non-response, firms mentioned a lack of time, restricting company policy and having no interest in cooperation with the researchers. To detect the presence of non-response bias and to judge upon the generalizability of our results, we compared respondents and non-respondents on their demographical characteristics, such as firm size and industry sector. Small firms are less likely to respond compared to medium-sized and large firms (χ^2=35.08, df=2, p=0.00). Also the proportion of the bakery firms is significantly smaller in the sample compared to the population, so that other F&B sectors are slightly overrepresented in the sample (χ^2=16.07, df=5, p=0.01). Because most bakery firms are small, we can conclude that our sample is skewed towards the larger firms. The underrepresentativeness of the smaller firms in the sample can hardly be avoided due to their lack of resources and skills for participation in research (Wagner, 2007). As an additional test, respondents were compared with the firms that started but did not complete the questionnaire on “sustainable process improvements” items that opened the questionnaire. The difference between respondents and these non-respondents was non-significant.

Also the common method bias (CMB) can pose a threat to the conclusions based on the survey data. When all data are collected with the same method, the systematic error can occur due to characteristics of respondents, question items, the circumstances in which the items were provided and measured (see MacKenzie and Podsakoff (2012)). The CMB can affect the estimates of constructs validity and reliability as well as the estimates of the relationships in the model (MacKenzie and Podsakoff, 2012). The presence of the CMB was tested with Harman’s single-factor test. When all the items are loaded on one factor in confirmatory factor analysis (CFA), CFA model with a single factor shows a poor fit to the data (normed chi-square [χ^2/df] = 4.20, comparative fit index [CFI] = .60, root mean square error of approximation [RMSEA] = .152, standardized root mean square residual [SRMR] = .103). Therefore, Harman’s single-factor test shows no serious concern for CMB. Nevertheless, the test was supplemented with a more recent marker variable approach. Employing competitive intensity in the industry (Leonidou et al., 2013) as a marker variable confirmed the results of Harman’s single-factor test.

4.3.2. Measures

The response format was a 7-point Likert scale ranging from 1=“not at all” to 7=“very much”. Only the “EM system” construct was measured with a 5-point scale from 1=“not implemented” to 5=“completely implemented” because the respondents during pre-test indicated that a 5-point scale can better capture the degree of EM system implementation. Each point of the scales was labelled with words, not numbers, to avoid ambiguity, increase precision and ease the response (Krosnick, 1999). Table 4.1 outlines statements that measured questionnaire items.

The items listed in the Table 4.1 were adapted from prior literature. To ensure that survey questions are not vague or ambiguous and that they reflect the context of the industry, we pretested the questionnaire with the branch organizations and industry representatives. Environmental collaboration with suppliers and customers was captured with 3-item scales based on Zhu et al. (2007). Four items to measure sustainable process improvements were adapted from Cheng and Shiu (2012). The items address process improvements to reduce pollution, material and energy usage and to reduce and recycle waste and packaging. We examined two major performance implications from environmental improvements: cost savings and market gains. Cost savings cover such benefits as lower energy, water, waste and waste water treatment cost (Carter, 2005; Yang et al., 2013; Zhu et al., 2013). Market gains refer to the opportunities to i.e. increase sales and market share, product price and quality (Rao and Holt, 2005; Yang et al., 2013). Two contextual factors, market and regulatory pressure, were measured with 3-item scales based on Horbach et al. (2012) and Zhu and Sarkis (2007) respectively but adjusted for public policy and country circumstances.

Table 4.1.
CFA results: scales descriptives, internal consistency reliability, and convergent validity measures.

	Mean (SD)	Loading	T-value
Regulatory pressure (Cronbach's alpha = 0.73, CR = 0.73, AVE = 0.48)			
Current environmental regulation	4.73 (1.56)	0.77	9.47
Expected environmental regulation	3.90 (1.59)	0.70	8.54
Membership in environmental covenants (e.g. energy covenant)	3.62 (1.93)	0.60	7.77
Market pressure (Cronbach's alpha = 0.85, CR = 0.86, AVE = 0.68)			
Social environmental awareness	4.41 (1.38)	0.78	10.44
Maintaining and/or increasing competitiveness	3.92 (1.64)	0.76	10.15
Maintaining and/or improving firm image	4.55 (1.49)	0.92	13.41
Environmental management system (Cronbach's alpha = 0.86, CR = 0.81, AVE = 0.59)			
Formulation of an environmental strategy / policy	3.12 (1.44)	0.92	12.49
Implementation of an environmental action plan	2.60 (1.53)	0.74	9.48
Internal environmental audits	2.43 (1.58)	0.61	7.38
Environmental collaboration with suppliers (Cronbach's alpha = 0.91, CR = 0.91, AVE = 0.76)			
Being informed about suppliers' activities done to reduce environmental impact	3.63 (1.42)	0.85	12.07
Provision of suppliers with environmental requirements for purchased inputs	3.28 (1.62)	0.92	13.72
Working together with suppliers on solutions to reduce environmental impact	3.25 (1.61)	0.86	12.24
Environmental collaboration with customers (Cronbach's alpha = 0.89, CR = 0.89, AVE = 0.73)			
Collaboration with customers to reduce/reuse/recycle the packaging	3.48 (1.49)	0.75	10.14
Collaboration with customers to reduce the energy use during the transportation	3.81 (1.64)	0.89	13.06
Working together with customers on solutions to reduce environmental impact	3.49 (1.44)	0.90	13.31
Environmentally sustainable process improvements (Cronbach's alpha = 0.81, CR = 0.82, AVE = 0.53)			
To overcome the pollution of air, water, soil and noise	3.98 (1.73)	0.63	7.83
To reduce materials and energy usage	4.62 (1.36)	0.85	11.84
To reduce packaging and waste during the production process	4.01 (1.62)	0.73	9.45
To reduce or valorise the product waste	4.46 (1.63)	0.69	8.78
Cost savings (Cronbach's alpha = 0.84, CR = 0.85, AVE = 0.66)			
Decrease in energy cost	3.85 (1.70)	0.87	12.35
Decrease in water and waste water cost	3.49 (1.54)	0.88	12.43
Decrease in waste and waste treatment cost	3.91 (1.49)	0.66	8.37
Market gains (Cronbach's alpha = 0.86, CR = 0.86, AVE = 0.68)			
Increase in product price	2.81 (1.39)	0.70	9.10
Increase in turnover	2.50 (1.40)	0.93	13.26
Increase in product quality	2.79 (1.57)	0.84	11.42

Note: CR [composite reliability], AVE [average variance extracted]

4.3.3. Statistical approach

The set of research hypotheses was tested with covariance-based structural equation modelling (SEM), EQS 6.2 application (Bentler and Wu, 2010). SEM allows to examine if rather complex theoretical models are supported by sample data taking into account the relationships between multiple observed and latent variables as well as the measurement error.

The analysis was conducted in two steps. First, the measurement model was estimated without placing any constrains on the structural parameters that relate latent constructs. After we confirmed the adequate fit of the measurement model and evaluated psychometric properties of latent construct, the structural model was tested. In this way, the second step provides an ultimate support for nomological validity[7]. As suggested by Hu and Bentler (1999), we employed χ^2, CFI, SRMR and RMSEA as model fit indicators.

4.4. Results

4.4.1. CFA: measurement model evaluation

CFA was conducted to evaluate measures reliability and validity. We specified an 8-factor model where every indicator loads on its respective construct and the constructs are allowed to correlate. Overall, the 8-factor structure provides a moderate fit to the data (χ^2/df=1.70, CFI=.92, RMSEA=.071, SRMR=.074).

Internal consistency reliability was evidenced by the values of Composite reliability (Table 4.1) above the established threshold of 0.8 (Nunnally, 1978), except for a small deviation in regulatory pressure construct. The latter is acceptable because the deviation is small and the value (0.73) is still above the threshold of 0.7 recommended for exploratory research. The same conclusion can be drawn when examining Cronbach's alphas. High indicator loadings above 0.60 ($p<0.01$) evidence **indicator reliability**.

Convergent validity is expressed by the average variance extracted (AVE), the proportion of the variance captured by the construct as opposed to the proportion of variance attributed to the measurement error. Because all the values of AVE exceed 0.5 with an exception of a small deviation for regulatory pressure, convergent validity can be established.

Discriminant validity refers to constructs being conceptually and empirically distinct. Discriminant validity was established in three steps (Anderson and Gerbing, 1988). *First*, we compared the unconstrained CFA model with the model where the correlation between each pair of constructs is constrained to 1 (Jöreskog, 1971). The unconstrained model shows significantly better fit that any constrained model (Table 4.2). All the χ^2 differences are significant ($p<0.001$) providing a full support to discriminant validity.

Second, the squared root of AVE was compared with the correlation coefficient between the construct and the other constructs to ensure that the construct better captures the variance of its own indicators rather than the variance of other constructs (Fornell and Larcker, 1981). Table 4.3 shows that AVE of each construct is higher that the correlation coefficients between this construct and other constructs, except a small deviation for regulatory pressure. Nevertheless, as two other criteria support discriminant validity claim, we decided to proceed with this construct.

Third, the confidence interval, constructed in the range of two standard errors around the estimate of the correlation coefficient, does not include one (Table 4.3). It means that correlations between the constructs are significantly different from unity. All three tests reach the same conclusion and establish discriminant validity.

[7] See Anderson and Gerbing (1988) for advantages of the two-step approach compared to the simultaneous estimation of the measurement and structural model.

Table 4.2.
Discriminant validity test: Chi-square difference between unconstrained and constrained models[8].

	1	2	3	4	5	6	7	8
1 Regulatory pressure								
2 Market pressure	66.58							
3 EM system	47.15	62.89						
4 Collaboration with suppliers	56.68	112.31	46.01					
5 Collaboration with customers	29.86	125.26	54.31	125.97				
6 Sustainable process improvements	55.49	64.83	39.54	87.77	73.10			
7 Cost savings	81.45	130.25	41.09	132.06	144.02	70.54		
8 Market gains	78.28	131.91	76.34	177.63	176.64	129.89	142.30	

Table 4.3.
Correlation matrix for discriminant validity test.

	1	2	3	4	5	6	7	8
1 Regulatory pressure	**0.69**[a]							
2 Market pressure	0.45[b] (0.09)[c]	**0.82**						
3 EM system	0.47 (0.09)	0.43 (0.08)	**0.77**					
4 Collaboration with suppliers	0.54 (0.08)	0.60 (0.06)	0.60 (0.07)	**0.87**				
5 Collaboration with customers	0.74 (0.06)	0.56 (0.07)	0.53 (0.07)	0.69 (0.05)	**0.85**			
6 Sustainable processes improvements	0.49 (0.09)	0.70 (0.06)	0.69 (0.06)	0.64 (0.06)	0.68 (0.06)	**0.73**		
7 Cost savings	0.33 (0.10)	0.50 (0.08)	0.71 (0.06)	0.52 (0.07)	0.45 (0.08)	0.68 (0.06)	**0.81**	
8 Market gains	0.34 (0.09)	0.52 (0.07)	0.34 (0.09)	0.39 (0.08)	0.40 (0.08)	0.48 (0.08)	0.44 (0.08)	**0.83**

[a] diagonal elements represent the square root of AVE;
[b] off-diagonal elements represent correlations between the constructs ($p<0.01$);
[c] off-diagonal elements in parentheses represent the standard errors of the correlation coefficients.

4.4.2. Structural model results

The proposed structural model yielded a good fit (χ^2/df=1.77, CFI=.91, RMSEA=.073, SRMR=.075). The sample size (N=139) meets the minimum requirement for estimation when looking at the ratio of the sample size to the number of free parameters 5:1 (Bentler and Chou, 1987). Nevertheless, “safe” SEM tangibly requires 200 observations (Bagozzi and Yi, 1988). The relatively small sample size is associated with an increased likelihood of sampling error that can affect goodness-of-fit statistics (Anderson and Gerbing, 1984). To assess the presence and influence of the sampling error on the overall model fit, we performed model-based bootstrapping (Bentler, 1989) with 1000 resamples. 139 cases were independently and repeatedly selected with replacement from original data set. The bootstrapping significantly improved the model fit ($\Delta\chi^2$=146.284; cf.: χ^2/df=1.19, CFI=.976; RMSEA=.0329, SRMR=.0495). Moreover, with the bootstrapping, we fail to reject H_0 that the models fits the data well with p=0.18 (cf.: p=0.00 for original model). The fact that bootstrapping contributes to significant improvement of the model fit indicates that the model fit

[8] All differences between the unconstrained model (correlations between the constructs are freely estimated) and constrained models (correlations are restricted to 1.00) are significant, $p<0.001$ (cf. 10.828 critical value, df=1). The more powerful test with smaller p-value for each individual difference between unconstrained and constrained models adjusts the significance level of the family of tests when a series of tests is performed.

without a bootstrapping was negatively affected by the sampling error. Sampling error can be corrected by collecting more data by future researchers. The bootstrapping proves that the proposed model is correct and would perform even better in larger sample conditions.

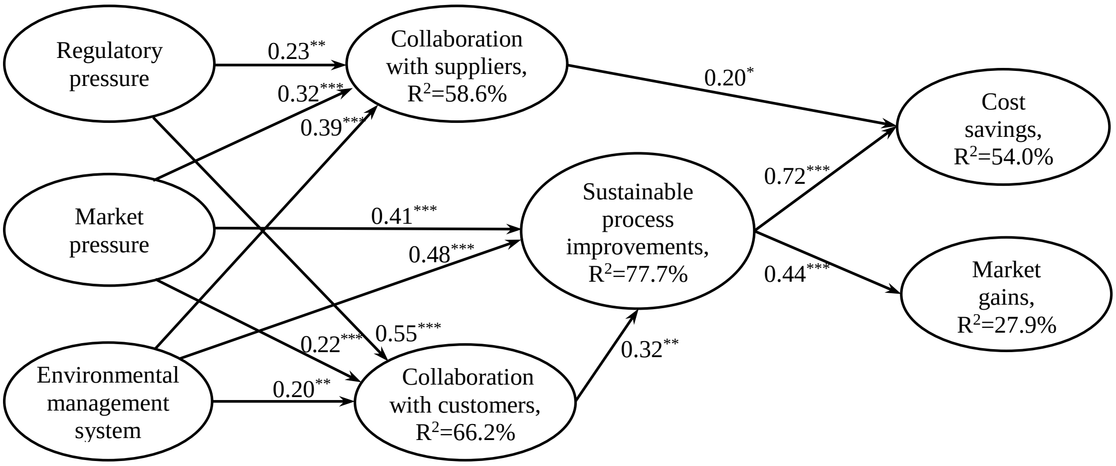

Figure 4.2. Structural model results.

Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.10$
Only significant relationships are shown.

Table 4.4.
Structural model results.
Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.10$

Path to	Path from	Coefficient	T-value	Hypothesis	Confirmed
Collaboration with suppliers (R^2 =58.6%)	Regulatory pressure	0.23**	2.319		
	Market pressure	0.32***	3.655		
	EM system	0.39***	3.885		
Collaboration with customers (R^2 =66.2%)	Regulatory pressure	0.55***	4.726		
	Market pressure	0.22***	2.595		
	EM system	0.20**	2.073		
Sustainable process improvements (R^2 =77.7%)	Collaboration with suppliers	-0.06	-0.548	H1a	Yes
	Collaboration with customers	0.32**	2.280	H1b	Yes
	Regulatory pressure	-0.13	-0.958		
	Market pressure	0.41***	4.007		
	EM system	0.48***	3.926		
Cost savings (R^2 =54.0%)	Collaboration with suppliers	0.20*	1.842	H3a	Yes
	Collaboration with customers	-0.18	-1.449	H3c	Yes
	Sustainable process improvements	0.72***	4.623	H2a	Yes
Market gains (R^2 =27.9%)	Collaboration with suppliers	0.09	0.787	H3b	Yes
	Collaboration with customers	0.03	0.232	H3d	No
	Sustainable process improvements	0.44***	2.881	H2b	Yes

Figure 4.2 and Table 4.4 illustrate the structural relationships in the model. Three control variables, regulatory pressure, market pressure and EM system, have a positive and significant impact on environmental collaboration with suppliers (R^2=58.6%) and customers (R^2=66.2%). Environmental collaboration with suppliers is primarily driven by internal factor - the functioning of EM system (β=0.39; $p<0.01$), but regulatory (β=0.23; $p<0.05$) and especially market pressures (β=0.32; $p<0.01$) have a positive impact on this collaboration as well. The EM system being the major determinant of

environmental collaboration with suppliers can be explained as follows. Suppliers are not expected to induce process changes on the side of F&B processors and such collaboration is likely to stimulate the implementation of environmental improvements on supplier's side. As earlier findings show (Grekova et al., 2014), firms are reluctant to extend environmental management beyond organizational boundaries before they reach sufficient progress with internal EM system. When EM system is well-developed, external pressures become less motivating for the implementation of proactive environmental practices such as environmental collaboration with suppliers.

Environmental collaboration with customers is mostly influenced by external regulatory pressure ($\beta=0.55$; $p<0.01$) and to a much smaller extent – by market pressure ($\beta=0.39$; $p<0.01$) and EM system ($\beta=0.39$; $p<0.01$). In the F&B industry, environmental collaboration with customers is often focused on sustainable packaging due to limited opportunities to modify the product itself. Nowadays, packaging is a heavily regulated by Dutch environmental policy (Rouw and Worrell, 2011). Consequently, we observe a strong impact of regulatory pressure on environmental collaboration with customers.

The fact that environmental collaboration with suppliers does not affect sustainable process improvements confirms Hypothesis 1a. In line with Hypothesis 1b, environmental collaboration with customers stimulates sustainable process improvements ($\beta=0.32$; $p<0.05$). Also control variables like market pressure ($\beta=0.41$; $p<0.01$) and the functioning of EM system ($\beta=0.48$; $p<0.01$) induce sustainable process improvements. Nevertheless, regulatory pressure does not affect the implementation of sustainable process improvements.

Environmentally sustainable process improvements induce cost savings ($\beta=0.72$; $p<0.01$) and market gains ($\beta=0.44$; $p<0.01$) as suggested by Hypotheses 2a and 2b. Also environmental collaboration with suppliers is directly related to cost savings ($\beta=0.20$; $p<0.10$) confirming Hypothesis 3a and not related to market gains confirming Hypothesis 3b. In correspondence with Hypothesis 3c, environmental collaboration with customers has no direct effect on cost savings. Contradictory to Hypothesis 3d, it has no direct effect on market gains.

4.4.3. Indirect effects

The significance of indirect effects of environmental collaboration on firm performance through the implementation of sustainable process improvements was examined with the product of coefficients (Sobel, 1982) and bootstrapping (Preacher and Hayes, 2008) approaches (Table 4.5). Although both are presented, we build our conclusions on the outcomes of bootstrapping. The product of coefficients approach relies on the assumption that the distribution of indirect effect is normal. This assumption is questionable for finite sample sizes (MacKinnon et al., 2004). The bootstrapping approach overcomes this flaw by making no distributional assumptions. In addition, the simulations (MacKinnon et al., 2004) show that bootstrapping is more powerful.

With 1000 resamples drawn from the original sample, we created an empirical approximation of the indirect effects' distribution. After sorting indirect effects in ascending order, we selected 1,000 x (0.5 -/+ ci/200)th elements as lower and upper bounds of the 95% confidence interval. If the confidence interval (Table 4.5) contains zero, we can conclude that indirect effect with $p<0.05$ is not different from zero. Otherwise, indirect effect is present. All methods converge to support the presence of indirect effects in the relationship between environmental collaboration with customers and cost savings and market gains through sustainable process improvements. There is no indirect effect in the relationship between environmental collaboration with suppliers and firm performance, because environmental collaboration with suppliers fails to induce the implementation of environmentally sustainable process improvements by Dutch F&B processors.

Table 4.5.
Testing indirect effects with the product of coefficients and bootstrapping approaches[9].

From:	To:	Product of coefficients approach Test statistics	SE	P-value	Bootstrapping 95% CI	Indirect effect
Collaboration with suppliers	Cost savings	-0.543	0.098	0.587	(-0.35;-0.20)	No
	Market gains	-0.538	0.041	0.591	(-0.15;0.08)	No
Collaboration with customers	Cost savings	2.045	0.144	0.041	(0.04;0.69)	Yes
	Market gains	1.788	0.068	0.074	(0.01;0.32)	Yes

4.5. Discussion and conclusions

The current study was conducted to address the gap in understanding of the relationships between environmental collaboration and firm performance. When committing resources and capabilities to environmental collaboration with suppliers and customers, managers wish to know if they would be able to appropriate value created in these relationships and in what ways this value can be appropriated. Especially the last issue was largely unexplored in environmental collaboration research. Our findings in the context of Dutch F&B processors show that environmental collaboration with suppliers is not likely to assist firms seeking to improve environmental sustainability of their internal processes as one of the outcomes of environmental collaboration. Environmental collaboration with suppliers only provides cost savings that do not result from internal process improvements. These cost savings might be attributed to the compensation for the benefits that were gained by suppliers from collaboration (e.g. lower prices of input materials). As for environmental collaboration with customers, it contributes to performance of F&B processors indirectly: environmental collaboration with customers prompts sustainable improvements in the internal processes and these improved processes bring about improved performance both in terms of cost savings and market gains.

Our findings confirm the great potential of inter-firm linkages to enhance firm performance (Dyer and Singh, 1998) in the context of environmental collaboration. Prior research mostly investigated a direct contribution of environmental collaboration to firm performance, although an investigation of potential indirect relationships was suggested to clarify inconclusive results (Gimenez and Tachizawa, 2012). The discussion on multiple pathways through which collaboration can improve firm performance in the general collaboration literature (i.e. Möller and Törrönen (2003), Lavie (2006), Cao and Zhang (2011)), is hardly reflected in the environmental collaboration literature. Our findings show that in a context of different dyads, the actual process improvements can occur primarily on one side. Consequently, when the improvements do not occur on the side of the focal firm, it is more difficult to appropriate the value from environmental collaboration like in case of Dutch F&B processors engaged in environmental collaboration with suppliers. Our finding that environmental collaboration is likely to generate sustainable process improvements primarily on the side of the seller corresponds to the findings from the case studies of Hall (2000). In the sample of Chiou et al. (2011), environmental collaboration with the suppliers resulted in sustainable process

[9] The outcomes of causal steps approach (Baron and Kenny, 1986) are consistent with the outcomes of the product of coefficients and bootstrapping approaches. We preferred not to rely on causal steps approach, because it is largely criticized, among others, for a lack of power and inability to produce a standard error or a point estimate of the indirect effect.

improvements on the side of the focal firm (buyer). However, their sample primarily consisted of medium-tech firms whose suppliers could have more opportunities to change their output to reduce its environmental impact. Findings similar to Chiou et al. (2011) were reported by Geffen and Rothenberg (2000) in the context of the mid-tech automotive industry. Therefore, future research should address the role of industry characteristics and characteristics of suppliers and customers when discussing the appropriation of the outcomes from environmental collaboration.

For manufacturing managers, our study generates important implications as it delineates more paths of control over the outcomes of environmental collaboration. Most importantly, environmental collaboration with customers and suppliers does not automatically lead to performance improvements. The result of environmental collaboration with suppliers depends on the suppliers' characteristics and the ability to induce environmentally sustainable process improvements on the focal firm's side. When such improvements do not occur, firms face difficulties appropriating economic outcomes of environmental collaboration. Our results show that in the F&B processors sector, cost savings from environmental collaboration with suppliers are likely but this relationship is not very strong ($p<0.10$). The customers of F&B processors seem not to reward their efforts in greening the suppliers: environmental collaboration with suppliers is not associated with market gains such as higher product prices, market share or product quality. For firms seeking to improve sustainability of their processes through environmental collaboration, working together with customers can be of assistance. However, they would be able to improve their performance only if this collaboration brings about improvements of internal processes. Customers do not reward environmental collaboration when their suppliers do not actually change internal processes to make them more sustainable.

Next to discussing present Chapter's contributions for academics and practitioners, we have to acknowledge some limitations that open avenues for future research. First, we focused on environmentally sustainable process improvements as one of the collaborative advantage constituents. Future studies should include other types of value created in collaboration, such as improved flexibility and other types of business synergies (Cao and Zhang, 2011). Second, conditions and pathways for environmental collaboration to improve business performance should be examined further. Position in a dyad, partners' characteristics (Kaufman et al., 2000; Schiele, 2006), bargaining power, the absorptive capacity of the partners (Lavie, 2006) and other characteristics of the dyad and of the partners could moderate discovered indirect effects. Lastly, rents from environmental collaboration can accumulate gradually, like relational rents (Dyer and Singh, 1998) or spillover rents (Lavie, 2006). These rents, invisible in the short-run, can cause significant long run benefits. Therefore, longitudinal studies could validate our findings with respect to the long-run implications of environmental collaboration.

CHAPTER FIVE

KNOWLEDGE SOURCING FOR ENVIRONMENTAL INNOVATION

Chapter Five answers the Research Question 4:

What is the impact of capabilities to tap external knowledge and of capabilities to develop and accumulate internal knowledge on environmental innovation?

This Chapter is based on:

K. Grekova, H.J. Bremmers, J.H. Trienekens, S.W.F. Omta. Sources and sourcing of knowledge for environmental innovation: empirical evidence from Dutch food and beverage processors. Submitted.

5.1. Introduction

Social pressure, consumer demand and tightening environmental regulation place the reduction of the environmental impact high on the industry agenda. Environmental innovation is attractive for firms due to its potential to reduce environmental impact and to generate economic benefits such as cost savings, increased market share, product price premium, etc. (Christmann, 2000; Eiadat et al., 2008; Rennings et al., 2006). One of the key questions regarding the relationships between environmental innovation and firm performance is "whether it pays to be green" (see e.g. Ambec and Lanoie (2008), Berchicci and King (2007), Blanco et al. (2009), Molina-Azorín et al. (2009a) for an overview). In other words, whether the benefits in terms of cost savings and market gains originating from environmental innovation can offset the additional costs associated with the development of this innovation.

The social and economic importance of environmental innovation has led to an extensive body of research that discusses the environmental innovation concept as well as its determinants and performance implications. *Prompted by the scant treatment in previous research, the present Chapter brings organizational capabilities for knowledge sourcing into the discussion regarding the relevance of internal and external knowledge sources for the development of environmental innovation.* In this context, we address the performance implications of environmental innovation. According to the OECD (2010), environmental innovation is "the implementation of new, or significantly improved, products (goods and services), processes, marketing methods, organizational structures, and institutional arrangements which, with or without intent, lead to environmental improvements compared to relevant alternatives" (see Schiederig et al. (2012) for the discussion on the definition of environmental innovation). Our investigation focuses on determinants and performance implications of technological environmental innovation and does not consider modifications in marketing, organizations, and institutions.

For practitioners and researchers, an understanding of environmental innovation determinants is crucial to stimulate its implementation. Prior research has revealed three groups of environmental innovation determinants: policy, demand-, and supply-side factors (i.e. Rehfeld et al. (2007), Horbach et al. (2012)). Supply-side determinants address the role of internal technological and management capabilities and the use of external knowledge (Triguero et al., 2013). From a managerial standpoint, supply-side factors are most promising as they are more subject to managerial control, compared to policy and demand-side factors. The role of supply-side determinants in environmental innovation is also increasingly being recognized and scrutinized in the academic literature. In the context of innovation research, the debate concerns the use of intra- and extramural knowledge sources (Berchicci, 2013; Caloghirou et al., 2004; del Carmen Haro-Domínguez et al., 2007; Murovec and Prodan, 2009). The role played by external and internal knowledge in environmental innovation is debated due to conflicting findings. It is not clear whether firms should rely primarily on external knowledge available in their networks or intensively invest in the development of internal knowledge. Internal knowledge can be sourced, for example, through the implementation of an environmental management system (EM system). EM system is associated with the generation of continuous improvement capabilities (Zutshi and Sohal, 2004). These capabilities require scrutiny of internal processes to identify opportunities to improve their environmental sustainability. In this way, the internal environmental knowledge is built up and accumulated within the firm (Darnall and Edwards, 2006; Epstein and Roy, 1997).

The evidence regarding the relevance of internal and external knowledge sources for environmental innovation is not clear cut. De Marchi (2012) showed that environmental innovation requires cooperation with external partners to a much greater extent than conventional innovation. This is because knowledge and skills for environmental innovation often fall outside the familiar scope. Ketata et al. (2014) found that access to information from a broader range of external sources and their importance are positively related to sustainable innovation. In contrast, Bönte and Dienes (2013) could not establish that firms relying on cooperation with external partners perform better in terms of environmental innovation compared to firms relying on internal knowledge and resources. In fact, excessive reliance on external partners (outsourcing) is negatively related to environmental innovation. Cuerva et al. (2014) disproved that collaboration with external partners has a significant impact on environmental innovation. In low-tech sectors, such as food and beverage (F&B), collaboration can even hamper environmental innovation due to the characteristics of the sector such as a high rate of spillovers and homogeneous products (Cuerva et al., 2014). In addition, Triguero et al. (2014) found that SMEs leading in environmental innovation are not so different from laggards in terms of valuing of the network involvement in environmental innovation. This was explained by the availability of sufficient in-house knowledge.

When discussing the role of external knowledge sources for environmental innovation, the literature rarely considers that having access to external knowledge is not sufficient for progress in environmental innovation. Firms should possess capabilities for knowledge sourcing in order to "recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990). The latter is known as absorptive capacity (AC). Although the network possesses knowledge that could be used to come up with new ways to reduce environmental impact, the successful conversion of this knowledge into environmental innovations relies on the firm's AC (del Río González, 2005, 2009). Empirical environmental literature addressing the role of AC is scarce. This is especially interesting given the growing body of literature on green collaboration and the role of external knowledge for environmental management and innovation (see e.g. Vachon and Klassen (2007), Gimenez and Tachizawa (2012), De Marchi and Grandinetti (2013)). Although conventional innovation and knowledge management literature recognizes AC as one of the major innovation determinants (Crossan and Apaydin, 2010), corresponding empirical research is scant. The present study aims to address this gap by investigating the role of AC as a capability for external knowledge appropriation required for environmental innovation.

Previous research has mainly addressed the influence of AC on proactive environmental management rather than on environmental innovation. AC was found to influence positively a firm's environmental proactivity and an ability to benefit from this proactivity in terms of business performance (Delmas et al., 2011). In contrast, case studies by Noci and Verganti (1999) show that AC is required for the implementation of a reactive environmental strategy, characterized by the implementation of minor technological adjustments and end-of-pipe solutions. In the context of environmental product innovation, case studies (Williander, 2007) illustrate the importance of interpretative systems to assimilate and transform environmental information acquired from the business environment. Except for these scarce and conflicting findings, we did not come across any *empirical quantitative* studies that could shed light on the relationships between AC and environmental innovation. Gluch et al. (2009) and Ketata et al. (2014) claim to investigate the potential of AC to enhance environmental innovation performance. However, their measures of AC are not sufficiently grounded in the AC theory; the internal and external validity of these measures is questionable (cf. Lane et al. (2006); Murovec and Prodan (2009)). In addition, Gluch et al. (2009) do not measure green innovation but rather its effect on business performance. We can conclude that although AC is hypothesized to be crucial in order to leverage network knowledge for environmental innovation, previous empirical research on this subject is very limited. *Our contribution* rests on the investigation of the roles of knowledge sourcing capabilities vested in AC and EM system in the debate regarding the importance of external and internal knowledge sources for environmental innovation. By connecting innovation management and environmental management literature, we take a step towards an integrative framework of environmental innovation and its contribution to firm performance.

Although the context of a specific industry influences the way firms address the environmental sustainability challenge (del Río et al., 2013), the studies on environmental innovation in specific industries and in the low-tech industries are scarce (Cuerva et al., 2014). Addressing this gap, our empirical research is conducted in the Dutch F&B industry. Although the industry is constrained by relatively low R&D intensity, which is typical for traditional low-tech sectors, and by relatively low profit margins, F&B processors are very active in addressing the environmental sustainability challenge (e.g. Grekova et al. (2014)). Consequently, we take the perspective of F&B processors to provide insight into supply-side determinants and performance implications of environmental innovation.

The Chapter is structured as follows. The next section presents a theoretical framework, the research model and hypotheses. Section 5.3 discusses the survey design, potential biases arising from the chosen methodology, and the measurement instrument. Then, the results of hypotheses testing with structural equation modelling (SEM) are presented. The concluding section discusses our findings, their contributions, limitations, and outlines avenues for future research.

5.2. Theoretical framework

In this section, we will discuss how access to network, AC capabilities, and the EM system influence environmental innovation as well as analyse the impact of environmental innovation on firm performance. The main elements of the research model, as depicted in Figure 5.1, are access to the external knowledge of the network, AC, the integration of environmental management within the organization, the EM system, environmental innovation, and firm performance.

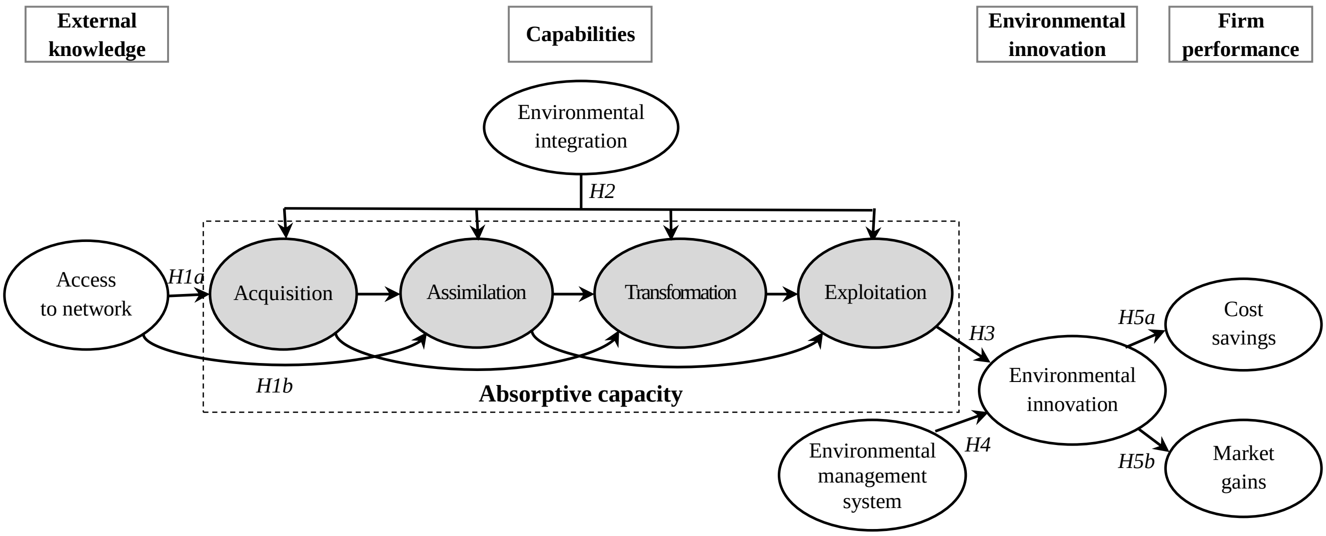

Figure 5.1. The research model.

5.2.1. Access to network and AC

Some studies consider access to network resources and knowledge among the main factors for the introduction of environmental innovation (Dangelico et al., 2013; de Medeiros et al., 2014; del Río González, 2005; Wong, 2013b). De Marchi (2012) and del Río et al. (2013) evidence that green innovators show higher scores in the use of external knowledge than other innovators. Other studies challenge the role of the network in environmental innovation. Gavronski et al. (2012) identified external knowledge exchange as not related to pollution prevention technologies. According to Bönte and Dienes (2013), firms relying on a cooperative innovation strategy or even complete outsourcing, do not outperform firms relying on in-house capabilities in terms of environmental innovation.

The fact that the studies on the role of the network for environmental innovation are inconclusive could be explained by the omission of an important variable that underpins the conversion of external knowledge rested in the network into environmental innovation: AC. Three cases of international automobile giants studied by Williander (2007) illustrate the crucial role of AC in tapping consumer demand for environmentally friendly vehicles and translating it into successful technological environmental innovations.

Also in conventional innovation literature, external knowledge available in the network serves as an input to AC that in turn stimulates innovation (i.e. Jansen et al. (2005), Van Wijk et al. (2008), Volberda et al. (2010)). AC also influences the proportion of benefits the focal firm can appropriate from its relationships with external partners (Lavie, 2006; Vachon and Klassen, 2008). This means that a certain level of AC is required in order to benefit from external relationships. Zahra and George (2002) conceptualized AC capability as having four consecutive dimensions (viz. acquisition, assimilation, transformation, and exploitation) that constitute two types of AC with different value-creating potentials: potential and realized AC. Potential AC allows firms to identify and acquire external knowledge (*acquisition*) as well as to analyse, interpret, and understand acquired external information (*assimilation*) but does not guarantee knowledge exploitation. Realized AC, on the contrary, enables acquired and assimilated external knowledge to be combined with existing knowledge *(transformation)* and to be ultimately applied to improve operations *(exploitation)*. Because the exposure to the network is expected to influence the acquisition of external knowledge as well as the manner of its analysis and interpretation (potential AC):

Hypothesis 1a. *The capability to acquire external knowledge is positively related to network access.*

Hypothesis 1b. *The capability to assimilate external knowledge is positively related to network access.*

5.2.2. Integration of environmental management within the firm and AC

Because knowledge is an essential input for business processes, the problem of knowledge integration within the firm is of key importance (Grant, 1996a). The integration of organizational functions and layers stimulates the breadth of scope of absorbed knowledge and the firm's flexibility in absorption (Van Den Bosch et al., 1999). The lack of integration of the environmental management function with the other business functions (i.e. marketing, quality, R&D, etc.) and organizational layers is an issue widely recognized in the literature. Its consequences are limited economic and environmental effectiveness as well as inconsistency in business functions (Wagner, 2007).

Case studies conducted in an environmental innovation context (Chadha, 2011) illustrate that the integration of environmental management across organizational functions helps to overcome the "not-invented here" syndrome (Katz and Allen, 1982) and ultimately prevents competence lock-ins (Arthur, 1989) in two ways. First, bringing together employees from different functions accelerates knowledge transfer and processing within the company and makes the firm more likely to tap external knowledge. Second, decentralization of decision making, which crosses vertical hierarchical lines and functional authorities, challenges present competences and established technologies and stimulates the search for new solutions outside the traditional scope. According to innovation literature, AC of the firm depends on the ACs of individual employees and on the firm's ability to leverage ACs of individuals by means of cross-functional interactions and interactions spanning organizational layers (Cohen and Levinthal, 1990; Jansen et al., 2005; Van Den Bosch et al., 1999). All these arguments suggest that the integration of the environmental management function within other organizational functions and layers is expected to stimulate all dimensions of AC.

Hypothesis 2. *Integration of environmental management within the firm is positively related to the capabilities to acquire, assimilate, transform, and exploit external knowledge.*

5.2.3. Tapping external knowledge through AC and environmental innovation

AC is expected to be an essential determinant of environmental innovation adoption because the managers need to be aware of available technological alternatives, ensure the presence of capabilities to implement and use environmental technologies, and assure the fit of the chosen technology with the market and regulation trends (del Río González, 2005). Some empirical research suggests that environmental innovators exhibit higher levels of both network exposure and internal R&D, compared to other innovators (De Marchi and Grandinetti, 2013; del Río et al., 2013). This is explained from the AC perspective (De Marchi and Grandinetti, 2013): the fact that knowledge is acquired does not imply that it will be exploited to improve business operations. Knowledge can be acquired but remain unused for a variety of reasons. The firms that invest in acquisition and assimilation of external knowledge, with the aim of updating their knowledge stock, might be unable to benefit from knowledge exploitation. On the contrary, firms that emphasize exploitation to achieve short-term profits, might lose sight of new external developments and breakthrough innovations (Ahuja and Lampert, 2001; Jansen et al., 2005). This suggests the importance of developing all consecutive dimensions of AC to be able to recognize the value of external knowledge and to be able to exploit it in order to bring forth environmental innovation. Preceded by acquisition, assimilation, and transformation, especially the last dimension of (realized) AC - exploitation – is required to implement environmental innovation.

Many studies emphasize the role of AC for environmental innovation but do not support their claim empirically (De Marchi and Grandinetti, 2013; del Río González, 2005; del Río et al., 2013). This might be attributed to difficulties in obtaining empirical measures of AC (Murovec and Prodan, 2009). In recent years, several studies have proposed AC measures (i.e. Jansen et al. (2005), Camisón and Forés (2010), Flatten et al. (2011), Jiménez-Barrionuevo et al. (2011)). This is expected to stimulate future research on the role of AC in environmental innovation. In prior research, Gluch et al. (2009) attempted to explore the influence of AC on environmental innovation. Nevertheless, the reliability and especially the validity of AC measures in this study are questionable. The authors hardly discussed these issues or the scale construction process. Moreover, the analysis that includes a series of simple regressions does not take into account the rest of the relationships in the model. The model itself connects AC to the measures of performance rather than to environmental innovation measures. Therefore, we cannot totally rely on this evidence. Ketata et al. (2014) also addressed the role of AC in sustainable innovation, but used R&D proxies for AC. This measurement approach is largely criticized for its ignorance of AC's multidimensionality (i.e. Flatten et al. (2011), lack of validity (Murovec and Prodan, 2009), and bias towards measuring the AC as the acquisition of R&D-related knowledge instead of other knowledge types (e.g. marketing experience and managerial techniques) (Lane et al., 2006). Therefore, we can conclude that although prior studies have demanded an empirical investigation of the role of AC for environmental innovation, the subject remains largely unexplored.

Hypothesis 3. *The capability to exploit external knowledge is positively related to environmental innovation.*

5.2.4. Developing internal knowledge through EM system and environmental innovation

EM system stimulates internal development of environmental knowledge as opposed to AC which serves to tap external knowledge. EM system is a mechanism for learning and capacity-building that can induce organizational improvements beyond the boundaries of the environmental management function (Epstein and Roy, 1997). The implementation of EM system is underpinned by continuous improvements capabilities. These capabilities stimulate the creation and accumulation of internal knowledge. This is because these capabilities encourage firms to analyse and investigate continuously their internal operations and evaluate the progress achieved in the reduction of environmental impact, which ultimately increases knowledge of the operations (Alberti et al., 2000; Darnall and Edwards, 2006). Environmental audit and internal reporting of the achieved results provides management with the input for making decisions about further ways to reduce environmental impact. The revision of achieved results contains a learning component as it outlines how created knowledge should be assessed and transferred within the organization (Epstein and Roy, 1998).

Hypothesis 4. *EM system is positively related to environmental innovation.*

5.2.5. Environmental innovation and firm performance

Pursuing an innovation strategy in the reduction of environmental impact has the potential to improve a firm's performance through two major channels: by offering opportunities to reduce costs and opportunities to increase revenues (Ambec and Lanoie, 2008). Cost savings were one of the first opportunities to offset the costs of compliance indicated in the "pays to be green" literature (i.e. Porter and Van der Linde (1995)). Environmental innovation can induce cost savings due to lower and more efficient use of materials and energy associated with the cost savings on inputs and reduced waste and waste treatment costs (see e.g. Christmann (2000), Ambec and Lanoie (2008)) for an extended overview of cost-saving opportunities). Concurrently, firms might have already exhausted the potential of simpler and cheaper measures with high potential returns, like picking the "low hanging fruit" (Hart and Ahuja, 1996). More complex environmental innovation might require intensive investments that might not be able to offset the cost-saving potential of these innovations (Walley and Whitehead, 1994).

Market gains mostly pertain to customers' or consumers' appreciation of the focal firm's efforts to reduce environmental impact and can be expressed in the greater market share, turnover, product price, and quality (Eiadat et al., 2008; Grekova et al., 2013; Molina-Azorín et al., 2009b; Rennings et al., 2006). The opportunities for F&B processors to experience market gains as a result of implemented environmental innovation are less certain than cost-saving opportunities. Firms' opportunities to gain a market share or a price premium from the efforts to reduce environmental impact vary per country, product, etc. (Carlsson et al., 2012; Thøgersen, 2010). In addition, Nehrt (1996) shows that the timing is crucial if environmental investments are to contribute to firm profitability. Pioneers or first-movers are more likely to expand their markets or charge higher prices due to the introduction of environmental innovations (Chen et al., 2006). Second or late-movers might benefit less from their environmental innovations in terms of market gains.

Hypothesis 5a. *Environmental innovation is positively related to firm performance improvement in terms of cost savings.*

Hypothesis 5b. *Environmental innovation is positively related to firm performance improvement in terms of market gains.*

5.3. Material and methods

5.3.1. Research design and data collection

Our empirical analysis is based on data from a survey conducted in 2013 among Dutch F&B processors. The contact data of the respondents were acquired from the Dutch Chamber of Commerce. The addressees were the managers responsible for environmental management in the organization. They were first contacted by phone to explain the objective of the research. If they agreed to participate, the respondents received a link to the on-line questionnaire. A reminder was sent after two weeks to increase the response rate. For the same purpose, the respondent's anonymity was ensured. Non-respondents were asked to give a reason for their refusal. Firms mentioned a lack of time, corporate policy, and simply unwillingness to cooperate. Out of 606 firms contacted, there were 136 usable responses, which corresponds to a 22% response rate. This is consistent with recent similar studies (see e.g. Santolaria et al. (2011), Chang (2011), Gavronski et al. (2012)). Originally, we received 143 questionnaires but 7 respondents were excluded due to the presence of missing values in the endogenous variables.

To address potential response bias, we compared respondents and non-respondents on their available aggregate characteristics. The chi-squares indicated that the sample contains less bakeries than the underlying population in terms of its distribution over the F&B industry sectors ($X^2 = 14.60$, df=5, $p<0.05$). As for the size groups, the sample is slightly skewed towards medium-sized and large firms compared to the population ($X^2 = 35.31$, df=2, $p<0.01$). The under-representation of bakeries and small firms in the sample is strongly related: most of the bakeries are small firms. The under-representation of small firms in environmental surveys conducted among manufacturing firms is common and largely unavoidable due to resource constraints (Wagner, 2007).

Non-response bias can pose a threat to external validity. Following an archival approach (Rogelberg and Luong, 1998), we compared respondents and non-respondents on their demographical characteristics such as the firm size expressed in the number of employees and F&B industry sector. Additional analysis of the number of employees yielded results similar to the comparison of the groups of small, medium-sized, and large firms. In particular, small firms are less likely to fill in the questionnaire than larger ones ($p<0.01$). It was not possible to contact non-respondents for their additional characteristics (i.e. other than demographic) because they had already refused any further cooperation when contacted for the first time by phone. We compared on the first items listed in the questionnaire (i.e. environmental innovation variables) the firms who completed the entire questionnaire and those who stopped with the questionnaire before it was complete. In this context, those who did not complete the questionnaire represented non-respondents. Finding no statistically significant differences indicated no serious concern for non-response bias.

Another bias that can be attributed to the chosen methodology is a common method bias. Common method variance (CMV) originates from the use of self-reporting as a measurement method for all the research variables. The CMV may bias the estimates of the relationships and pose a threat to the external validity of the study (Podsakoff et al., 2003; Podsakoff et al., 2012; Williams et al., 2010). We pretested the questionnaire in the industry and discussed it with branch organizations and used their feedback to eliminate ambiguity. For the same reason, every point of the scale was labelled (Krosnick, 1999) and varying scales were applied to the questionnaire items to decrease common scale properties (Podsakoff et al., 2012). In order to detect the presence of the CMV, we relied on the Harman's single factor test. CFA with all the items loading on one factor shows a poor model fit (χ^2/df = 4.06, comparative fit index [CFI] = .79, root mean square error of approximation [RMSEA] = .18, standardized root mean square residual [SRMR] = .12) suggesting no concern for the CMV. The same conclusion is drawn from the application of the marker-variable technique. In line with previous studies (Leonidou et al., 2013), we used competitive intensity in the industry as a marker variable.

5.3.2. Measures

An overview of the research variables' operationalization is provided in Table 5.1. Each construct was captured with multiple items. All the items were assessed by the respondents on a 7-point Likert scale ranging from 1 = "Not at all" to 7 = "Very much", except the measures of the EM system and network access. The EM system was assessed by its degree of implementation (5-point scale). The items that construct the access to network index evaluate the frequency of contacts with network actors (viz. consultants, research institutes, universities, customers, suppliers, competitors, branch organizations, covenants) with respect to environmental issues.

We employed the measures developed in previous studies. Their verification by the industry and branch organization experts resulted in adjustments that ensured the applicability of the measures to the F&B processors' context and their understanding of the measures. Environmental innovation was operationalized with four items based on the measures developed by Cheng and Shiu (2012). In line with previous studies (Tien et al. (2005), López-Gamero et al. (2010)), we measured two pathways for environmental innovation to contribute to business performance: cost savings and market gains. Cost savings were constructed using three items based on Zhu et al. (2005), i.e. savings on material and energy, waste, and waste treatment. Market gains were captured with three items addressing the increase in market share, product price, and quality (Azevedo et al., 2011; Rennings et al., 2006; Wagner, 2007). The scale of Jansen et al. (2005) was adapted to measure four dimensions of AC. The integration capabilities were measured with three items based on Branzei et al. (2004) and Pujari et al. (2003) that express cross-functional and vertical environmental cooperation and information exchange. The measure of the EM system consists of five items. They represent the most important aspects of EM system implementation (i.e. the formulation of environmental policy, implementation of environmental action plan, measurements of environmental impact, environmental audits, and internal reporting) (Darnall et al., 2008).

Table 5.1.
Survey items used in the scales.

Construct	Mean	SD	Loading	T-value
Acquisition *(Cronbach's alpha* = 0.85*, Composite reliability* = 0.85*, AVE* = 0.65*)*				
Collecting information about new opportunities in the sector through informal meetings with sector business partners	3.17	1.67	0.78	10.36
Periodically organizing special meetings with customers or other business partners to acquire new knowledge	2.35	1.49	0.75	9.78
Devoting much time to establish the contact with the parties that can provide information about new developments in the sector	3.40	1.62	0.89	12.48
Assimilation *(Cronbach's alpha* =0.96 *, Composite reliability* = 0.96*, AVE* = 0.89*)*				
Being among the first to recognize the changes in market competition	3.74	1.55	0.93	14.23
Being among the first to recognize the changes in regulation	3.74	1.60	0.93	14.13
Being among the first to recognize the changes in technology	3.86	1.64	0.97	15.50
Transformation *(Cronbach's alpha* = 0.92*, Composite reliability* = 0.93*, AVE* = 0.81*)*				
Employees record and store newly acquired knowledge for future reference	3.92	1.44	0.89	13.12
Quickly recognizing the usefulness of new external knowledge to existing knowledge	3.93	1.53	0.91	13.52
Periodically meeting to discuss how obtained new knowledge can be applied to business	3.44	1.66	0.90	13.19
Exploitation *(Cronbach's alpha* = 0.90*, Composite reliability* = 0.90*, AVE* = 0.75*)*				
Being able to translate external information directly into new business applications	3.60	1.32	0.80	10.90
Application of external information to the business contributes to the profitability	3.21	1.40	0.89	12.82
Being skilful in applying new external information to improve the business and profitability	3.46	1.48	0.90	13.23
Environmental integration *(Cronbach's alpha* = 0.89*, Composite reliability* = 0.90*, AVE* = 0.75*)*				
Regular dialog on environmental issues between people working in different functions	3.61	1.72	0.89	12.90
Functional specialists are encouraged to take environmental initiatives	3.49	1.58	0.91	13.48
Employees on the work floor are coming up with propositions on how to reduce environmental impact	2.93	1.44	0.79	10.66
Environmental management system *(Cronbach's alpha* =0.91 *, Composite reliability* = 0.91*, AVE* = 0.67*)*				
Formulation of an environmental strategy or policy	3.10	1.45	0.82	11.49
Implementation of an environmental action plan	2.57	1.53	0.82	11.34
Internal environmental audits	2.40	1.57	0.73	9.58
Periodic measurement of environmental impact	3.27	1.65	0.87	12.44
Periodic internal reporting on environmental impact and environmental measures	2.51	1.63	0.85	12.12
Environmental innovation *(Cronbach's alpha* = 0.81*, Composite reliability* = 0.82*, AVE* = 0.53*)*				
To overcome the pollution of air, water, soil, and noise	3.96	1.74	0.66	8.13
To reduce materials and energy usage	4.65	1.36	0.86	11.81
To reduce packaging and waste during the production process	4.04	1.63	0.72	9.12
To reduce or valorise the product waste	4.47	1.64	0.68	8.51
Cost savings *(Cronbach's alpha* = 0.85*, Composite reliability* = 0.86*, AVE* = 0.67*)*				
Energy costs have decreased	3.83	1.70	0.88	12.56
Water and waste water costs have decreased	3.49	1.54	0.90	12.91
Savings on waste and waste treatment	3.93	1.49	0.66	8.27
Market gains *(Cronbach's alpha* = 0.86*, Composite reliability* = 0.86*, AVE* = 0.68*)*				
Product price has increased	2.80	1.40	0.71	9.10
The turnover has increased	2.49	1.41	0.92	12.95
Product quality has improved	2.79	1.57	0.84	11.40

5.4. Results

5.4.1. CFA: measurement model analysis and validation of constructs

In this Chapter, we adopted the two-step approach of Anderson and Gerbing (1988) that consists of confirmatory factor analysis (CFA) to estimate and specify the measurement model correctly and of simultaneous estimation of the measurement and the structural models. First, we conducted a maximum likelihood CFA with Lisrel 8.8 (Jöreskog and Sörbom, 2006) to evaluate psychometric properties of multi-item measures. Due to the presence of different theoretical perspectives and empirical findings regarding the structure of the AC construct (see e.g. Jansen et al. (2005), Flatten et al. (2011)), we conducted a separate analysis to compare alternative structures of the AC construct. Second, we estimated the structural model presented in Figure 5.1.

AC. We tested a four-factor model, where every item was allowed to load on only one dimension of AC. The fit indices evidenced a high consistency of the model with the data (χ^2/df = 1.76, CFI = .987, RMSEA = .075, SRMR = .034). As $\Delta X^2{}_5$ = 254.8, $p<0.001$, we had to reject the alternative two factor model that makes a distinction between potential and realized AC (Zahra and George, 2002). Also the lower quality of fit indices for an alternative two-factor model (χ^2/df = 6.40, CFI = .896, RMSEA = .200, SRMR = .112) supported our decision to reject the two-factor model in favor of the four-factor model. We also specified a model, where four dimensions of AC load on one common AC factor. This model was rejected ($\Delta X^2{}_6$ = 413.4, $p<0.01$; χ^2/df = 9.22, CFI = .853, RMSEA = .235, SRMR = .092). Consequently, the CFA results suggest that four dimensions of AC can be empirically discriminated. This corresponds to the earlier empirical findings of Jansen et al. (2005).

The combined measurement model. The 9-factor model achieved a satisfactory fit with the data (χ^2/df = 1.73, CFI = .98, RMSEA = .067, SRMR = .057). The *indicator reliability* was assured because all the indicator loading exceeded .66 and indicators loaded significantly on the respective constructs ($p<0.01$) (Table 5.1). The values of Cronbach's alpha and Composite reliability in a range of 0.81 - 0.96 indicated a high *internal consistency reliability* of different items constructing the scale (compare against the cut-offs of 0.7 for early research stages and of 0.8-0.9 for later phases in Nunnally (1978)). *Convergent validity* was established by examining the Average variance extracted (AVE) values. The latter compare the variance captured by the construct indicators to the error variance. All the AVE values were sufficiently high (i.e. > 0.5).

Discriminant validity. We compared the models with unconstrained correlations between a pair of constructs with the model where the correlation between every pair of constructs was fixed to 1. Table 5.2 displays the χ^2 differences between the unconstrained and constrained models compared against one degree of freedom. For each pair of constructs, the constrained model showed a significantly ($p < 0.001$)[10] worse fit than the unconstrained model: the χ^2 increased by at least 64.79 against the critical value of 10.828 when $p=0.001$. This indicated that the correlation coefficient between every pair of constructs was significantly different from 1. Consequently, the constructs were shown to be empirically distinct.

[10] The smaller p-value was chosen for each individual difference test to adjust the significance level of the family of tests when a series of tests is performed (see Anderson and Gerbing (1988) and Hatcher (1994)).

To ensure the discriminant validity, the variance captured by the construct should exceed the variance shared by the construct with other constructs (Fornell and Larcker, 1981). Table 5.3 demonstrated that the square root of AVE always exceeded the correlation coefficient between the construct and other constructs. The confidence interval of the correlation coefficient was examined as a complementary verification of discriminant validity (Anderson and Gerbing, 1988). The confidence interval was built in the range of two standard errors around the correlation coefficient estimate (both are presented in Table 5.3). We examined all confidence intervals and neither of them included 1.00. Hence, correlation coefficients between any pair of constructs are significantly different from unity.

Table 5.2.

Data for assessment of internal consistency reliability, convergent validity, and discriminant validity test: Chi-square difference between unconstrained and constrained models.

	1	2	3	4	5	6	7	8	9
1 Acquisition									
2 Assimilation	106.68								
3 Transformation	64.79	160.54							
4 Exploitation	101.64	145.88	111.67						
5 EM system	134.27	422.97	238.81	198.07					
6 Environmental innovation	157.11	139.95	133.49	126.84	73.86				
7 Integration	128.45	186.76	181.34	173.56	108.53	67.18			
8 Cost savings	173.47	182.29	169.97	137.19	111.77	75.18	141.29		
9 Market gains	163.29	188.45	174.34	175.00	176.69	124.97	141.94	155.16	

Table 5.3.

Correlation coefficients and standard errors for examination of discriminant validity.

		1	2	3	4	5	6	7	8	9
1	Acquisition	**0.809**[a]								
2	Assimilation	0.642[b] (0.059)[c]	**0.944**							
3	Transformation	0.770 (0.046)	0.744 (0.044)	**0.899**						
4	Exploitation	0.632 (0.063)	0.673 (0.053)	0.731 (0.048)	**0.864**					
5	EM system	0.490 (0.076)	0.366 (0.080)	0.524 (0.070)	0.481 (0.075)	**0.819**				
6	Environmental innovation	0.320 (0.092)	0.460 (0.077)	0.464 (0.079)	0.497 (0.077)	0.708 (0.056)	**0.731**			
7	Integration	0.519 (0.074)	0.555 (0.065)	0.555 (0.067)	0.569 (0.067)	0.730 (0.049)	0.712 (0.056)	**0.864**		
8	Cost savings	0.366 (0.086)	0.302 (0.085)	0.405 (0.080)	0.563 (0.068)	0.658 (0.058)	0.682 (0.060)	0.534 (0.071)	**0.821**	
9	Market gains	0.279 (0.091)	0.260 (0.087)	0.374 (0.083)	0.374 (0.084)	0.375 (0.083)	0.496 (0.078)	0.533 (0.071)	0.437 (0.080)	**0.826**

[a] – diagonal elements represent the square root of AVE;
[b] – off-diagonal elements represent the correlation coefficients between the constructs; all the correlations are significant at p<0.01 level.
[c] – off-diagonal elements in parenthesis represent the standard errors of the correlation coefficients.

5.4.2. Structural model analysis and hypotheses testing

The research model was tested by means of SEM (Figure 5.2). The proposed model showed a good fit to the data (χ^2/df=1.78, CFI = .97, SRMR = .069, RMSEA = .071). Table 5.4 provides a detailed overview of the structural estimates, their t-values, proportions of the variance of dependent variables explained by the model, and conclusions with respect to formulated hypotheses.

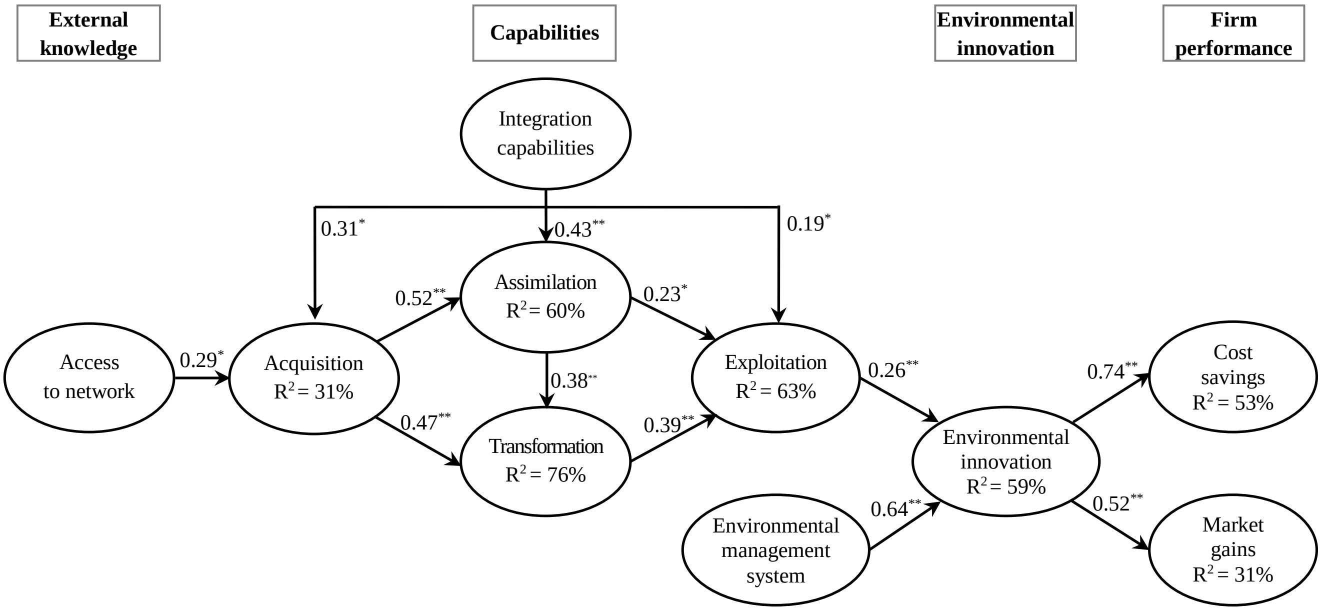

Figure 5.2. Structural model overview.
** significant at p<0.01 level,
* significant at p<0.05 level.
Only significant (p<0.05) relationships are shown.

The findings show that the access to the network is positively associated with the acquisition of external knowledge (β=0.29, p<0.05) in line with Hypothesis 1, but not with its assimilation in conflict with Hypothesis 1b. It means that increasing frequency of contacts with external partners on environmental issues is related to the development of the internal capability to identify and acquire new knowledge. However, we could not confirm that higher frequency of external contacts on environmental issues improves knowledge assimilation. Perhaps the analysis and interpretation of external knowledge becomes more difficult when the firm is subject to information from a broader range of, and more frequent communication with, external actors. Many perspectives on new knowledge provided by a broad range of different actors might obstruct knowledge assimilation. In accordance with Hypothesis 2, integration of environmental management within the firm stimulates all dimensions of AC. The only exception is the relationship with the transformation dimension. This peculiarity will be discussed in the next section. While four dimensions of AC are mutually related, its last dimension – exploitation of external knowledge – induces environmental innovation (β=0.26, p<0.01) as suggested by Hypothesis 3. It implies that firms must follow the knowledge absorption process from acquisition to exploitation to increase the chances of benefitting from external knowledge in terms of innovation. Environmental innovation is not only positively influenced by the capability to exploit external knowledge, but also by internal mechanisms for knowledge development and accumulation embraced by the EM system (β=0.64, p<0.01). This in line with Hypothesis 4. The findings showing the importance of both AC and

EM system for environmental innovation challenge the idea of substitution of internal and external knowledge in an environmental innovation context. With respect to the performance implications of environmental innovation, the results support the "pays to be green" case among F&B processors: environmental innovation is positively associated with both cost savings ($\beta=0.74$, $p<0.01$) and market gains ($\beta=0.52$, $p<0.01$). Therefore, we can confirm Hypotheses 5a and 5b respectively.

Table 5.4.
Structural model overview

Path to:	Path from:	Coefficient	T-value	R^2	Hypothesis testing
Acquisition	Network	0.29*	2.11	32%	*supports H1a*
	Integration	0.31*	2.24		*supports H2*
Assimilation	Acquisition	0.52**	5.29	49%	
	Network	-0.19	-1.65		*contradicts H1b*
	Integration	0.43**	3.49		*supports H2*
Transformation	Acquisition	0.47**	4.99	71%	
	Assimilation	0.38**	4.57		
	Integration	0.11	1.42		*contradicts H2*
Exploitation	Acquisition	0.08	0.65	60%	
	Assimilation	0.23*	2.21		
	Transformation	0.39**	2.83		
	Integration	0.19*	2.20		*supports H2*
Environmental innovation	Exploitation	0.26**	3.15	63%	*supports H3*
	EM system	0.64**	5.92		*supports H4*
Cost savings	Environmental innovation	0.74**	6.67	55%	*supports H5a*
Market gains	Environmental innovation	0.52**	4.66	27%	*supports H5b*

5.5. Discussion and conclusions

This study was conducted to examine the roles of internal and external knowledge sources for environmental innovation while considering organizational capabilities for internal and external knowledge sourcing: AC capability to tap *external* knowledge available in the network and the EM system reflecting the development and accumulation of *internal* environmental knowledge within the firm. In this context, we aimed to inform the managers of the implications of their investments in environmental innovation by exploring its impact on firm performance. In this section, we show how our findings extend the discussion regarding the roles of external and internal knowledge for environmental innovation. We will discuss largely unexplored relationships between external knowledge sources, AC capability for external knowledge sourcing and environmental innovation. Furthermore, we will provide insights into the process of knowledge absorption by exploring the structure of the AC concept, the relationships between its dimensions, and ways to enhance the AC. The potential of environmental innovation to improve firm performance will be outlined. To conclude, we will formulate recommendations for managers on how to apply our findings.

5.5.1. Discussion of the findings, theoretical contributions, and implications

The findings are intriguing and demonstrate that in the development of environmental innovations Dutch F&B processors rely on both absorption of external knowledge available in their network and on internal knowledge built through EM system capabilities. This corroborates empirically the stream of findings that suggests the importance of both internal and external knowledge sources for environmental innovation (e.g. Ketata et al. (2014), del Río et al. (2013)) and challenges the presence of a substitution effect (De Marchi, 2012). Contradictory findings regarding prevailing roles of external and internal knowledge for environmental innovation form a discussion in the literature. The special meaning of external knowledge for environmental innovation is derived from the "complex and systemic nature" of this innovation and from a lack of resources and competences within the firm to address the relatively new challenge of environmental impact reduction (De Marchi, 2012). The main argument for advocating the dependence of environmental innovation on internal knowledge is that the external knowledge transfer in case of environmental innovation might not be efficient due to its complexity and the firm-specific character of this knowledge (Bönte and Dienes, 2013). The present study shows that the two above-mentioned arguments have empirical grounds. This is because the findings in the context of F&B processors indicate that both internal and external knowledge sourcing is essential for environmental innovation.

A handful of empirical studies that focused on the roles of external and internal knowledge sources for environmental innovation addressed the role of AC as a knowledge sourcing capability. Even in conventional innovation research, empirical studies using AC measures other than R&D proxies are scarce. We can rely only on case studies of Williander (2007), which illustrate the importance of AC for environmental innovation in the automotive context. Our contribution stems from an empirical quantitative investigation of the role of AC as a capability that enables external knowledge exploitation. Having access to external knowledge sources does not automatically imply that the firm can recognize its value, understand its applicability, and ultimately make use of it. Our results indicate that access to the network stimulates the first dimension of AC - acquisition of external knowledge. Conducted analysis shows that external knowledge passing through all dimensions of AC, from acquisition to exploitation, can induce environmental innovation. These findings reinforce our assumption that analysis of the role of external actors for environmental innovation has to allow for the AC.

The present Chapter advances prior research on the relationships between external knowledge access and the AC by taking into consideration our findings regarding the AC structure. In the innovation literature, the influence of network on AC with its two dimensions, knowledge acquisition and assimilation, is proposed (Zahra and George, 2002). We could not confirm the relationships between the network access and the second dimension of potential AC - knowledge assimilation. The latter could be explained by the inappropriateness of the distinction between potential and realized AC and subsequently by the inappropriateness of hypotheses based on this distinction. The effect of network access on knowledge assimilation was hypothesized based on the proposition of Zahra and George (2002) regarding the impact of external knowledge sources on potential AC. The other studies, which did not support the distinction between potential and realized AC, propose a relationship between external knowledge sources and the first dimension of AC – knowledge acquisition (cf. Cohen and Levinthal (1990), Todorova and Durisin (2007)). Our findings suggest that the terms 'potential AC' and 'realized AC' might be too broad compared to the four-dimensional AC structure. Notably, our CFA substantiates that the four-dimensional AC structure outperforms the AC structure that distinguishes between potential and realized AC (cf. Jansen et al. (2005), Flatten et al. (2011)).

The present study informs the discussion of relationships between four AC dimensions. All dimensions of AC appeared to be positively related to each other, when every succeeding dimension is influenced by the preceding one (cf. Abareshi and Molla (2013), Tepic et al. (2012)). It is of particular interest that knowledge acquisition rather than assimilation appeared to have a stronger impact on knowledge transformation. Furthermore, not only knowledge transformation but also assimilation was shown to induce knowledge exploitation. These findings pertain more to the AC model conceptualized by Todorova and Durisin (2007) than the AC conceptualization of Zahra and George (2002). In the context of our study, the main difference between these two AC conceptualizations stems from the understanding of roles of knowledge assimilation and transformation. Zahra and George (2002) suggest that knowledge transformation follows its assimilation. Todorova and Durisin (2007) view knowledge transformation and assimilation as alternative processes while acknowledging the presence of reciprocal relationships between them. When acquired external knowledge fits existing cognitive structures, knowledge can be assimilated with existing cognitive structures and then exploited. Knowledge transformation is then not required. When acquired external knowledge is not easily compatible with existing knowledge, it cannot be readily assimilated with existing cognitive structures. These structures need to be transformed so that new knowledge can be exploited (Todorova and Durisin, 2007). Against this background, we found that knowledge transformation is primarily affected by knowledge acquisition rather than assimilation. This implies that acquired knowledge does not necessary need to be assimilated in order to be transformed. Furthermore, we found that both assimilation and transformation lead to knowledge exploitation. This finding means that assimilated knowledge can be directly exploited without being transformed. Overall, our results reinforce the idea that acquired knowledge should be either assimilated or transformed (depending on its compatibility with existing cognitive structures) and then exploited. Hence, this study provides empirical support in favor of the AC conceptualization by Todorova and Durisin (2007) and advances the research on AC operationalization.

The specific results we found are especially interesting. Integration capabilities were shown to affect positively two dimensions of potential AC: acquisition and assimilation of external knowledge. This is in accordance with previous studies (i.e. Jansen et al. (2005)). However, we observed that the impact of integration on two dimensions of realized AC (i.e. transformation and exploitation) is not the same. Integration induces the exploitation of external knowledge but has no impact on knowledge transformation. Embedding new knowledge into present operations through knowledge exploitation might require the participation of different functional specialists and employees of different organizational layers. Transformation embodies the combination of existing and newly acquired knowledge. New knowledge might be relevant for specific groups in the organization, so that the efforts to incorporate new knowledge into the whole organization might not be efficient.

Within the “pays to be green” discussion, our findings pertain to the advocates of win-win innovations that can generate both public and private benefits (cf. Hart (1995)). While reducing environmental impact, environmental innovation was shown to induce cost savings in terms of material, energy, and water usage as well as market gains such as higher product price, market share, and product quality. As we expected, Dutch F&B processors appeared to be more likely to realize cost savings compared to market gains.

5.5.2. Managerial implications

For business management, our findings indicate that firms should rely on both internal and external knowledge to implement environmental innovation. An excessive reliance on external knowledge is not desirable as internal knowledge development mechanisms embraced in the EM system appeared to have a strong influence on environmental innovations. We also warn against the ‘not-invented here’ syndrome, when the firm ignores external developments simply because they come from outside the organization. Knowledge available in the firm’s network appeared to be an important determinant of environmental innovation, if properly absorbed. The latter attracts the special attention of managers to the development of capabilities that facilitate knowledge absorption. An access to network knowledge requires AC capabilities so that external knowledge can be converted into environmental innovations. When developing AC capability, managers should emphasize all four AC dimensions because they are shown to be highly interdependent. The firm that is good at spotting new opportunities and recognizing their values might fail to introduce corresponding innovation due to a lack of capabilities to merge existing knowledge with new trends and to exploit external knowledge. Although our study was not focused on AC determinants, it outlines the opportunity to enhance AC. Integration of environmental management across organizational functions and layers stimulates all dimensions of AC, except knowledge transformation. Because AC capability is not restrained to a specific organizational function (e.g. quality, R&D, manufacturing, etc.), improving AC through environmental integration has the potential to induce benefits beyond environmental innovation. We found that environmental innovation pays off in terms of performance, which can help managers to justify investments in networking, environmental integration, EM system, and AC. This is because environmental innovation appeared to be positively related to cost savings and market gains.

5.5.3. Limitations and recommendations for future research

Our research has some limitations that should be addressed by future studies. First, we did not include in our investigation the distinction between process and product environmental innovation. Some studies do not suggest separating process innovation from product innovation in an environmental context due to their interdependencies (Bönte and Dienes, 2013). Other studies show that the relative importance of EM system and network might be different for process and product innovation (Grekova et al., 2013). Second, the roles of EM system and AC might vary depending on the firm’s innovation strategy. Generators might be more likely to rely on internal knowledge-building while adopters may rely on AC (Del Río González, 2009). Third, we built the theoretical framework on the AC conceptualization by Zahra and George (2002), while our findings regarding the relationships between AC dimensions provide support for the AC conceptualization of Todorova and Durisin (2007). Therefore, further in-depth investigation into the relationships between the dimensions of AC is required. Lastly, from a methodological perspective, the cross-sectional type of data places restrictions on causality claims. Future panel data research might provide a better understanding of the directions of the relationships in the model.

CHAPTER SIX

DISCUSSION AND CONCLUSIONS

Since environmental sustainability of operations climbs up the agenda of the industry, policy makers, consumers and citizens, we have been witnessing a tremendous growth of environmental sustainability measures as well as an increasing complexity of these measures. The present dissertation explores how Dutch F&B firms address the challenge of environmental sustainability while focusing on the following types of environmental measures: environmental innovation and supply chain-oriented environmental management (EM). From an academic standpoint, this dissertation expands our understanding of determinants and performance implications of environmental innovation and supply chain-oriented EM by specifying organizational capabilities and external pressures that support their development and by exploring their potential to improve business performance. The outcomes of this dissertation can serve the decision making of the industry and of policy representatives concerning measures to stimulate sustainable growth in the context of the individual firms, their supply chains, and networks. Our findings provide practitioners with an outline of the impact of these measures on corporate profitability.

We formulated a set of research questions that serve the development of a framework for decision making concerning the implementation of environmental innovation and the implementation of supply chain-oriented EM and their implications for business processes and performance. Every chapter, corresponding to one of the research questions, uncovers the research problem mainly through the theoretical lens of the RBV and its spin-offs. In Chapter 2, the combination of the Natural RBV and neo-institutional theory provides new insights into dynamics of determinants of supply chain-oriented EM. In particular, Chapter 2 studies the changes that occur in course of time in the roles of institutional pressures and organizational determinants in supply chain-oriented EM. Based on the RBV and its spin-offs, Chapter 3 provides a better understanding of the interaction of organizational capabilities that support supply chain-oriented EM. Furthermore, it outlines the impact of supply chain-oriented EM on firm performance while treating supply chain-oriented EM as a capability to integrate environmental concerns into the relationships with supply chain partners. An application of the extended RBV in Chapter 4 leads to the crystallization of outcomes of supply chain-oriented EM in terms of environmental innovation and firm performance. Chapter 5, drawing on the AC perspective, elaborates the impact of external partners' knowledge on environmental innovation. Furthermore, Chapter 5 brings organizational capabilities into the discussion regarding the relevance of internal and external knowledge sources for environmental innovation.

The present Chapter discusses our findings and contributions, acknowledges limitations and outlines directions for future research. Importantly, we provide recommendations for managers and policy makers. Section 6.1 reviews the findings and contributions of Chapters with respect to the posed research questions. Section 6.2 contains a synthesis of the contributions provided with respect to individual research questions and the formulation of an overarching contribution of the dissertation. Furthermore, Section 6.2 acknowledges overall research limitations and suggests future research directions. Finally, Section 6.3 illustrates how our findings can assist managers and policy makers in addressing the environmental sustainability challenge.

6.1. Main findings with respect to the research questions

As firms gain experience in the reduction of environmental impact, the measures they apply are increasingly growing in complexity and involvement of external actors. In-house environmental innovation and EM, that engages external actors in supply chains and networks, are increasingly becoming a new industrial philosophy to achieve sustainable growth.

The present dissertation aimed:

1. *To analyse how firms address the challenge of obtaining environmental sustainability through environmental innovation and supply chain-oriented EM;*
2. *To get insight in the performance implications of these EM practices.*

In particular, the following research **objective** was targeted:

- ***To investigate determinants of environmental innovation and of supply chain-oriented EM and their impact on firm performance.***

<u>Research question 1 (Chapter 2):</u>

Determinants of supply chain-oriented environmental management.

Chapter 2 contributes to the research objective by investigating how firms address the challenge of environmental sustainability through supply chain-oriented EM in a dynamic perspective. Examples of different practices associated with E-EM (in a broad sense) are reported by researchers and practitioners: working together with supply chain partners to reduce environmental impact, joint environmental planning, developing shared understanding of responsibilities, collaboration with customers to change product specifications, green packaging, green transportation channels, and reverse logistics (Ageron et al., 2012; De Giovanni and Esposito Vinzi, 2012; Zhu et al., 2008a), etc. (see e.g. Srivastava (2007), Zhu et al. (2008b), Azevedo et al. (2011) for an overview). Supply chain-oriented EM is seen as a *"a paradigm shift, going from end-of-pipe control to meet environmental regulations to the situation of not only minimizing ecological damage, but also leading to overall economic profit"* (Srivastava, 2007). The contribution of supply chain-oriented EM to corporate profitability is still a subject for debate (De Giovanni, 2012; Seuring and Müller, 2008). However, the potential of such a contribution in combination with the general consensus that supply chain-oriented EM improves environmental performance (Azevedo et al., 2011; Gimenez and Tachizawa, 2012; Zhu and Sarkis, 2004) fuels E-EM's diffusion and academic interest in the concept. A rich body of the literature focuses on determinants of supply chain-oriented EM in order to provide industry and policy makers with recommendations concerning its further development. Analysing prior research, it was noticed that internal organizational and external institutional determinants were treated mostly in isolation (Wu et al., 2012), while considering specific types of external pressures instead of a full range of institutional influences (cf. Barros et al. (1998), Louwers et al. (1999), Hu et al. (2002), Listeş and Dekker (2005), Gamberini et al. (2008)). Another gap in scholars' understanding of supply chain-oriented EM determinants concerns the absence of multi-period studies. The necessity of mutli-period studies is explained by the relatively early stage of supply chain-oriented EM development, dynamic progress in its implementation, and increasing industry experience (Carter and Rogers, 2008; Zhu et al., 2008a). In response to these gaps, Chapter 2 answered the following research question:

> **Research question 1 (Chapter 2):** *How do the relationships between external institutional pressures, adoption of in-company EM, and supply chain-oriented EM evolve over time?*

The data of two surveys conducted in 2002 and 2010 among Dutch F&B processors were employed to answer the research question. The findings point out that primarily institutional pressures rather than internal organizational factors stimulated supply chain-oriented EM in the earlier observation period (2002), when supply chain-oriented EM was less developed in the industry. These findings empirically corroborate Goodrick and Salancik (1996) and Delmas and Toffel (2008) who suggest that institutional pressures are the major driving forces of a practice's implementation when this practice is less institutionalized. Studying implementation of supply chain-oriented EM by Dutch F&B processors, we show that, in spite of the strengthening of institutional pressures in course of time, these pressures became less influential by 2010 compared to internal organizational factors. In 2010, when supply chain-oriented EM has become more common, exerting the pressure on firms to implement supply chain-oriented EM turns out to be less important than in 2002. As firms are increasingly considering the implementation of supply chain-oriented EM as appropriate behaviour, institutional pressures are becoming less influential. In 2010, internal organizational factors are shown to be crucial to enable the implementation of the supply chain-oriented EM by Dutch F&B processors.

Overall, our study proves institutional pressures to be an important determinant of supply chain-oriented EM. However, pressures on different levels vary considerably with respect to their potential to induce supply chain-oriented EM. We found that pressures from supply chain partners and increasingly from long-term public–private environmental covenants significantly influence the implementation of supply chain-oriented EM among Dutch F&B processors. Interestingly, regulative institutional pressure from public authorities appeared to have no impact on supply chain-oriented EM, both in 2002 and in 2010. These findings are of particular interest as they suggest that Dutch public policy has chosen to rely on responsibility culture, initiative, and self-organization rather than on direct steering regulation. Positioning this contribution in the context of existing literature yields two major contributions. First, our findings corroborate empirically the dynamic theoretical framework of Dutch public policy with respect to sustainable supply chain management, as suggested by Driessen et al. (2012). Second, the outcomes of our study inform the discussion of the role of direct steering regulation in the implementation of proactive environmental practices, like supply chain-oriented EM. Challenging some prior evidence of the positive impact of direct regulation on supply chain-oriented EM (e.g. Rivera (2004), Zhu et al. (2005)), our empirical findings substantiate the stream of literature that suggests that other than regulative institutional forces drive proactive environmental practices (Buysse and Verbeke, 2003; Miemczyk, 2008).

The outcomes with respect to Research question 1 pertain to the research stream that focuses on potential complementarities between organizational capabilities that ease the implementation of more proactive environmental practices (Christmann, 2000; Darnall et al., 2008; Hart, 1995). Chapter 2 illustrates how internal organizational capabilities can induce the development of capabilities that span organizational boundaries. The findings show that F&B processors with more developed EM systems, associated with the presence of continuous improvement capabilities, are more likely to advance their EM by implementing supply chain-oriented EM, associated with the capabilities for stakeholders integration. This finding addresses an important gap in the literature (Shi et al., 2012) by affirming the claim of path dependency of environmental strategies as formulated by the Natural RBV (Hart, 1995).

<u>Research question 2 (Chapter 3):</u>
Organisational capabilities for supply chain-oriented environmental management.

Chapter 2 illustrates the increasing importance of organizational capabilities for EM that spans organizational boundaries. Chapter 3 offers further insight into organizational capabilities for supply chain-oriented EM. Prior research rarely considered how the firms used their capabilities developed within the core business strategy and the capabilities developed within their environmental strategy to come up with new better ways to reduce environmental impact. For instance, Christmann (2000) illustrates how in-house best practices of EM can be complemented by the capabilities of continuous innovation and implementation in order to generate cost advantage. Chapter 3 investigates whether the integration of environmental concerns within the firm can provide an additional impetus to the implementation of supply chain-oriented EM, when combined with innovative orientation. Furthermore, to answer research question 2, we consider supply chain-oriented EM as an organizational capability for the integration of stakeholders in supply chains into EM, not as a set of environmental practices. Chapter 3 assesses performance implications of capabilities for supply chain-oriented EM to provide academics and practitioners with the input for the decision making regarding the efficiency of their development.

Research question 2 (Chapter 3): *What organizational capabilities support the development of supply chain-oriented EM and how does supply chain-oriented EM influence firm performance?*

A survey conducted among Dutch F&B processors in 2013 served as research material for Chapters 3-5. Analysing the data with variance-based structural equation modelling, Chapter 3 provides a framework that connects internal organizational capabilities, supply chain-oriented EM, and firm performance. The findings show that the development of supply chain-oriented EM is supported by both the capabilities of innovative orientation and environmental integration and is accelerated by their combination. We found that integration capabilities on in-house and supply chain levels are interconnected. In particular, the capability to integrate environmental concerns within the firm induces the integration of environmental concerns in the relationships with supply chain partners. This finding empirically strengthens the theoretical propositions of Hart (1995) and Christmann (2000) that firms with a cross-functional approach to in-house EM are more likely to develop capabilities of stakeholder integration in the context of environmental impact reduction.

Finally, it was demonstrated that the overarching capability to engage supply chain partners in EM pays off. Earlier empirical research is not consistent regarding the value-creating potential of the separate practices that construct supply chain-oriented EM (cf. e.g. Azevedo et al. (2011); Carter et al. (2000); Green et al. (2012); Hall (2000); Zhu et al. (2007)). Against this background, we referred to supply chain-oriented EM as an overarching capability to integrate supply chain partners into EM. This capability is induced by the implementation of interconnected environmental practices that involve supply chain partners, such as green purchasing, environmental collaboration with customers, and eco-design. In this context, Chapter 3 shows that overarching capability to integrate supply chain partners into EM is beneficial for firms in terms of cost savings and market gains.

Research question 3 (Chapter 4):
Supply chain-oriented environmental management and firm performance.

Chapter 3 outlines business performance implications of supply chain-oriented EM. Chapter 4 deepens our understanding of this relationship. Like earlier studies (e.g. Zhu et al. (2007), De Giovanni (2012), Gimenez and Tachizawa (2012)), Chapter 3 considers that supply chain-oriented EM directly induces firm-level performance. Grounded in RBV spin-offs (viz. relational view (Dyer and Singh, 1998; Dyer et al., 2008) and extended RBV (Lavie, 2006)), Chapter 4 claims that supply chain-oriented EM can enhance the performance of the focal firm not only directly, but also indirectly - by stimulating the focal firm to implement more environmentally sustainable processes that in turn contribute to firm's performance. Advancing the understanding of relationships between inter-firm linkages and firm-level performance, the extended RBV introduces the problem of appropriation of benefits created by the partners. Appropriation of benefits created in collaboration is an issue largely overlooked in the past environmental research. However, it has important implications for practice. Providing manufacturing managers with a better understanding of the direct and indirect relationships between supply chain-oriented EM and firm performance can gain them more control over the outcomes of supply chain-oriented EM.

Research question 3 (Chapter 4): *What is the potential of supply chain-oriented EM to improve environmental sustainability of internal processes and firm performance?*

The approach to the measurement of supply chain-oriented EM adopted in Chapter 4 differs substantially from the ones observed in Chapters 2 and 3. In Chapters 2 and 3, we considered supply chain-oriented EM as an aggregated construct, paying less attention to its components. In Chapter 4, supply chain-oriented EM is considered in two contexts: involving up-stream and down-stream supply chain partners. This deviation proceeds from the shift in research focus towards crystallization of the implications of supply chain-oriented EM. Earlier studies showed that a potential of a supply chain partner to induce improvements in internal processes of a focal firm depends on the supply chain partner's characteristics (Hall, 2000) such as a buyer-seller status. Therefore, we specified supply chain-oriented EM as an up-stream practice involving suppliers and a down-stream practice involving customers. Using covariance-based SEM, we found that, potentially because of partner's characteristics, supply chain-oriented EM involving customers can induce in-house environmental innovation. This innovation results in strong performance improvements. Interestingly, supply chain-oriented EM involving suppliers brings about weak performance improvements as a result of appropriation of the advantage realized by suppliers. Therefore, supply chain-oriented EM involving suppliers has a limited value and potential for Dutch F&B processors. Possibly, as the case studies of Hall (2000) show, supply chain-oriented EM involving suppliers can induce process changes among suppliers, not among focal firms. The findings regarding the impact of supply chain-oriented EM on the sustainability of internal operations have a link with firm performance. As supply chain-oriented EM that involves suppliers induces no changes in environmental sustainability of operations among F&B processors, it generates no market advantage in terms of higher product price, market share, and improved product quality. Although the findings that address the impact of supply chain-oriented EM on internal organizational processes are scarce (Chiou et al., 2011), our findings challenge some prior empirical evidence (Chiou et al., 2011; Geffen and Rothenberg, 2000) concerning suppliers' potential to improve environmental sustainability of their customers. It is worth noting that these prior evidences were collected in a different context, where suppliers are likely to have different characteristics compared to the suppliers of Dutch F&B processors. Hence, Chapter 4 illustrates the necessity to integrate the characteristics of supply chain actors into the research on the implications of supply chain-oriented EM.

Unlike supply chain-oriented EM involving suppliers, supply chain-oriented EM involving customers has an indirect effect on firm performance. This is because supply chain-oriented EM involving customers induces environmental innovation among Dutch F&B processors. This innovation enhances their performance in terms of additional cost savings and market gains. Our findings deepen earlier empirical evidences of a direct contribution of supply chain-oriented EM to firm performance.

Research question 4 (Chapter 5):
Knowledge sourcing for environmental innovation.

Chapter 4 provides new insights into the implications of supply chain-oriented EM through the prism of the extended RBV (Lavie, 2006). In particular, extended RBV takes into account the problem of appropriation of benefits from the involvement of external partners into EM. The extended RBV views the organizational capability of absorptive capacity (AC) as one of the factors that enables firms to appropriate the benefits of collaboration (Lavie, 2006). Therefore, compared with previous chapters, Chapter 5 takes a next step by bringing AC into the discussion regarding the role of external partners in environmental innovation (Bönte and Dienes, 2013; Cuerva et al., 2014; De Marchi, 2012; De Marchi and Grandinetti, 2013; Ketata et al., 2014; Triguero et al., 2014). External partners are a source of new knowledge. Prior research regarding the relative roles of internal and external knowledge for environmental innovation mainly investigated the relative roles of internal and external knowledge *sources*. In innovation literature, it is considered that having access to the sources of external knowledge is not sufficient for its exploitation. Firms should develop the capability to tap external knowledge – AC – so that access to *external knowledge* sources could be used for the development of (environmental) innovation (Cohen and Levinthal, 1990; Van Wijk et al., 2008; Volberda et al., 2010; Zahra and George, 2002). Environmental innovation can also rely on internal knowledge sources. Development and accumulation of *internal knowledge* can be supported by the continuous improvement capability vested in the EM system (Darnall and Edwards, 2006; Epstein and Roy, 1997, 1998). Therefore, Chapter 5 informs the discussion of the roles of internal and external knowledge for environmental innovation by considering organizational capabilities required for knowledge sourcing: (1) absorptive capacity capability to exploit *external* knowledge and (2) a continuous improvement capability to develop and accumulate *internal* environmental knowledge.

Research question 4 (Chapter 5): *What is the impact of capabilities to tap external knowledge and of capabilities to develop and accumulate internal knowledge on environmental innovation?*

Chapter 5 demonstrates that Dutch F&B processors develop environmental innovations relying on both *external knowledge* in their network tapped with the help of AC and on *internal knowledge* built within the EM system, associated with continuous improvement capabilities. This result corroborates empirically the literature stream that advocates the importance of both internal and external knowledge sources for environmental innovation (del Río et al., 2013; Ketata et al., 2014). We expand the research on the determinants of environmental innovation by considering not only different knowledge sources but by providing insights into the knowledge sourcing process. This is done by taking into account organizational capabilities for knowledge sourcing: *AC* to source external knowledge and *continuous improvement capabilities* vested in the EM system for internal environmental knowledge. Furthermore, our findings challenge the presence of a substitution effect between internal and external knowledge that was proposed in previous literature (De Marchi, 2012).

The study sheds new light on external knowledge sourcing through the AC perspective. Chapter 5 contains intriguing findings regarding the structure of the AC concept and the relationships between its dimensions. First, our analysis provides evidence in favour of a four-dimensional AC structure. This challenges the AC reconceptualization by Zahra and George (2002) that suggests the presence of two higher order AC types: potential and realized. Our findings substantiate earlier empirical research of Jansen et al. (2005) and theoretical arguments of Todorova and Durisin (2007) regarding the superiority of the four-dimensional AC structure.

Second, the relationships between AC dimensions appeared not only to have a simple ordered sequence (Zahra and George, 2002). Simple ordered sequence means that acquired new knowledge should be assimilated, transformed through integration with already available knowledge, and only then exploited. The ordered sequence means that the first AC dimension influences the second one, the second one influences the third one, etc. Our findings point out the potential of a concurrent explanation of the relationships between AC dimensions suggested by Todorova and Durisin (2007).

In the context of our study, the key difference between AC conceptualizations suggested by Zahra and George (2002) and Todorova and Durisin (2007) lies in the respective roles of two AC dimensions: assimilation and transformation of external knowledge. While Zahra and George (2002) view knowledge assimilation as a step prior to its transformation, Todorova and Durisin (2007) consider knowledge assimilation and transformation as interconnected but alternative processes. The latter means that firms can either assimilate or transform acquired external knowledge, depending on the correspondence of this knowledge to existing cognitive structures within the firm. We found that knowledge acquisition leads to both knowledge assimilation and transformation, and both assimilation and transformation are positively associated with knowledge exploitation. These results corroborate empirically the relationships between AC suggested by Todorova and Durisin (2007) and dispute the concurrent but largely accepted view of Zahra and George (2002).

6.2. Discussion and conclusions

The overview of our main conclusions is presented in Section 6.2.1. From an academic perspective, Section 6.2.2 documents how this dissertation provides a number of theoretical contributions in light of the RBV and its spin-offs regarding determinants and performance implications of supply chain-oriented EM and environmental innovation. Section 6.2.3 acknowledges the main limitations of the present research and outlines future research perspectives.

6.2.1. Main conclusions

Prompted by the novelty and complexity of the problem, a large body of literature is focusing on in-house and externally-oriented environmental measures that could provide sustainable growth opportunities. This dissertation offers new insights regarding organizational capabilities and external pressures that could stimulate and accelerate the implementation of environmental innovation and supply chain-oriented EM. Our research helps also to foresee their impact on firm operations and performance.

Overall, the study evidences an increasing importance of internal organizational capabilities to enable sustainable industry growth. Internal organizational capabilities appeared to be decisive to induce environmental innovation and supply chain-oriented EM. Also the appropriation of benefits created in cooperation with external partners and exploitation of external knowledge require certain organizational capabilities. In the earlier periods of the corporate environmentalism external pressures were of the primary importance to induce the reduction of environmental impact. Nowadays, the increasing role of organizational capabilities implies that a lot of power is concentrated in the hands of managers.

In Chapter 2, we determined that the implementation of proactive environmental practices, such as supply chain-oriented EM, at an early stage of their development in the industry are especially driven by external institutional pressures. In the context of Dutch F&B processors, it was shown that institutional pressures to implement supply chain-oriented EM pertain mostly to the social obligation of the firms and their desire to mimic the behaviour of successful industry peers rather than on expedience to direct steering regulation. Especially the pressure from supply chain partners, and increasingly from environmental covenants, stimulates the implementation of supply chain-oriented EM.

Novel environmental practices suggest to consider external actors not primarily as a source of pressure to reduce environmental impact, but as a source of new knowledge and resources and as potential partners for collective reduction of environmental impact in supply chains and networks. Proactive firms are likely to engage in more frequent communication or even collaboration with external partners to leverage their knowledge and resources and thus improve the sustainability of internal operations and firm performance.

Environmental proactiveness with respect to the involvement of supply chain actors into EM is not possible for all firms. The implementation of proactive EM requires the development of certain organizational capabilities. The more common environmental practice becomes among the industry peers and the more it is seen as an "appropriate" behaviour, i.e. institutionalized, the greater importance is attached to organizational factors that enable the implementation of the practice. Higher level of EM system development stimulates firms to look beyond the boundaries of an individual organization. This is because the EM system is underpinned by the capabilities of continuous improvement that urge firms to revise continuously their operations in search of ways to reduce their environmental impact also beyond organizational boundaries. In this way, EM systems serve the development and accumulation of internal environmental knowledge. Firms with a higher level of EM implementation are more likely to engage into supply chain-oriented EM.

This dissertation provides further details to draw a profile of the firms that are likely to implement supply chain-oriented EM. Next to possessing a developed EM system, firms should be able to integrate environmental concerns within organizational functions (e.g. R&D, quality, manufacturing, procurement, etc.) and organizational layers. In Chapter 3, it was shown that this capability to integrate environmental concerns within the firm induces the development of the capability of stakeholders integration. Stakeholders integration capability lies in the core of supply chain-oriented EM. Also firms with a strong innovative orientation are more likely to implement supply chain-oriented EM because they are attentive to changes in the competition, market, and consumer preferences. Moreover, it was shown that firms with both innovative orientation and integration of environmental concerns have an additional impetus to develop supply chain-oriented EM.

Considering external actors not as a threat but as a source of knowledge and resources or even as potential strategic partners can be advantageous. Overall, capabilities for supply chain-oriented EM are associated with performance improvements. Nevertheless, our dissertation points out that these relationships are more complex. Many firms engage in supply chain-oriented EM to improve environmental sustainability of their own operations by means of environmental innovation. Supply chain-oriented EM can induce improvements on the side of partners of the focal firm. This makes it difficult for focal firms to appropriate the benefits from the investments in supply chain-oriented EM. The results of Chapter 4 draw the attention to the characteristics of the partners and their position in the buyer-seller dyad that influence the outcomes of supply chain-oriented EM.

Effective sourcing of knowledge from external partners requires the presence of the capability of absorptive capacity. Induced by frequent networking, absorptive capacity enables firms to spot new knowledge, realize its value for the business, integrate it with available knowledge, and exploit it. The capability to exploit external knowledge is essential for environmental innovation. This finding shows that frequent networking as such is not sufficient. Knowledge creates value for the firm when properly absorbed. Absorption of external knowledge requires efforts of the whole organization, including various layers and functions. Firms that manage to develop environmental innovation can harvest associated benefits in terms of cost savings and better market position.

6.2.2. Academic contributions

In this section, we provide a synthesis of academic contributions of our findings in Chapters 2-5.

Determinants of environmental innovation and of supply chain-oriented EM

Internal organizational determinants

First, we deepened the understanding of organizational capabilities that support environmental innovation and supply chain-oriented EM in the light of the RBV (Barney, 1991; Peteraf, 1993; Wernerfelt, 1984). Prior discussion regarding the relevance of internal and external knowledge determinants for environmental innovation (Bönte and Dienes, 2013; De Marchi, 2012; Ketata et al., 2014) was primarily addressing the relevance of internal and external knowledge sources. In empirical environmental literature, organizational capabilities for knowledge sourcing, widely discussed in innovation literature, were mostly neglected. Especially the AC capability to tap external knowledge is considered to be crucial for external knowledge exploitation in conventional innovation literature (Cohen and Levinthal, 1990; Lane et al., 2006; Zahra and George, 2002). AC is often referred to (del Río González, 2005, 2009) but is hardly addressed in empirical literature on environmental innovation. Chapter 5 brings AC into the debate on the roles of internal and external knowledge in environmental innovation. By connecting innovation management and environmental management literature, we make a step towards an integrative framework of environmental innovation.

Second, we rely on the RBV and its spin-off – Natural RBV (Hart, 1995) to get insight into organizational capabilities for supply chain-oriented EM. While empirical support of the Natural RBV's postulates is lacking (Shi et al., 2012), Chapter 2 provides evidence from a multi-period perspective that firms with a more developed EM system and corresponding continuous improvement capabilities are more likely to engage in supply chain-oriented EM. This substantiates path dependency of environmental strategies, what constructs the core of the Natural RBV. Chapter 3 sheds new light on organizational capabilities for supply chain-oriented EM by modelling it not as a set of organizational practices but as a capability to integrate stakeholders in EM. The results display that the capability to integrate environmental concerns *within the firm* gives impetus to the development of capabilities to integrate environmental concerns into the relationships with external partners on a *supply chain* level.

External determinants

The dissertation addresses one of the key issues in environmental literature: the roles of external actors and especially of public authorities (i.e. environmental regulation) in the implementation of environmental measures. Through the lens of Neo-institutional theory (DiMaggio and Powell, 1983; Hoffman, 2001b; Scott, 2001), we informed the discussion of the impact of external pressures on supply chain-oriented EM in the course of its institutionalization. Notably, our findings show that Dutch public policy does not rely on direct steering regulation but rather on normative and culturally cognitive pressures to induce isomorphism in the implementation of supply chain-oriented EM among F&B processors. Within the debate on the roles of direct steering regulation in proactive environmental practices, the outcomes of Chapter 2 oppose the advocates of regulatory pressure promoting supply chain-oriented EM (e.g. Rivera (2004), Zhu et al. (2005)) and corroborate the sceptics (Buysse and Verbeke, 2003; Miemczyk, 2008; Qian et al., 2009)[11].

Chapter 2 suggests that institutional pressures might be especially strong when the practice is not institutionalized. In this period when the practice is not institutionalized, the uncertainty about what constitutes an appropriate behaviour is especially high. Therefore, firms are more guided with external pressures regarding the implementation of proactive environmental practices. Corroborating Delmas and Toffel (2008) and Goodrick and Salancik (1996), it was shown that when the institutionalization is increasing, internal organizational factors become prevailing compared to external institutional pressures.

Performance implications of environmental innovation and of supply chain-oriented EM

Since supply chain-oriented EM came to the research agenda, the analysis of its determinants and performance implications has been primarily conducted through the prism of the RBV. The RBV is based on the assumption that competitive advantage is derived from resources owned or controlled by a firm (Barney, 1991; Prahalad and Hamel, 1990). This understanding of competitive advantage reflects a competitive paradigm in strategic management research. Contrarily, the cooperative paradigm regards firms as interdependent actors that could derive mutual benefits through collaboration (Lado et al., 1997). Vested in the competitive paradigm, the RBV is largely myopic to the benefits of cooperation. Chapter 4 introduces the application of the RBV spin-offs, relational view and especially the extended RBV, in order to capture the benefits of cooperative environmental practices such as supply chain-oriented EM. We integrate into the field of environmental management the issue of appropriation of collaboration benefits, which is widely discussed in alliance and collaboration literature. Our findings in Chapter 4 show that an appropriation of benefits from supply chain-oriented EM is conditional on where in the partnership the collaboration benefits occur (i.e. on focal firm/partner side) and on the partner's potential to induce improvements on the side of the focal firm. While the role of partner's characteristics is widely discussed in collaboration literature (e.g. Kaufman et al. (2000), Schiele (2006)), environmental literature remains scant in this respect. Chapter 4 draws attention to the characteristics of supply chain partners that could influence the outcomes of supply chain-oriented EM.

Finally, the study informs the "pays to be green" debate (Ambec and Lanoie, 2008; Blanco et al., 2009; Hart and Ahuja, 1996) of performance implications of environmental innovation and of supply chain-oriented EM in the context of Dutch F&B processors. Overall, our findings empirically corroborate the literature stream favouring the positive effect of proactive environmental practices on firm performance (Ambec and Lanoie, 2008; Hart, 1995; Shrivastava, 1995). Chapters 3,4, and 5 document the contribution of in-house environmental innovation and supply chain-oriented EM to firm performance, both in terms of cost savings and market gains.

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[11] It is worth noting that the above mentioned pertains to the impact of the *direct steering regulation* that falls under the *regulative* level of institutional pressure within the framework of neo-institutional theory (Hoffman, 2001b; Oliver, 1997; Scott, 2001) used in Chapter 2. However, it is also common to use the notion of "*regulatory* pressure" in a broader scope, including proactive anticipation of the future changes in environmental regulation and incentives "in a shadow of the law" (i.e. public-private covenants) (Huppes et al., 2009). Taking into account the findings of the Chapter 2, it can be seen that these aggregative *regulatory* pressure refers to more than one institutional level (i.e. *regulative*, normative, culturally-cognitive) or some of its components might not express pure *regulative* pressure at all (e.g. covenants pertain mostly to the institutional pressure on normative and culturally-cognitive levels). Chapter 4 had a different objective rather than examination of the impact of external pressures on supply chain-oriented EM. External pressures were considered as control variables and were analysed not within the framework of neo-institutional theory. Therefore, in Chapter 4 we referred to the factor "*regulatory pressure*" in a broad sense, including anticipated legislation and covenants. Against this background, it becomes clear why Chapters 2 finds no impact of *regulative* pressure on supply chain-oriented EM while Chapter 4 illustrates the contribution of *regulatory* pressure to supply chain-oriented EM.

6.2.3. Limitations and directions for future research

While acknowledging scientific contributions of the present dissertation, we also have to acquaint the reader with its limitations. The main limitation of this study is caused by the characteristics of data collected for our empirical analysis: subjective perceptual data from a single respondent in the firm. Although these data are of great value, they are associated with a number of limitations discussed both by economists and psychologists. Examples of these limitations are *(1) common method bias* that induces artificial covariance between the items due to the fact that they are collected from the same source with the same method; *(2) consistency motif* that stimulates respondents to provide similar answers to the series of questions they implicitly perceive as interconnected; (3) *respondents characteristics* such as memories and perceptions affecting the response style such as a tendency to perceive things negatively (viz. negative affectivity) or to agree irrespective of the content (viz. acquiescence); (4) *social desirability* due to respondent's willingness to create a positive image of themselves or their firm; (5) *item and scale characteristics* such as common scale format, ambiguity in the formulation, (6) *the context* in which the items are presented and measured (Campbell and Fiske, 1959; Podsakoff et al., 2003; Podsakoff et al., 2012; Podsakoff and Organ, 1986; Spector, 2006). Though researchers might have more control over some above mentioned sources of bias, the other biases are unavoidable and inherent in the approach. Conducting the research on objective data can overcome these limitations, allow a broader replication and validation of the findings and reduce the chance that the research design gets biased by the research objective (Calantone and Vickery, 2009).

In spite of these limitations of subjective data analysis, *follow-up studies willing to overcome these limitations should realize that also objective data have many drawbacks in this case*. These drawbacks become evident when looking at the past research. Objective data studies on supply chain-oriented EM are rare due to unavailability of these data. A stream of literature analysed environmental innovation determinants based on the data of Community Innovation Survey (CIS) in Europe (e.g. Rennings and Rammer (2011), Bönte and Dienes (2013), De Marchi (2012), Horbach et al. (2012)). However, they contain a very limited amount of data on environmental innovation. Therefore, the studies of environmental innovation determinants have to consider determinants of conventional innovation available in CIS. In this context, also the use of proxies is disputed. For instance, Wagner (2007) discusses multiple disadvantages of objective measures of EM system certification compared to the a multi-item scale measuring EM system implementation. When measuring AC, discussed in Chapter 5, many studies rely on its proxies such as R&D intensity, R&D training, expertise of employees (Escribano et al., 2009; Grimpe and Sofka, 2009), prior cumulative patents (Nooteboom et al., 2007), etc. These proxies are widely disputed due to their ignorance of AC's multidimensionality (Flatten et al., 2011). Furthermore, such proxies tend to create a bias towards measuring the AC as the acquisition of R&D-related knowledge instead of other types of knowledge such as marketing experience and managerial techniques (Lane et al., 2006). Future research has to address this measurement challenge in environmental innovation and supply chain-oriented EM research.

Furthermore, our data are mostly cross-sectional. Only Chapter 2 contains a multi-period empirical investigation. Although it provides intriguing insights into the relative dynamics of institutional and organizational determinants of supply chain-oriented EM, it is not based on panel data. Future longitudinal studies could further deepen the causalities in the relationships between various organizational capabilities, external pressures, supply chain-oriented EM, and environmental innovation as well as firm performance. In addition, a longitudinal investigation could provide insights into both short- and long-term implications of EM. In Chapter 4, we found a weak association between environmental collaboration with suppliers and cost advantage and suggested that positive effects of these practices might be realized in the long run.

6.3. Implications

This dissertation aimed to analyse how the firms address the challenge of environmental sustainability through environmental innovation and supply chain-oriented EM. Our findings can assist decision making of managers regarding the implementation of environmental innovations and of supply chain-oriented EM, regarding the development of capabilities that these practices require. By improving the understanding of the implications of environmental innovation and supply chain-oriented EM, the conclusions of this dissertation can gain managers more control over the outcomes of these practices. Policy makers can use our findings to assess the effectiveness of the current policy. Besides, the dissertation offers new knowledge of the industry needs that could serve the development of future policy.

6.3.1. Implications for policy makers

As indicated, this dissertation can be used by policy makers. In Chapter 2, we observed that Dutch F&B processors perceive strengthening institutional pressure to adopt supply chain-oriented EM on normative and culturally-cognitive levels. The perception of increasing pressures is especially strong for smaller firms. Normative and culturally-cognitive levels of institutional pressures pertain mostly to such motives as social obligation, appropriateness of behaviour, and mimicry of the industry peers that are perceived as successful (Hoffman, 2001a). Our findings show that public-private agreements (i.e. covenants) are an important driver of supply chain-oriented EM implementation by Dutch F&B processors. Comparing the implementation of supply chain-oriented EM in 2002 and 2010 indicated that Dutch F&B processors have made a significant improvement. Based on these findings alone, we could conclude that Dutch public environmental policy that relies less on regulatory institutional pressure (direct steering) and leaves more power to the industry as well as stimulates responsibility culture and self-organisation is effective. However, the progress of food processors in supply chain-oriented EM could have been greater. Mimetic institutional pressure on the culturally-cognitive level and normative pressure (attributed to e.g. covenants and supply chain partners) could be associated with F&B processors willing to meet a certain common level of supply chain-oriented EM rather than to exceed it (Bansal and Roth, 2000). Firms might not wish to bear risks associated with first movers' strategies and just want to be in line with industry peers. Although this provides an incentive for firms to work on supply chain-oriented EM, it does not stimulate fast progress. Covenants rely on the threat of direct steering regulation, in case if the covenants objectives are not achieved (de Bruijn and Norberg-Bohm, 2005). Given the inconsistency of public environmental policy in the implementation of this threat in the Netherlands, we can assume that this incentive might be not sufficient. Other incentives, for example, information disclosure as used in the USA, could supplement existing practices.

The present dissertation shows that internal organizational capabilities are extremely important in the implementation of environmental innovation and supply chain-oriented EM. Therefore, the policy that stimulates proactive environmental practices should emphasize internal capabilities building. For instance, in Germany, energy-intensive firms could receive a tax advantage according to the Renewable Energy Law, if, among other conditions, they implement a certified EM system. Although there is a risk that such an implementation appears to be a symbolic act (Darnall et al.,

2008) and would be terminated once associated financial benefits are gone, it can also result in the development of continuous improvement capabilities. The latter were shown by this dissertation as extremely valuable to support environmental innovation and supply chain-oriented EM.

6.3.2. Implications for managers

The findings of this dissertation illustrate that the development of supply chain-oriented EM requires managers to build strong organizational capabilities within the firm. First, the firms with more developed EM systems and corresponding continuous improvement capabilities are more likely to progress in supply chain-oriented EM. Especially nowadays, as supply chain-oriented EM is becoming more common among Dutch F&B processors, the importance of continuous improvement capabilities is especially high to stimulate environmental practices on the supply chain level.

The lack of integration of environmental concerns within organizational layers and functions (e.g. quality, R&D, procurement, marketing, etc.) is a problem of many firms. Our findings draw attention to the necessity to develop this organizational capability. At the in-house level, our findings show that the integration of environmental concerns within the organization prompts the absorption of external knowledge that serves as an input for environmental innovation. Because exploitation of external knowledge can produce benefits beyond the reduction of environmental impact, the integration of environmental concerns within the firm can induce a wide range of organizational changes and gains. Our findings reinforce the view of an effective EM as a cross-functional task, that spans organizational layers. Furthermore, we point clearly to the danger of EM isolation in the firm. This dissertation outlines a high competitive potential of treating EM as an operational and strategic philosophy of continuous improvement, covering the whole organization.

On the supply chain level, the integration of environmental concerns within the firm appeared to act as a major determinant of the firm's ability to integrate environmental concerns into relationships with external partners. Not only integration capabilities, but also capabilities for continuous innovation induce supply chain-oriented EM. Innovative F&B processors with developed capabilities to integrate environmental concerns within the firm receive an additional impetus to apply their innovativeness in an environmental context and, therefore, are more likely to implement supply chain-oriented EM.

The outcomes of this dissertation evidence a high potential of capabilities to integrate environmental concerns into supply chain relationships to improve firm performance. Overall, firms' ability to integrate supply chain partners in EM brings about cost savings (i.e. savings on inputs due to lower and more efficient use of materials and energy, and reduced waste and waste treatment costs) and market gains (i.e. greater market share, turnover, product price, and quality). When we zoom in on specific environmental practices on the supply chain level, it appears that collaboration with different supply chain partners has a different value-creating potential. Partners' position in a buyer-seller dyad as well as partner's characteristics influence the outcomes of supply chain-oriented EM. In case of Dutch F&B processors, it was shown that collaboration with customers stimulates improvements in environmental sustainability of internal processes that in turn can lead to cost savings and market gains. Potentially because of suppliers' characteristics, the engagement of suppliers into EM was not shown to enhance environmental sustainability of in-house processes among Dutch F&B processors. The case studies of Hall (2000) point out that sustainable process improvements are likely to occur on suppliers (sellers) side in a buyer-seller dyad. Accordingly, involvement of suppliers into EM was shown to induce only weak cost savings among Dutch F&B

processors as an appropriation of benefits created on the supplier's (seller) side. These findings draw attention of the manufacturing managers to the issue of appropriation of benefits created in cooperation with external partners and especially to partner's characteristics and the position in a buyer-seller dyad.

At the in-house level, our findings regarding the importance of knowledge sourcing capabilities for environmental innovation have important managerial implications. Managers should be aware that having access to sources of knowledge and resources is a necessary but not sufficient condition for the development of environmental innovation. Not only the availability of various knowledge sources should be considered, but also the presence of capabilities to exploit it. This dissertation illustrates the complexity of the knowledge sourcing (i.e. knowledge absorption) process in the case of *external* knowledge available in the firm's networks. External knowledge acquisition is induced by intensive networking with a broad range of external actors – knowledge sourcing. The stages of knowledge absorption (i.e. knowledge acquisition, assimilation, the integration of new knowledge with already available knowledge, and ultimately knowledge exploitation) are highly interdependent. The lack of one of above mentioned capabilities can hinder the conversion of external knowledge into environmental innovation. For instance, firms that are good in new knowledge spotting and firms with a developed cognitive structure to recognize the value and applicability of new knowledge, might fail to use it to improve environmental sustainability of internal processes due to the lack of capabilities for knowledge exploitation. Our empirical investigation was mainly focused on external knowledge sourcing, as one of the most understudied, yet gaining importance, determinants of environmental innovation. However, we also addressed the role of internal environmental knowledge development and accumulation within the EM system. The results show that both capabilities to develop and accumulate *internal* environmental knowledge and capabilities to absorb *external* knowledge are required for environmental innovation. Environmental innovation among Dutch F&B processors appeared to induce cost savings and market gains. This evidences its promising potential to achieve sustainable growth in the food industry.

SUMMARY

As business is gaining experience in in-house environmental innovations, the focus is shifting towards the integration of environmental concerns into supply chain and network relationships (Pagell and Wu, 2009; Sarkis et al., 2011). Efforts in the reduction of environmental impact are increasingly spanning organizational boundaries. Firms approach external actors to reduce environmental impact throughout the product's lifecycle, to leverage each other's resources, and to exploit learning and knowledge sharing opportunities. Environmental management (EM) that involves external partners has a promising potential to induce sustainable growth in the industry. Recent studies increasingly connect it not only to improved environmental but also to improved economic performance (Gimenez and Tachizawa, 2012). However, the research concerning the implications of supply chain-oriented EM for firm performance is not clear-cut and requires further investigation (Chan et al., 2012; Seuring and Müller, 2008; Zhu et al., 2012). In this context, the current research agenda focuses on internal organizational capabilities and on external factors (such as the roles of public policies, consumer demand, and other stakeholder pressures) that support the development of supply chain-oriented EM (Beske, 2012).

Having access to knowledge and resources of the partners in supply chains and networks does not imply that a firm can appropriate (i.e. capture) corresponding benefits (Cao and Zhang, 2010; Lavie, 2006) that could enhance environmental sustainability of in-house operations and performance. Firm's network can be seen as a rich source of knowledge. However, the exploitation of external knowledge requires the development of organizational capabilities to realize the value of new external knowledge, assimilate it and "apply to commercial ends" (Cohen and Levinthal, 1990). In this context, current literature is oriented towards the investigation of the roles of external partners, external knowledge exploitation, and capabilities to tap external knowledge for in-house environmental innovation. Taking these considerations into account, the present dissertation aims:

- ***to investigate determinants of environmental innovation and of supply chain-oriented EM and their impact on firm performance.***

Mainly through the theoretical lens of the Resource-based view (RBV) and its spins-offs, this dissertation provides new insights into determinants and performance implications of environmental innovation and supply chain-oriented EM. Empirical analysis is conducted on the survey data collected from Dutch food and beverage (F&B) processors in 2002, 2010, and 2013. To answer the research question 1, the 2002 and 2010 survey data are used. The data collected in 2013 provide material to study research questions 2-4.

Chapter 2 contributes to the research objective by investigating from a dynamic perspective how firms address the challenge of environmental sustainability through supply chain-oriented EM. Analysing prior research, it was noticed that internal organizational and external institutional determinants were mostly treated in isolation (Wu et al., 2012). At the same time, specific types of external pressures instead of a full range of institutional influences were considered. A related gap in scholars' understanding of supply chain-oriented EM determinants is the absence of multi-period studies (Carter and Rogers, 2008; Zhu et al., 2008a). In response to these gaps, Chapter 2 answers the following research question:

> ***Research question 1 (Chapter 2):*** *How do the relationships between external institutional pressures, adoption of in-company EM, and supply chain-oriented EM evolve over time?*

The data of two surveys conducted in 2002 and 2010 among Dutch F&B processors were employed to answer the research question. The findings point out that primarily institutional pressures rather than internal organizational factors stimulated supply chain-oriented EM in the earlier observation period (2002). At that time, supply chain-oriented EM was less developed in the industry. Studying implementation of supply chain-oriented EM by Dutch F&B processors, we showed that, in spite of the strengthening of institutional pressures in course of time, these pressures became less influential by 2010 compared to internal organizational factors. In 2010, when supply chain-oriented EM has become more common, exerting pressure on firms to implement supply chain-oriented EM turns out to be less important than in 2002. As firms increasingly consider the implementation of supply chain-oriented EM as appropriate behaviour, institutional pressures become less influential. In 2010, internal organizational factors are shown to be crucial to enable the implementation of the supply chain-oriented EM.

Overall, our study proved institutional pressures to be an important determinant of supply chain-oriented EM. However, pressures on different levels vary considerably with respect to their potential to induce supply chain-oriented EM. We found that pressures from supply chain partners and increasingly from long-term public–private environmental covenants significantly influence the implementation of supply chain-oriented EM. Interestingly, regulative institutional pressure from public authorities appeared to have no impact on supply chain-oriented EM, both in 2002 and in 2010. These findings are of particular interest as they suggest that Dutch public policy has chosen to rely on a responsibility culture, initiative, and self-organization, rather than on direct steering. Challenging prior evidence of the positive impact of direct regulation on supply chain-oriented EM (e.g. Rivera (2004), Zhu et al. (2005)), our empirical findings substantiate the stream of literature that suggests that other than regulative institutional forces drive proactive environmental practices (Buysse and Verbeke, 2003; Miemczyk, 2008).

Chapter 2 illustrates how internal organizational capabilities can induce the development of capabilities that span organizational boundaries. The findings show that F&B processors with more developed EM systems, associated with the presence of continuous improvement capabilities, are more likely to advance their EM by implementing supply chain-oriented EM. This finding addresses an important gap in the literature (Shi et al., 2012) by affirming the claim of path dependency of environmental strategies formulated by the Natural RBV (Hart, 1995).

Research question 2 (Chapter 3): *What organizational capabilities support the development of supply chain-oriented EM and how does supply chain-oriented EM influence firm performance?*

Chapter 3 offers further insights into organizational capabilities for supply chain-oriented EM. Prior research rarely considered how firms used their existing capabilities and the capabilities developed within their environmental strategy to come up with new and better ways to reduce environmental impact. Chapter 3 investigates whether the integration of environmental concerns within the firm can provide an additional impetus to the implementation of supply chain-oriented EM, when combined with innovative orientation (Christmann, 2000; Hart, 1995; Sharma and Vredenburg, 1998). In this context, Chapter 3 assesses performance implications of capabilities for supply chain-oriented EM. Compared with the past research, we consider supply chain-oriented EM as an organizational capability for the integration of supply chain partners into EM, not as a set of environmental practices.

Analysing the data with variance-based structural equation modelling, Chapter 3 provides a framework that connects internal organizational capabilities, supply chain-oriented EM, and firm performance. The findings show that the development of supply chain-oriented EM is supported by both capabilities of innovative orientation and environmental integration and is accelerated by their combination. Furthermore, we found that integration capabilities on in-house and supply chain levels are interconnected. The capability to integrate environmental concerns within the firm induces the integration of environmental concerns in the relationships with supply chain partners.

Finally, it was demonstrated that the overarching capability to engage supply chain partners in EM pays off. Earlier empirical research is not consistent regarding the value-creating potential of the separate practices that construct supply chain-oriented EM (cf. e.g. Azevedo et al. (2011); Carter et al. (2000); Green et al. (2012); Hall (2000); Zhu et al. (2007)). Against this background, we referred to supply chain-oriented EM as an overarching capability to integrate supply chain partners into EM. This capability is induced by the implementation of interconnected environmental practices that involve supply chain partners (e.g. green purchasing, environmental collaboration with customers, and eco-design). Chapter 3 shows that the overarching capability of the integration of supply chain partners in EM is beneficial for firms.

Research question 3 (Chapter 4): *What is the potential of supply chain-oriented EM to improve environmental sustainability of internal processes and firm performance?*

Chapter 4 deepens the understanding of the impact of supply chain-oriented EM on firm performance. Grounded in the RBV spin-offs (viz. relational view (Dyer and Singh, 1998; Dyer et al., 2008) and in the extended RBV (Lavie, 2006)), Chapter 4 claims that supply chain-oriented EM can enhance the performance of the focal firm not only directly, but also indirectly. Indirect relationship implies that supply chain-oriented EM stimulates the focal firm to implement more environmentally sustainable processes that in turn contribute to firm's performance. Advancing the understanding of relationships between inter-firm linkages and firm-level performance, the extended RBV introduces the problem of appropriation of benefits created by the partners. Appropriation of benefits created in collaboration is an issue largely overlooked in past environmental research. However, it has important implications for practice. Providing managers with a better understanding of the relationships between supply chain-oriented EM and firm performance can gain them more control over the outcomes of supply chain-oriented EM.

With covariance-based SEM, we found that supply chain-oriented EM involving customers can induce in-house environmental innovation that results in strong performance improvements. Interestingly, supply chain-oriented EM involving suppliers brings about weak performance improvements as a result of appropriation of the advantage realized by suppliers. Therefore, supply chain-oriented EM involving suppliers has a limited value and potential for Dutch F&B processors. Possibly, supply chain-oriented EM involving suppliers can induce process changes among suppliers, not focal firms (Hall, 2000). In this context, Chapter 4 illustrates the necessity to integrate the characteristics of supply chain actors into the research on the implications of supply chain-oriented EM. The findings regarding the impact of supply chain-oriented EM on the sustainability of internal operations have a link with firm performance. Supply chain-oriented EM that involves suppliers was shown to induce no significant improvements in environmental sustainability of operations among F&B processors. Therefore, it generates no market advantage in terms of higher product price, market share, and improved product quality. Unlike supply chain-oriented EM involving suppliers, supply chain-oriented EM involving customers has an indirect effect on firm performance via environmental innovation. This is because it induces environmental innovation that enhances performance of Dutch F&B processors in terms of additional cost savings and market gains. Our findings advance earlier empirical evidences of a direct contribution of supply chain-oriented EM to firm performance.

Research question 4 (Chapter 5): *What is the impact of capabilities to tap external knowledge and of capabilities to develop and accumulate internal knowledge on environmental innovation?*

Chapter 5 takes a next step by bringing absorptive capacity (AC) into the discussion regarding the role of external partners in environmental innovation (Bönte and Dienes, 2013; Cuerva et al., 2014; De Marchi, 2012; De Marchi and Grandinetti, 2013; Ketata et al., 2014; Triguero et al., 2014). External partners are a source of new knowledge. Prior research regarding the relative roles of internal and external knowledge for environmental innovation mainly investigated the relative roles of internal and external knowledge *sources*. Having access to the sources of external knowledge is not sufficient for its exploitation. Firms should develop the capability to tap external knowledge – AC – so that access to *external knowledge* sources could be used for the development of (environmental) innovation (Van Wijk et al., 2008; Volberda et al., 2010). Environmental innovation can also rely on internal knowledge sources. Development and accumulation of *internal knowledge* can be supported by the continuous improvement capability vested in the EM system (Epstein and Roy, 1997, 1998). Therefore, Chapter 5 informs the discussion of the roles of internal and external knowledge for environmental innovation by considering organizational capabilities for knowledge sourcing: (1) absorptive capacity to exploit external knowledge and (2) continuous improvement to develop and accumulate internal environmental knowledge.

Chapter 5 demonstrates that Dutch F&B processors develop environmental innovations relying on both *external knowledge* in their network tapped with the help of AC and on *internal knowledge* built within the EM system and associated with continuous improvement capabilities. We expand the research on the determinants of environmental innovation by considering not only different knowledge sources but by providing insights into the knowledge sourcing process. Furthermore, our findings challenge the presence of a substitution effect between internal and external knowledge (De Marchi, 2012).

The study sheds new light on external knowledge sourcing through the AC perspective. Chapter 5 contains intriguing findings regarding the structure of the AC concept and the relationships between its dimensions. In particular, the findings in Chapter 5 challenge the conceptualization of AC proposed by Zahra and George (2002)

Overall, the dissertation evidences an increasing importance of internal organizational capabilities to enable sustainable industry growth. Internal organizational capabilities appeared to be decisive to induce environmental innovation and supply chain-oriented EM. Also the appropriation of benefits created in cooperation with external partners and exploitation of external knowledge require certain organizational capabilities. In the earlier periods of corporate environmentalism, external pressures were of primary importance to induce the reduction of environmental impact. Nowadays, the increasing role of organizational capabilities implies that a lot of power is concentrated in the hands of managers. For public policy, these findings suggest a focus on the development of instruments to stimulate the accumulation of organizational capabilities and capacity building.

SAMENVATTING

SAMENVATTING

Naarmate een bedrijf meer ervaring krijgt in interne milieu-innovaties zal de focus veranderen van de integratie van milieuzorg naar keten- en netwerkrelaties (Pagell en Wu, 2009; Sarkis et al., 2011). De inspanningen om een reductie van de invloed op het milieu te realiseren vinden steeds meer buiten de organisatie plaats. Bedrijven benaderen externe actoren om een reductie van de milieu-impact gedurende de productlevenscyclus te realiseren, elkaars middelen te benutten en ervoor te zorgen dat men deelt in elkaars kennis. Milieumanagement, waarbij externe partners een rol spelen, is veelbelovend om duurzame groei van de industrie te bewerkstelligen. Recent onderzoek verbindt dat niet alleen aan verbeterde milieuprestaties, maar ook aan verbeterde economische prestaties (Gimenez en Tachizawa, 2012). Echter, het onderzoek met betrekking tot de gevolgen van ketengeoriënteerd milieumanagement voor de prestatie van het bedrijf is niet helder gedefinieerd en vereist verdere studie (Chan et al., 2012; Seuring en Müller, 2008; Zhu et al., 2012). Dit onderzoek is gericht op interne organisatorische capabiliteiten en op externe factoren (bijv. de rol van publiek beleid, consumentenvraag en andere druk van belanghebbenden), die de ontwikkeling van ketengericht milieumanagement stimuleren (Beske, 2012).

Toegang hebben tot kennis en middelen van partners in ketens en in netwerken houdt niet automatisch in dat een bedrijf ook de bijbehorende voordelen kan verkrijgen (Cao en Zhang, 2010; Lavie, 2006) die de milieuduurzaamheid van interne operaties en prestaties versterken. Het netwerk van een bedrijf kan worden beschouwd als een rijke bron voor het putten van kennis. Echter, de exploitatie van externe kennis vergt ontwikkeling van de organisatorische capabiliteiten om de waarde van de nieuwe externe kennis te realiseren, te verwerken en toe te passen ten behoeve van commerciële doeleinden (Cohen en Levinthal, 1990). De huidige literatuur is gericht op onderzoek naar de rol van externe partners, de exploitatie van externe kennis en op de noodzakelijke capabiliteiten om externe kennis te verkrijgen en om deze te gebruiken voor interne milieu-innovatie. Met inachtneming van deze kennis zal deze dissertatie zich richten op:

- ***het onderzoeken van bepalende factoren voor milieu-innovatie en voor ketengericht milieumanagement en hun effect op de prestaties van het bedrijf.***

Voornamelijk vanuit het theoretische gezichtspunt van de Resource-Based View (RBV) en haar spin-offs geeft deze dissertatie nieuwe inzichten in de bepalende factoren en de gevolgen voor de bedrijfsprestaties op het gebied van milieu-innovatie en ketengericht milieumanagement. Er is een analyse uitgevoerd van onderzoeksdata die zijn verkregen van de Nederlandse levensmiddelen- en drankenindustrie in de jaren 2002, 2010 en 2013. Om onderzoeksvraag 1 te beantwoorden zijn data uit de jaren 2002 en 2010 gebruikt. De data die zijn verkregen in het jaar 2013 hebben bijgedragen aan het beantwoorden van onderzoeksvragen 2 tot en met 4.

Hoofdstuk 2 draagt bij aan de onderzoeksdoelstelling door vanuit een dynamisch perspectief na te gaan hoe bedrijven de uitdaging aangaan van het realiseren van milieutechnische duurzaamheid door ketengericht milieumanagement. Door eerder onderzoek te analyseren bleek dat tot nu toe interne organisatorische en externe institutionele factoren los van elkaar worden behandeld (Wu et al., 2012). Tegelijkertijd worden er specifieke typen van externe druk overwogen in plaats van een breed pallet aan institutionele invloeden. Een kenniskloof bij onderzoekers met betrekking tot ketengericht milieumanagement is de ontwikkeling daarvan in de tijd (Carter en Rogers, 2008; Zhu et al., 2008a). Om te voorzien in deze kennislacune geeft hoofdstuk 2 antwoord op de volgende onderzoeksvraag:

Onderzoeksvraag 1 (Hoofdstuk 2): Hoe ontwikkelen relaties tussen externe institutionele druk, invoering van bedrijfsintern milieumanagement en ketengericht milieumanagement zich in de loop van de tijd?

De gegevens van twee onderzoeken, uitgevoerd in 2002 en 2010, onder de Nederlandse voedingsmiddelen- en drankenindustrie werden gebruikt om deze onderzoeksvraag te beantwoorden. De resultaten laten zien dat in 2002 de institutionele druk het ketengerichte milieumanagement meer heeft gestimuleerd dan interne organisatorische factoren. In die tijd was het ketengericht milieumanagement minder ontwikkeld in de industrie. Door de implementatie van ketengericht milieumanagement door de Nederlandse voedingsmiddelen- en drankenindustrie te bestuderen toonden we aan dat, ondanks het versterken van de institutionele druk, na verloop van tijd deze druk minder belangrijk werd en juist interne organisatorische factoren belangrijker werden in 2010. In het jaar 2010, toen ketengericht milieumanagement gebruikelijker was geworden, bleek dat het uitoefenen van druk op bedrijven om ketengericht milieumanagement toe te passen minder belangrijk was dan in het jaar 2002. Naarmate bedrijven in toenemende mate de implementatie van ketengericht milieumanagement als gewenst gedrag beschouwen, wordt de institutionele druk minder invloedrijk. In het jaar 2010 blijkt dat interne organisatorische factoren cruciaal zijn om de invoering van ketengericht milieumanagement mogelijk te maken.

In het algemeen heeft ons onderzoek bewezen dat institutionele druk een belangrijke determinerende factor is voor ketengericht milieumanagement. Hoe dan ook, druk van verschillende niveaus vertoont aanzienlijke verschillen met betrekking tot het potentieel om ketengericht milieumanagement te bewerkstelligen. We hebben gevonden dat druk van ketenpartners, en in toenemende mate van publiek-private lange termijn convenanten met betrekking tot milieu, een significante invloed heeft op de implementatie van ketengericht milieumanagement. Merkwaardig genoeg bleek dat de regulerende institutionele druk van de overheid geen invloed heeft op ketengericht milieumanagement, niet in 2002 en evenmin in 2010. Deze bevindingen zijn van bijzonder belang aangezien zij suggereren dat de Nederlandse overheid terecht heeft gekozen om te vertrouwen op verantwoordelijkheid, initiatief en zelforganisatie, en niet op directe sturing. Dit in tegenstelling tot eerder onderzoek dat heeft aangetoond dat er juist een positieve invloed uitgaat van directe overheidssturing op ketengericht milieumanagement (e.g. Rivera, 2004; Zhu et al., 2005). Onze bevindingen suggereren dat andere middelen dan overheidsdruk milieumanagement initiëren (Buysse en Verbeke, 2003; Miemczyk, 2008).

Hoofdstuk 2 illustreert hoe interne organisatorische capabiliteiten de ontwikkelingen van capabiliteiten die over organisatorische grenzen heengaan kunnen induceren. De resultaten tonen aan dat verwerkers van voedingsmiddelen en dranken met een beter ontwikkeld milieumanagementsysteem en met continue verbetercapabiliteiten eerder hun milieumanagement verbeteren door ketengericht milieumanagement te implementeren. Dit onderzoeksresultaat vult een belangrijk gat in de literatuur (Shi et al., 2012), door te bevestigen dat padafhankelijkheid van milieustrategieën bestaat, zoals dat naar voren is gekomen in de Natural RBV (Hart, 1995).

Onderzoeksvraag 2 (Hoofdstuk 3): Welke organisatorische capabiliteiten ondersteunen de ontwikkeling van ketengericht milieumanagement en hoe beïnvloedt ketengericht milieumanagement de bedrijfsprestatie?

Hoofdstuk 3 biedt meer inzicht in de organisatorische capabiliteiten die noodzakelijk zijn voor ketengericht milieumanagement. Eerder onderzoek geeft nauwelijks inzicht in hoe bedrijven hun bestaande capabiliteiten en nieuw ontwikkelde capabiliteiten gebruiken om met nieuwe en verbeterde manieren te komen om de milieu-impact te verminderen. Hoofdstuk 3 onderzoekt of de integratie van milieuzorg in het bedrijf kan zorgen voor een extra impuls voor de implementatie van ketengericht milieumanagement, indien dit wordt gecombineerd met een innovatieve houding (Christmann, 2000; Hart, 1995; Sharma en Vredenburg, 1998). In deze context onderzoekt hoofdstuk 3 de gevolgen voor prestaties van aanwezige capabiliteiten om ketengericht milieumanagement in te voeren. Anders dan eerder onderzoek aangeeft beschouwen wij ketengericht milieumanagement als een organisatorische capabiliteit ten behoeve van de integratie van ketenpartners in milieumanagement en niet als een geheel van werkwijzen op het gebied van milieu.

Door de data te analyseren met behulp van de methode: "variance-based structural equation modelling" is in hoofdstuk 3 een raamwerk gecreëerd dat interne organisatorische capabiliteiten, ketengericht milieumanagement en bedrijfsprestatie met elkaar verbindt. De resultaten tonen dat de ontwikkeling van ketengericht milieumanagement wordt ondersteund door zowel de capabiliteit ‘innovatieve oriëntatie’ als door ‘milieu-integratie’, en in een stroomversnelling komt door de combinatie van deze twee. Tevens hebben we aangetoond dat de capabiliteit “integratie” op interne- en ketenniveau met elkaar zijn verbonden. De capabiliteit om milieuzorg te integreren binnen het bedrijf induceert de integratie van milieuzorg op netwerkniveau.

Tot slot is aangetoond dat een overkoepelende capabiliteit om ketenpartners te betrekken bij milieumanagement loont. Eerder empirisch onderzoek is verdeeld over het potentieel om een toegevoegde waarde te creëren die bijdraagt aan ketengericht milieumanagement (cf. bijv. Azevedo et al. (2011); Carter et al. (2000); Green et al. (2012); Hall (2000); Zhu et al. (2007)). Vanuit deze achtergrond zien wij ketengericht milieumanagement als een overkoepelende capabiliteit om ketenpartners te betrekken bij milieumanagement. Deze capabiliteit ontstaat door de implementatie van onderling met elkaar verbonden milieupraktijken, waarbij ketenpartners zijn betrokken (bijv. groene inkoop, samenwerking met betrekking tot milieu met klanten en eco-design). Hoofdstuk 3 laat zien dat de overkoepelende capabiliteit van de integratie van ketenpartners in milieumanagement lonend is voor bedrijven.

Onderzoeksvraag 3 (Hoofdstuk 4): Wat is het potentieel van ketengericht milieumanagement om milieutechnische duurzaamheid van interne processen en bedrijfsprestatie te verbeteren?

Hoofdstuk 4 gaat dieper in op het effect van ketengericht milieumanagement op de bedrijfsprestatie. Gebaseerd op de RBV spin-offs (viz. relational view (Dyer en Singh, 1998; Dyer et al., 2008) en de uitbreide RBV (Lavie, 2006)), poneert hoofdstuk 4 dat ketengericht milieumanagement de prestatie van het bedrijf niet alleen direct, maar ook indirect, kan verbeteren. Indirecte relaties impliceren dat ketengericht milieumanagement een bedrijf kan stimuleren om meer duurzame processen te implementeren, die vervolgens bijdragen aan de bedrijfsprestatie. Om het inzicht in de relaties tussen verbindingen tussen bedrijven en prestaties op bedrijfsniveau te bevorderen, introduceert de uitgebreide RBV het probleem van toe-eigening van de voordelen die zijn gecreëerd door de partners. Toe-eigening van voordelen die in samenwerking zijn gerealiseerd is een probleem dat grotendeels over het hoofd wordt gezien door eerder onderzoek. Desalniettemin heeft het belangrijke gevolgen voor de praktijk. Door managers meer inzicht te geven in de relaties tussen ketengericht milieumanagement en de bedrijfsprestatie kan hun meer controle worden verschaft over de resultaten van ketengericht milieumanagement.

Met behulp van “covariance-based SEM” vonden we dat ketengericht milieumanagement, waarbij klanten betrokken worden, interne milieu-innovatie kan induceren die resulteert in een sterke verbetering van de prestatie. Interessant is dat ketengericht milieumanagement met leveranciers slechts leidde tot een lichte verbetering van de prestaties als een resultaat van de toe-eigening van voordelen die door de leveranciers worden gerealiseerd. Om deze reden heeft ketengericht milieumanagement waarbij leveranciers zijn betrokken slechts een beperkte waarde en potentieel voor de Nederlandse voedingsmiddelenindustrie. Mogelijk kan ketengericht milieumanagement waarbij leveranciers zijn betrokken wel procesveranderingen onder leveranciers induceren, maar niet bij het focusbedrijf (Hall, 2000). In deze context beschrijft hoofdstuk 4 de noodzaak om de kenmerken van ketenactoren in het onderzoek naar de implicaties van ketengericht milieumanagement te betrekken. De bevindingen aangaande de invloed van ketengericht milieumanagement op de duurzaamheid van interne operaties hebben een relatie met de bedrijfsprestatie. Ketengericht milieumanagement, waarbij leveranciers zijn betrokken, bleek geen significante verbetering van duurzame milieuactiviteiten van de voedingsmiddelenindustrie te induceren. Om deze reden genereert dit geen marktvoordeel in termen van een hogere prijs van het product, groter marktaandeel of een verbeterde kwaliteit van het product. In tegenstelling tot ketengericht milieumanagement waarbij leveranciers zijn betrokken heeft ketengericht milieumanagement waarbij klanten zijn betrokken een indirect effect op de bedrijfsprestatie via milieu-innovatie, en wel door extra kostenbesparingen en hogere winsten. Onze bevindingen bevestigen daarmee de eerdere empirische bevindingen van een directe bijdrage van ketengericht milieumanagement aan de bedrijfsprestatie.

Onderzoeksvraag 4 (Hoofdstuk 5): Wat is de impact van de capabiliteit om externe kennis te verkrijgen en van de capabiliteit om interne kennis te ontwikkelen en te accumuleren op milieu-innovatie?

Hoofdstuk 5 neemt een volgende stap door absorptievermogen (AC) in te brengen in de discussie aangaande de rol van externe partners in milieu-innovatie (Bönte en Dienes, 2013; Cuerva et al., 2014; De Marchi, 2012; De Marchi en Grandinetti, 2013; Ketata et al., 2014; Triguero et al., 2014). Externe partners zijn een bron van nieuwe kennis. Eerder onderzoek inzake de relatieve rol van interne en externe kennis voor milieu-innovatie heeft zich hoofdzakelijk gericht op de rol van interne en externe kennis*bronnen*. Het hebben van toegang tot externe kennisbronnen is echter niet voldoende voor de exploitatie ervan. Bedrijven zouden de capabiliteit moeten ontwikkelen om externe kennis te verkrijgen – AC – zodat de toegang tot *externe kennis*bronnen gebruikt kan worden voor de ontwikkeling van (milieu-) innovatie (Van Wijk et al., 2008; Volberda et al., 2010). Milieu-innovatie kan ook rekenen op interne kennisbronnen. De ontwikkeling en het bijeenbrengen van *interne kennis* kan worden ondersteund door de capabiliteit om continu te verbeteren, een capabiliteit die mede is verkregen door het milieumanagementsysteem (Epstein en Roy, 1997, 1998). Daarmee gaat hoofdstuk 5 in op de discussie omtrent de rol van interne en externe kennis voor milieu-innovatie, specifieker op: (1) absorptievermogen door het exploiteren van externe kennis en (2) het continu verbeteren door het ontwikkelen en bijeenbrengen van interne milieukennis.

Hoofdstuk 5 laat zien dat de Nederlandse verwerkers van voedingsmiddelen en dranken milieu-innovatie ontwikkelen door zowel externe kennis met behulp van AC en interne kennis uit het milieumanagementsysteem te gebruiken en deze te verbinden met de capabiliteit om continu te verbeteren. We breiden het onderzoek naar de determinanten van milieu-innovatie uit door niet alleen verschillende kennisbronnen te overwegen maar ook door inzicht te geven in het kennisverwervingsproces. Bovendien betwisten onze bevindingen een substitutie effect tussen interne en externe kennis (De Marchi, 2012).

Het onderzoek schijnt daarmee nieuw licht op externe kennis vanuit het AC perspectief. Hoofdstuk 5 bevat intrigerende bevindingen aangaande de structuur van het AC concept en de relaties tussen haar dimensies. In het bijzonder dagen de bevindingen in hoofdstuk 5 de conceptualisatie van AC uit zoals voorgesteld door Zahra en George (2002).

Kortom, de dissertatie toont een toenemend belang van interne organisatorische capabiliteit aan om duurzame industriële groei mogelijk te maken. Interne organisatorische capabiliteit blijkt beslissend te zijn om zowel milieu-innovatie als ketengericht milieumanagement te induceren. Ook de toe-eigening van voordelen die zijn gecreëerd in de samenwerking met externe partners en het exploiteren van externe kennis vraagt om bepaalde organisatorische capabiliteiten. In eerdere perioden van milieubewustzijn van bedrijven was externe druk van essentieel belang om de vermindering van de milieubelasting te induceren. Tegenwoordig impliceert de toenemende rol van de organisatorische capabiliteit dat er veel macht in handen ligt van de managers. Voor het overheidsbeleid suggereren deze bevindingen een focus op de ontwikkeling van instrumenten om de accumulatie van organisatorische capabiliteiten te stimuleren.

SAMENVATTING

REFERENCES

REFERENCES

Dossier Energie in de voedingssector.
Abareshi, A., Molla, A., 2013. Greening logistics and its impact on environmental performance: An absorptive capacity perspective. International Journal of Logistics-Research and Applications 16, 209-226.
Ageron, B., Gunasekaran, A., Spalanzani, A., 2012. Sustainable supply management: An empirical study. International Journal of Production Economics 140, 168-182.
Ahuja, G., Lampert, M.C., 2001. Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. Strategic management journal 22, 521-543.
Alberti, M., Caini, L., Calabrese, A., Rossi, D., 2000. Evaluation of the costs and benefits of an environmental management system. International Journal of Production Research 38, 4455-4466.
Ambec, S., Lanoie, P., 2008. Does it pay to be green? A systematic overview. The Academy of Management Perspectives 22, 45-62.
Amit, R., Schoemaker, P.J.H., 1993. Strategic assets and organizational rent. Strategic management journal 14, 33-46.
Anderson, J.C., Gerbing, D.W., 1984. The effect of sampling error on convergence, improper solutions, and goodness-of-fit indices for maximum likelihood confirmatory factor analysis. Psychometrika 49, 155-173.
Anderson, J.C., Gerbing, D.W., 1988. Structural equation modeling in practice: A review and recommended two-step approach. Psychological bulletin 103, 411.
Aragón-Correa, J.A., Hurtado-Torres, N., Sharma, S., García-Morales, V.J., 2008. Environmental strategy and performance in small firms: A resource-based perspective. Journal of Environmental Management 86, 88-103.
Aragon-Correa, J.A., Sharma, S., 2003. A contingent resource-based view of proactive corporate environmental strategy. The Academy of Management Review, 71-88.
Arimura, T.H., Darnall, N., Katayama, H., 2011. Is ISO 14001 a gateway to more advanced voluntary action? The case of green supply chain management. Journal of Environmental Economics and Management 61, 170-182.
Arthur, W.B., 1989. Competing technologies, increasing returns, and lock-in by historical events. The Economic Journal 99, 116-131.
Azevedo, S.G., Carvalho, H., Cruz Machado, V., 2011. The influence of green practices on supply chain performance: A case study approach. Transportation Research Part E: Logistics and Transportation Review 47, 850-871.
Bagozzi, R.P., Yi, Y., 1988. On the evaluation of structural equation models. Journal of the Academy of Marketing Science 16, 74-94.
Bansal, P., Roth, K., 2000. Why Companies Go Green: A Model of Ecological Responsiveness. The Academy of Management Journal 43, 717-736.
Barney, J., 1991. Firm resources and sustained competitive advantage. Journal of management 17, 99-120.
Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology 51, 1173.
Barros, A., Dekker, R., Scholten, V., 1998. A two-level network for recycling sand: a case study. European Journal of Operational Research 110, 199-214.
Becker, J.-M., Klein, K., Wetzels, M., 2012. Hierarchical latent variable models in PLS-SEM: guidelines for using reflective-formative type models. Long Range Planning 45, 359-394.
Beise, M., Rennings, K., 2005. Lead markets and regulation: a framework for analyzing the international diffusion of environmental innovations. Ecological economics 52, 5-17.
Belderbos, R., Carree, M., Diederen, B., Lokshin, B., Veugelers, R., 2004. Heterogeneity in R&D cooperation strategies. International Journal of Industrial Organization 22, 1237-1263.
Bentler, P., Wu, E., 2010. EQS (Version 6.1) for Windows [Computer software]. Encino, CA: Multivariate Software.
Bentler, P.M., 1989. EQS 6 structural equations program manual. Los Angeles: BMDP Statistic Software, 86-102.

Bentler, P.M., Chou, C.-P., 1987. Practical issues in structural modeling. Sociological Methods & Research 16, 78-117.
Berchicci, L., 2013. Towards an open R&D system: Internal R&D investment, external knowledge acquisition and innovative performance. Research Policy 42, 117-127.
Berchicci, L., King, A., 2007. 11 Postcards from the edge: A review of the business and environment literature. The Academy of Management Annals 1, 513-547.
Beske, P., 2012. Dynamic capabilities and sustainable supply chain management. International journal of physical distribution & logistics management 42, 372-387.
Blanco, E., Rey-Maquieira, J., Lozano, J., 2009. The economic impacts of voluntary environmental performance of firms: A critical review. Journal of Economic Surveys 23, 462-502.
Bönte, W., Dienes, C., 2013. Environmental innovations and strategies for the development of new production technologies: Empirical evidence from Europe. Business strategy and the Environment 22, 501-516.
Branzei, O., Ursacki-Bryant, T.J., Vertinsky, I., Zhang, W., 2004. The formation of green strategies in Chinese firms: Matching corporate environmental responses and individual principles. Strategic management journal 25, 1075-1095.
Bremmers, H., Haverkamp, D.-J., Omta, O., 2009. 'Dynamic behavioral fingerprinting': what drives the deployment of environmental information and communication capabilities? Journal of Cleaner Production 17, 751-761.
Bremmers, H., Omta, O., Kemp, R., Haverkamp, D.-J., 2007. Do stakeholder groups influence environmental management system development in the Dutch agri-food sector? Business strategy and the Environment 16, 214-231.
Bressers, H.T.A., Bruijn, T.J.N.M., Croci, E., 2005. Environmental Voluntary Agreements in the Dutch Context. The Handbook of Environmental Voluntary Agreements. Springer Netherlands, pp. 261-281.
Bressers, H.T.A., de Bruijn, T., Lulofs, K., O'Toole, L.J., 2011. Negotiation-based Policy Instruments and Performance: Dutch Covenants and Environmental Policy Outcomes. Journal of Public Policy 31, 187-208.
Buysse, K., Verbeke, A., 2003. Proactive environmental strategies: a stakeholder management perspective. Strategic management journal 24, 453-470.
Calantone, R., Vickery, S.K., 2009. Special Topic Forum on Using Archival and Secondary Data Sources in Supply Chain Management Research. Journal of Supply Chain Management 45, 94-95.
Caloghirou, Y., Kastelli, I., Tsakanikas, A., 2004. Internal capabilities and external knowledge sources: complements or substitutes for innovative performance? Technovation 24, 29-39.
Camisón, C., Forés, B., 2010. Knowledge absorptive capacity: New insights for its conceptualization and measurement. Journal of Business Research 63, 707-715.
Campbell, D.T., Fiske, D.W., 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. Psychological bulletin 56, 81.
Cantor, D.E., Morrow, P.C., Montabon, F., 2012. Engagement in environmental behaviors among supply chain management employees: An organizational support theoretical perspective. Journal of Supply Chain Management 48, 33-51.
Cao, M., Zhang, Q., 2010. Supply chain collaborative advantage: A firm's perspective. International Journal of Production Economics 128, 358-367.
Cao, M., Zhang, Q., 2011. Supply chain collaboration: impact on collaborative advantage and firm performance. Journal of Operations Management 29, 163-180.
Cao, M., Zhang, Q., 2012. Supply Chain Collaboration: Roles of Interorganizational Systems, Trust, and Collaborative Culture. Springer.
Carlsson, F., Kataria, M., Krupnick, A., Lampi, E., Löfgren, Å., Qin, P., Chung, S., Sterner, T., 2012. Paying for mitigation: A multiple country study. Land Economics 88, 326-340.
Carmines, E.G., Zeller, R.A., 1979. Reliability and validity assessment. Sage.
Carter, C.R., 2005. Purchasing social responsibility and firm performance: the key mediating roles of organizational learning and supplier performance. International journal of physical distribution & logistics management 35, 177-194.

Carter, C.R., Kale, R., Grimm, C.M., 2000. Environmental purchasing and firm performance: an empirical investigation. Transportation Research Part E: Logistics and Transportation Review 36, 219-228.
Carter, C.R., Rogers, D.S., 2008. A framework of sustainable supply chain management: moving toward new theory. International journal of physical distribution & logistics management 38, 360-387.
Chadha, A., 2011. Overcoming competence lock-in for the development of radical eco-innovations: The case of biopolymer technology. Industry and Innovation 18, 335-350.
Chan, R.Y., He, H., Chan, H.K., Wang, W.Y., 2012. Environmental orientation and corporate performance: The mediation mechanism of green supply chain management and moderating effect of competitive intensity. Industrial Marketing Management 41, 621-630.
Chang, C.-H., 2011. The influence of corporate environmental ethics on competitive advantage: The mediation role of green innovation. Journal of business ethics 104, 361-370.
Chen, Y.-S., Lai, S.-B., Wen, C.-T., 2006. The influence of green innovation performance on corporate advantage in Taiwan. 67, 331-339.
Cheng, C.C., Shiu, E.C., 2012. Validation of a proposed instrument for measuring eco-innovation: An implementation perspective. Technovation 32, 329-344.
Cheng, J.-H., Sheu, J.-B., 2012. Inter-organizational relationships and strategy quality in green supply chains—Moderated by opportunistic behavior and dysfunctional conflict. Industrial Marketing Management 41, 563-572.
Cheng, J.-H., Yeh, C.-H., Tu, C.-W., 2008. Trust and knowledge sharing in green supply chains. Supply Chain Management: An International Journal 13, 283-295.
Chin, W.W., Newsted, P.R., 1999. Structural equation modeling analysis with small samples using partial least squares. Statistical strategies for small sample research 1, 307-341.
Chiou, T.-Y., Chan, H.K., Lettice, F., Chung, S.H., 2011. The influence of greening the suppliers and green innovation on environmental performance and competitive advantage in Taiwan. Transportation Research Part E: Logistics and Transportation Review 47, 822-836.
Christmann, P., 2000. Effects of “best practices” of environmental management on cost advantage: The role of complementary assets. Academy of Management Journal 43, 663-680.
Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly 35, 128-152.
Corsten, D., Felde, J., 2005. Exploring the performance effects of key-supplier collaboration: an empirical investigation into Swiss buyer-supplier relationships. International journal of physical distribution & logistics management 35, 445-461.
Crossan, M.M., Apaydin, M., 2010. A multi-dimensional framework of organizational innovation: A systematic review of the literature. Journal of Management Studies 47, 1154-1191.
Cuerva, M.C., Triguero-Cano, Á., Córcoles, D., 2014. Drivers of green and non-green innovation: Empirical evidence in Low-Tech SMEs. Journal of Cleaner Production 68, 104-113.
Dangelico, R.M., Pontrandolfo, P., 2013. Being ‘Green and Competitive’: The Impact of Environmental Actions and Collaborations on Firm Performance. Business strategy and the Environment.
Dangelico, R.M., Pontrandolfo, P., Pujari, D., 2013. Developing sustainable new products in the textile and upholstered furniture industries: Role of external integrative capabilities. Journal of Product Innovation Management 30, 642-658.
Darby, M.R., Karni, E., 1973. Free competition and the optimal amount of fraud. JL & econ. 16, 67.
Darnall, N., Edwards, D., 2006. Predicting the cost of environmental management system adoption: The role of capabilities, resources and ownership structure. Strategic management journal 27, 301-320.
Darnall, N., Jolley, G.J., Handfield, R., 2008. Environmental management systems and green supply chain management: complements for sustainability? Business strategy and the Environment 17, 30-45.
de Bruijn, T.J., Norberg-Bohm, V., 2005. Industrial transformation: environmental policy innovation in the United States and Europe. MIT Press.

de Faria, P., Lima, F., Santos, R., 2010. Cooperation in innovation activities: The importance of partners. Research Policy 39, 1082-1092.
De Giovanni, P., 2012. Do internal and external environmental management contribute to the triple bottom line? International Journal of Operations & Production Management 32, 265-290.
De Giovanni, P., Esposito Vinzi, V., 2012. Covariance versus component-based estimations of performance in green supply chain management. International Journal of Production Economics 135, 907-916.
De Marchi, V., 2012. Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. Research Policy 41, 614-623.
De Marchi, V., Grandinetti, R., 2013. Knowledge strategies for environmental innovations: The case of Italian manufacturing firms. Journal of Knowledge Management 17, 569-582.
de Medeiros, J.F., Ribeiro, J.L.D., Cortimiglia, M.N., 2014. Success factors for environmentally sustainable product innovation: A systematic literature review. Journal of Cleaner Production 65, 76-86.
del Carmen Haro-Domínguez, M., Arias-Aranda, D., Javier Lloréns-Montes, F., Ruíz Moreno, A., 2007. The impact of absorptive capacity on technological acquisitions engineering consulting companies. Technovation 27, 417-425.
del Río González, P., 2005. Analysing the factors influencing clean technology adoption: A study of the Spanish pulp and paper industry. Business strategy and the Environment 14, 20-37.
Del Río González, P., 2009. The empirical analysis of the determinants for environmental technological change: A research agenda. Ecological economics 68, 861-878.
del Río, P., Peñasco, C., Romero-Jordán, D., 2013. Distinctive features of environmental innovators: An econometric analysis. Business strategy and the Environment.
Delmas, M., Hoffmann, V.H., Kuss, M., 2011. Under the tip of the iceberg: Absorptive capacity, environmental strategy, and competitive advantage. Business & Society 50, 116-154.
Delmas, M.A., Toffel, M.W., 2008. Organizational responses to environmental demands: Opening the black box. Strategic Management Journal 29, 1027-1055.
Deming, W.E., 1986. Out of the crisis. Cambridge, MA: Massachusetts Institute of Technology. Center for Advanced Engineering Study, 6.
Diabat, A., Govindan, K., 2011. An analysis of the drivers affecting the implementation of green supply chain management. Resources, Conservation and Recycling 55, 659-667.
DiMaggio, P.J., Powell, W.W., 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American sociological review, 147-160.
Driessen, P.P.J., Dieperink, C., Laerhoven, F., Runhaar, H.A.C., Vermeulen, W.J.V., 2012. Towards a Conceptual Framework for The Study of Shifts in Modes of Environmental Governance–Experiences From The Netherlands. Environmental Policy and Governance.
Dyer, J.H., Singh, H., 1998. The relational view: cooperative strategy and sources of interorganizational competitive advantage. Academy of management review 23, 660-679.
Dyer, J.H., Singh, H., Kale, P., 2008. Splitting the pie: rent distribution in alliances and networks. Managerial and Decision Economics 29, 137-148.
Eiadat, Y., Kelly, A., Roche, F., Eyadat, H., 2008. Green and competitive? An empirical test of the mediating role of environmental innovation strategy. Journal of World Business 43, 131-145.
Eltayeb, T.K., Zailani, S., Ramayah, T., 2011. Green supply chain initiatives among certified companies in Malaysia and environmental sustainability: Investigating the outcomes. Resources, Conservation and Recycling 55, 495-506.
Epstein, M., Roy, M.-J., 1997. Using ISO 14000 for improved organizational learning and environmental management. Environmental Quality Management 7, 21-30.
Epstein, M., Roy, M.-J., 1998. Managing corporate environmental performance: A multinational perspective. European Management Journal 16, 284-296.
Escribano, A., Fosfuri, A., Tribó, J.A., 2009. Managing external knowledge flows: The moderating role of absorptive capacity. Research Policy 38, 96-105.
Farla, J.C.M., Blok, K., 2002. Industrial long-term agreements on energy efficiency in The Netherlands. A critical assessment of the monitoring methodologies and quantitative results. Journal of Cleaner Production 10, 165-182.

Flatten, T.C., Engelen, A., Zahra, S.A., Brettel, M., 2011. A measure of absorptive capacity: Scale development and validation. European Management Journal 29, 98-116.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of marketing research, 39-50.
Friedman, M., 1973. The social responsibility of business is to increase its profits. The New York Times Magazine.
FrieslandCampina, 2012. CSR Report.
Frondel, M., Horbach, J., Rennings, K., 2007. End-of-pipe or cleaner production? An empirical comparison of environmental innovation decisions across OECD countries. Business strategy and the Environment 16, 571-584.
Gamberini, R., Gebennini, E., Grassi, A., Mora, C., Rimini, B., 2008. An innovative model for WEEE recovery network management in accordance with the EU directives. International Journal of Environmental Technology and Management 8, 348-368.
Gattiker, T.F., Carter, C.R., 2010. Understanding project champions' ability to gain intra-organizational commitment for environmental projects. Journal of Operations Management 28, 72-85.
Gavronski, I., Klassen, R.D., Vachon, S., Nascimento, L.F.M.d., 2011. A resource-based view of green supply management. Transportation Research Part E: Logistics and Transportation Review 47, 872-885.
Gavronski, I., Klassen, R.D., Vachon, S., Nascimento, L.F.M.d., 2012. A learning and knowledge approach to sustainable operations. International Journal of Production Economics 140, 183-192.
Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy 33, 897-920.
Gefen, D., Rigdon, E.E., Straub, D., 2011. Gefen, D., E.E. Rigdon and D. Straub, 2011. An Update and Extension to SEM Guidelines for Administrative and Social Science Research. . MIS Quarterly 35.
Geffen, C.A., Rothenberg, S., 2000. Suppliers and environmental innovation: the automotive paint process. International Journal of Operations & Production Management 20, 166-186.
Gerbing, D.W., Anderson, J.C., 1988. An Updated Paradigm for Scale Development Incorporating Unidimensionality and Its Assessment. Journal of Marketing Research 25, 186-192.
Gimenez, C., Tachizawa, E.M., 2012. Extending sustainability to suppliers: A systematic literature review. Supply Chain Management: An International Journal 17, 531-543.
Gluch, P., Gustafsson, M., Thuvander, L., 2009. An absorptive capacity model for green innovation and performance in the construction industry. Construction Management and Economics 27, 451-464.
Gold, A.H., Malhotra, A., Segars, A.H., 2001. Knowledge management: an organizational capabilities perspective. J. of Management Information Systems 18, 185-214.
Gold, S., Seuring, S., Beske, P., 2010. Sustainable supply chain management and inter-organizational resources: a literature review. Corporate Social Responsibility and Environmental Management 17, 230-245.
Goodrick, E., Salancik, G.R., 1996. Organizational Discretion in Responding to Institutional Practices: Hospitals and Cesarean Births. Administrative Science Quarterly 41, 1-28.
Grant, R.M., 1996a. Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. Organization Science 7, 375-387.
Grant, R.M., 1996b. Toward a Knowledge-Based Theory of the firm. Strategic management journal 17, 109-122.
Green, K.W., Zelbst, P.J., Meacham, J., Bhadauria, V.S., 2012. Green supply chain management practices: impact on performance. Supply Chain Management: An International Journal 17, 290-305.
Grekova, K., Bremmers, H.J., Trienekens, J.H., Kemp, R.G.M., Omta, S.W.F., 2013. The mediating role of environmental innovation in the relationship between environmental management and firm performance in a multi-stakeholder environment. Journal on Chain and Network Science 13, 119-137.

Grekova, K., Bremmers, H.J., Trienekens, J.H., Kemp, R.G.M., Omta, S.W.F., 2014. Extending environmental management beyond the firm boundaries: An empirical study of Dutch food and beverage firms. International Journal of Production Economics 152, 174-187.
Grimpe, C., Sofka, W., 2009. Search patterns and absorptive capacity: Low- and high-technology sectors in European countries. Research Policy 38, 495-506.
Grolleau, G., Mzoughi, N., Thomas, A., 2007. What drives agrifood firms to register for an Environmental Management System? European Review of Agricultural Economics 34, 233-255.
Gunningham, N., Kagan, R.A., Thornton, D., 2004. Social License and Environmental Protection: Why Businesses Go Beyond Compliance. Law & Social Inquiry 29, 307-341.
Hall, J., 2000. Environmental supply chain dynamics. Journal of Cleaner Production 8, 455-471.
Handfield, R., Sroufe, R., Walton, S., 2005. Integrating environmental management and supply chain strategies. Business Strategy and the Environment 14, 1-19.
Hart, C., Hoogeveen, H., Janssen, N., Kropff, M., Rijsingen, J.v., 2011. Topsector Agro&Food:'Agro&Food: De Nederlandse groeidiamant'.
Hart, S.L., 1995. A natural-resource-based view of the firm. Academy of management review 20, 986-1014.
Hart, S.L., Ahuja, G., 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. Business strategy and the Environment 5, 30-37.
Hart, S.L., Dowell, G., 2010. A Natural-Resource-Based View of the Firm: Fifteen Years After. Journal of management.
Hatcher, L., 1994. A step-by-step approach to using the SAS system for factor analysis and structural equation modeling. Sas Institute.
Henseler, J., Chin, W.W., 2010. A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. Structural Equation Modeling 17, 82-109.
Hines, F., Johns, R., 2001. Environmental supply chain management: evaluating the use of environmental mentoring through supply chain, greening of industry network conference, Bangkok.
Hoffman, A.J., 2001a. From heresy to dogma: An institutional history of corporate environmentalism. Stanford Business Books.
Hoffman, A.J., 2001b. Linking organizational and field-level analyses. Organization & Environment 14, 133-156.
Horbach, J., Rammer, C., Rennings, K., 2012. Determinants of eco-innovations by type of environmental impact — The role of regulatory push/pull, technology push and market pull. Ecological economics 78, 112-122.
Hu, L.t., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Structural Equation Modeling: A Multidisciplinary Journal 6, 1-55.
Hu, T.-L., Sheu, J.-B., Huang, K.-H., 2002. A reverse logistics cost minimization model for the treatment of hazardous wastes. Transportation Research Part E: Logistics and Transportation Review 38, 457-473.
Hult, G.T.M., Hurley, R.F., Knight, G.A., 2004. Innovativeness: Its antecedents and impact on business performance. Industrial Marketing Management 33, 429-438.
Hult, G.T.M., Ketchen, D.J., Arrfelt, M., 2007. Strategic supply chain management: Improving performance through a culture of competitiveness and knowledge development. Strategic management journal 28, 1035-1052.
Huppes, G., Simonis, U.E., Boersema, J.J., Reijnders, L., 2009. Environmental Policy Instruments

Principles of Environmental Sciences. Springer Netherlands, pp. 239-280.
Inkpen, A.C., 1996. Creating knowledge through collaboration. California management review 39.
Iraldo, F., Testa, F., Frey, M., 2009. Is an environmental management system able to influence environmental and competitive performance? The case of the eco-management and audit scheme (EMAS) in the European union. Journal of Cleaner Production 17, 1444-1452.

Jansen, J.J.P., Van Den Bosch, F.A.J., Volberda, H.W., 2005. Managing potential and realized absorptive capacity: How do organizational antecedents matter? Academy of Management Journal 48, 999-1015.
Jiménez-Barrionuevo, M.M., García-Morales, V.J., Molina, L.M., 2011. Validation of an instrument to measure absorptive capacity. Technovation 31, 190-202.
Johannsen, K.S., 2002. Combining voluntary agreements and taxes — an evaluation of the Danish agreement scheme on energy efficiency in industry. Journal of Cleaner Production 10, 129-141.
Jöreskog, K.G., 1971. Statistical analysis of sets of congeneric tests. 36, 109-133.
Jöreskog, K.G., Sörbom, D., 2006. LISREL 8.8 for Windows Scientific Software International, Inc., Skokie, IL.
Katz, R., Allen, T.J., 1982. Investigating the Not Invented Here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R&D Project Groups. R&D Management 12, 7-20.
Kaufman, A., Wood, C.H., Theyel, G., 2000. Collaboration and technology linkages: a strategic supplier typology. Strategic management journal 21, 649-663.
Kemp, R., 2000. Technology and Environmental Policy—Innovation effects of past policies and suggestions for improvement. Innovation and the Environment, 35-61.
Ketata, I., Sofka, W., Grimpe, C., 2014. The role of internal capabilities and firms' environment for sustainable innovation: Evidence for Germany. R&D Management.
King, A.A., Lenox, M.J., Terlaak, A., 2005. The strategic use of decentralized institutions: Exploring certification with the ISO 14001 management standard. The Academy of Management Journal, 1091-1106.
Klassen, R.D., McLaughlin, C.P., 1996. The Impact of Environmental Management on Firm Performance. Management Science 42, 1199-1214.
Kroon, L., Vrijens, G., 1995. Returnable containers: an example of reverse logistics. International journal of physical distribution & logistics management 25, 56-68.
Krosnick, J.A., 1999. Survey research. Annual Review of Psychology 50, 537-567.
Lado, A.A., Boyd, N.G., Hanlon, S.C., 1997. Competition, cooperation, and the search for economic rents: A syncretic model. Academy of management review 22, 110-141.
Lane, P.J., Koka, B., Pathak, S., 2002. A thematic analysis and critical assessment of absorptive capacity research, Academy of Management Proceedings. Academy of Management, pp. M1-M6.
Lane, P.J., Koka, B.R., Pathak, S., 2006. The reification of absorptive capacity: A critical review and rejuvenation of the construct. The Academy of Management Review 31, 833-863.
Lavie, D., 2006. The competitive advantage of interconnected firms: An extension of the resource-based view. Academy of management review 31, 638-658.
Lee, S.-Y., 2008. Drivers for the participation of small and medium-sized suppliers in green supply chain initiatives. Supply Chain Management: An International Journal 13, 185-198.
Lee, S.M., Kim, S.T., Choi, D., 2012. Green supply chain management and organizational performance. Industrial Management & Data Systems 112, 1148-1180.
Leonidou, C.N., Katsikeas, C.S., Morgan, N.A., 2013. "Greening" the marketing mix: Do firms do it and does it pay off? Journal of the Academy of Marketing Science 41, 151-170.
Lepoutre, J., Heene, A., 2006. Investigating the impact of firm size on small business social responsibility: a critical review. Journal of Business Ethics 67, 257-273.
Listeş, O., Dekker, R., 2005. A stochastic approach to a case study for product recovery network design. European Journal of Operational Research 160, 268-287.
Lohmöller, J.-B., 1989. Latent variable path modeling with partial least squares. Physica-Verlag Heidelberg.
López-Gamero, M.D., Molina-Azorín, J.F., Claver-Cortés, E., 2010. The potential of environmental regulation to change managerial perception, environmental management, competitiveness and financial performance. Journal of Cleaner Production 18, 963-974.
Louwers, D., Kip, B.J., Peters, E., Souren, F., Flapper, S.D.P., 1999. A facility location allocation model for reusing carpet materials. Computers & Industrial Engineering 36, 855-869.
MacKenzie, S.B., Podsakoff, P.M., 2012. Common Method Bias in Marketing: Causes, Mechanisms, and Procedural Remedies. Journal of Retailing 88, 542-555.

MacKinnon, D.P., Lockwood, C.M., Williams, J., 2004. Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate behavioral research 39, 99-128.
Mahoney, J.T., Pandian, J.R., 1992. The resource-based view within the conversation of strategic management. Strategic management journal 13, 363-380.
Manzini, R., Accorsi, R., 2013. The new conceptual framework for food supply chain assessment. Journal of Food Engineering 115, 251–263.
Melnyk, S.A., Sroufe, R.P., Calantone, R., 2003. Assessing the impact of environmental management systems on corporate and environmental performance. Journal of Operations Management 21, 329-351.
Menguc, B., Auh, S., 2006. Creating a firm-level dynamic capability through capitalizing on market orientation and innovativeness. Journal of the Academy of Marketing Science 34, 63-73.
Miemczyk, J., 2008. An exploration of institutional constraints on developing end-of-life product recovery capabilities. International Journal of Production Economics 115, 272-282.
Miles, M., Covin, J., 2000. Environmental Marketing: A Source of Reputational, Competitive, and Financial Advantage. Journal of business ethics 23, 299-311.
Miller, L.E., Smith, K.L., 1983. Handling nonresponse issues. Journal of extension 21, 45-50.
Min, H., Galle, W.P., 2001. Green purchasing practices of US firms. International Journal of Operations & Production Management 21, 1222-1238.
Molina-Azorín, J.F., Claver-Cortés, E., López-Gamero, M.D., Tarí, J.J., 2009a. Green management and financial performance: A literature review. Management Decision 47, 1080-1100.
Molina-Azorín, J.F., Claver-Cortés, E., Pereira-Moliner, J., Tarí, J.J., 2009b. Environmental practices and firm performance: An empirical analysis in the Spanish hotel industry. Journal of Cleaner Production 17, 516-524.
Möller, K.E.K., Törrönen, P., 2003. Business suppliers' value creation potential: A capability-based analysis. Industrial Marketing Management 32, 109-118.
Murovec, N., Prodan, I., 2009. Absorptive capacity, its determinants, and influence on innovation output: Cross-cultural validation of the structural model. Technovation 29, 859-872.
Narver, J.C., Slater, S.F., MacLachlan, D.L., 2004. Responsive and Proactive Market Orientation and New-Product Success*. Journal of Product Innovation Management 21, 334-347.
Nehrt, C., 1996. Timing and intensity effects of environmental investments. Strategic management journal 17, 535-547.
Noci, G., Verganti, R., 1999. Managing 'green' product innovation in small firms. R&D Management 29, 3-15.
Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., van den Oord, A., 2007. Optimal cognitive distance and absorptive capacity. Research Policy 36, 1016-1034.
Nunnally, J., 1978. Psychometric methods. McGraw-Hill, New York, NY.
OECD, 2010. Eco-Innovation in Industry. Enabling Green Growth OECD Publishing.
Oliver, C., 1997. Sustainable competitive advantage: Combining institutional and resource-based views. Strategic management journal 18, 697-713.
Pagell, M., Wu, Z., 2009. Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. Journal of Supply Chain Management 45, 37-56.
Pagell, M., Wu, Z., Wasserman, M.E., 2010. Thinking differently about purchasing portfolios: an assessment of sustainable sourcing. Journal of Supply Chain Management 46, 57-73.
Palmer, J., 2000. Helping small and medium-sized enterprises improve environmental management, in: Hillary, R. (Ed.), Small and medium-sized enterprises and the environment. Greenleaf Publishing, Sheffield, U.K.
Paulraj, A., 2009. Environmental motivations: a classification scheme and its impact on environmental strategies and practices. Business strategy and the Environment 18, 453-468.
Paulraj, A., 2011. Understanding the relationships between internal resources and capabilities, sustainable supply management and organisational sustainability. Journal of Supply Chain Management 47, 19-37.
Peteraf, M.A., 1993. The cornerstones of competitive advantage: A resource-based view. Strategic management journal 14, 179-191.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y., Podsakoff, N.P., 2003. Common method biases in behavioral research: A critical review of the literature and recommended remedies. Journal of applied psychology 88, 879.

Podsakoff, P.M., MacKenzie, S.B., Podsakoff, N.P., 2012. Sources of method bias in social science research and recommendations on how to control it. Annual Review of Psychology 63, 539-569.

Podsakoff, P.M., Organ, D.W., 1986. Self-reports in organizational research: Problems and prospects. Journal of management 12, 531-544.

Porter, M.E., Van der Linde, C., 1995. Toward a new conception of the environment-competitiveness relationship. Journal of economic perspectives 9, 97-118.

Prahalad, C., Hamel, G., 1990. The core competence of the corporation. Boston (MA), 235-256.

Preacher, K.J., Hayes, A.F., 2008. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behavior research methods 40, 879-891.

Productschap Vee en Vlees [PVV], 2007. Annual report. Productschap Vee en Vlees, The Hague.

Pujari, D., Wright, G., Peattie, K., 2003. Green and competitive: Influences on environmental new product development performance. Journal of Business Research 56, 657-671.

Qian, W., Burritt, R., Schaltegger, S., Bennett, M., Burritt, R.L., Jasch, C., 2009. The Development of Environmental Management Accounting: An Institutional View

Environmental Management Accounting for Cleaner Production, in: Tukker, A. (Ed.). Springer Netherlands, pp. 233-248.

Ramus, C.A., Steger, U., 2000. The Roles of Supervisory Support Behaviors and Environmental Policy in Employee "Ecoinitiatives" at Leading-Edge European Companies. Academy of Management journal 43, 605-626.

Rao, P., Holt, D., 2005. Do green supply chains lead to competitiveness and economic performance? International Journal of Operations & Production Management 25, 898-916.

Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. Biological conservation 141, 2417-2431.

Rehfeld, K.-M., Rennings, K., Ziegler, A., 2007. Integrated product policy and environmental product innovations: An empirical analysis. Ecological economics 61, 91-100.

Rennings, K., 2000. Redefining innovation — eco-innovation research and the contribution from ecological economics. Ecological economics 32, 319-332.

Rennings, K., Rammer, C., 2011. The impact of regulation-driven environmental innovation on innovation success and firm performance. Industry and Innovation 18, 255-283.

Rennings, K., Ziegler, A., Ankele, K., Hoffmann, E., 2006. The influence of different characteristics of the EU environmental management and auditing scheme on technical environmental innovations and economic performance. Ecological Economics 57, 45-59.

Reuter, C., Foerstl, K., Hartmann, E., Blome, C., 2010. Sustainable global supplier management: the role of dynamic capabilities in achieving competitive advantage. Journal of Supply Chain Management 46, 45-63.

Ringle, C., Sarstedt, M., Straub, D., 2012. A Critical Look at the Use of PLS-SEM in MIS Quarterly. MIS Quarterly (MISQ) 36.

Ringle, C.M., Wende, S., Will, A., 2005. SmartPLS, 2.0 (beta) ed. SmartPLS, Hamburg, Germany.

Rivera, J., 2002. Assessing a voluntary environmental initiative in the developing world: The Costa Rican Certification for Sustainable Tourism. 35, 333-360.

Rivera, J., 2004. Institutional Pressures and Voluntary Environmental Behavior in Developing Countries: Evidence From the Costa Rican Hotel Industry. Society & Natural Resources 17, 779-797.

Rogelberg, S.G., Luong, A., 1998. Nonresponse to mailed surveys: A review and guide. Current Directions in Psychological Science 7, 60-65.

Rondinelli, D., Vastag, G., 2000. Panacea, common sense, or just a label?: The value of ISO 14001 environmental management systems. European Management Journal 18, 499-510.

Rouw, M., Worrell, E., 2011. Evaluating the impacts of packaging policy in The Netherlands. Resources, Conservation and Recycling 55, 483-492.

Russo, M.V., Fouts, P.A., 1997. A Resource-Based Perspective on Corporate Environmental Performance and Profitability. The Academy of Management Journal 40, 534-559.
Santolaria, M., Oliver-Solà, J., Gasol, C.M., Morales-Pinzón, T., Rieradevall, J., 2011. Eco-design in innovation driven companies: perception, predictions and the main drivers of integration. The Spanish example. Journal of Cleaner Production 19, 1315-1323.
Sarkis, J., Cordeiro, J.J., 2001. An empirical evaluation of environmental efficiencies and firm performance: Pollution prevention versus end-of-pipe practice. European Journal of Operational Research 135, 102-113.
Sarkis, J., Zhu, Q., Lai, K.-h., 2011. An organizational theoretic review of green supply chain management literature. International Journal of Production Economics 130, 1-15.
Schiederig, T., Tietze, F., Herstatt, C., 2012. Green innovation in technology and innovation management–an exploratory literature review. R&D Management 42, 180-192.
Schiele, H., 2006. How to distinguish innovative suppliers? Identifying innovative suppliers as new task for purchasing. Industrial Marketing Management 35, 925-935.
Schoenherr, T., 2012. The role of environmental management in sustainable business development: A multi-country investigation. International Journal of Production Economics 140, 116-128.
Scott, W.R., 2001. Institutions and organizations. Sage Publications, Inc.
Scott, W.R., 2012. The institutional environment of global project organizations. Engineering Project Organization Journal 2, 27-35.
Seuring, S., Müller, M., 2008. From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production 16, 1699-1710.
Sharfman, M.P., Fernando, C.S., 2008. Environmental risk management and the cost of capital. Strategic management journal 29, 569-592.
Sharfman, M.P., Shaft, T.M., Anex Jr., R.P., 2009. The road to cooperative supply-chain environmental management: trust and uncertainty among pro-active firms. Business strategy and the Environment 18, 1-13.
Sharma, S., 2000. Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy. Academy of Management Journal 43, 681-697.
Sharma, S., Henriques, I., 2005. Stakeholder influences on sustainability practices in the Canadian forest products industry. Strategic management journal 26, 159-180.
Sharma, S., Vredenburg, H., 1998. Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities. Strategic management journal 19, 729-753.
Shi, V.G., Koh, S.L., Baldwin, J., Cucchiella, F., 2012. Natural resource based green supply chain management. Supply Chain Management: An International Journal 17, 54-67.
Shih, L.-H., 2001. Reverse logistics system planning for recycling electrical appliances and computers in Taiwan. Resources, Conservation and Recycling 32, 55-72.
Shrivastava, P., 1995. Environmental technologies and competitive advantage. Strategic management journal 16, 183-200.
Siegel, D.S., 2009. Green Management Matters Only If It Yields More Green: An Economic/Strategic Perspective. Academy of Management Perspectives 23, 5-16.
Siegel, D.S., Vitaliano, D.F., 2007. An Empirical Analysis of the Strategic Use of Corporate Social Responsibility. Journal of Economics & Management Strategy 16, 773-792.
Simpson, D., Power, D., Samson, D., 2007. Greening the automotive supply chain: a relationship perspective. International Journal of Operations & Production Management 27, 28-48.
Sobel, M.E., 1982. Asymptotic confidence intervals for indirect effects in structural equation models. Sociological methodology 13, 290-312.
Spector, P.E., 2006. Method variance in organizational research truth or urban legend? Organizational research methods 9, 221-232.
Spekman, R.E., Kamauff Jr, J.W., Myhr, N., 1998. An empirical investigation into supply chain management: a perspective on partnerships. Supply Chain Management: An International Journal 3, 53-67.
Spengler, T., Püchert, H., Penkuhn, T., Rentz, O., 1997. Environmental integrated production and recycling management. European Journal of Operational Research 97, 308-326.

Srivastava, S.K., 2007. Green supply-chain management: a state-of-the-art literature review. International journal of management reviews 9, 53-80.
Statistics Netherlands, 2012.
Tate, W.L., Dooley, K.J., Ellram, L.M., 2011. Transaction cost and institutional drivers of supplier adoption of environmental practices. Journal of Business Logistics 32, 6-16.
Tencati, A., Zsolnai, L., 2009. The Collaborative Enterprise. 85, 367-376.
Tepic, M., Trienekens, J.H., Hoste, R., Omta, S.W.F., 2012. The influence of networking and absorptive capacity on the innovativeness of farmers in the Dutch pork sector. International Food and Agribusiness Management Review 15, 1-33.
Testa, F., Iraldo, F., 2010. Shadows and lights of GSCM (Green Supply Chain Management): determinants and effects of these practices based on a multi-national study. Journal of Cleaner Production 18, 953-962.
Theuvsen, L., Plumeyer, C.H., Gawron, J.C., 2007. Certification systems in the meat industry: Overview and consequences for chain-wide communication. Polish Journal of Food and Nutrition Sciences 57, 563-569.
Thøgersen, J., 2010. Country differences in sustainable consumption: The case of organic food. Journal of Macromarketing 30, 171-185.
Thomas, T., Schermerhorn, J.R., Dienhart, J.W., 2004. Strategic leadership of ethical behavior in business. The Academy of Management Executive 18, 56-66.
Tien, S.-W., Chung, Y.-C., Tsai, C.-H., 2005. An empirical study on the correlation between environmental design implementation and business competitive advantages in Taiwan's industries. Technovation 25, 783-794.
Todorova, G., Durisin, B., 2007. Absorptive capacity: Valuing a reconceptualization. Academy of management review 32, 774-786.
Triguero, A., Moreno-Mondéjar, L., Davia, M.A., 2013. Drivers of different types of eco-innovation in European SMEs. Ecological economics 92, 25-33.
Triguero, A., Moreno-Mondéjar, L., Davia, M.A., 2014. Leaders and laggards in environmental innovation: An empirical analysis of SMEs in Europe. Business strategy and the Environment.
Unilever, 2012a. Unilever sustainable living plan: progress report 2012.
Unilever, 2012b. Unilever Sustainable Living: Sustainable sourcing.
Utterback, J.M., Abernathy, W.J., 1975. A dynamic model of process and product innovation. Omega 3, 639-656.
Vachon, S., Klassen, R.D., 2006. Extending green practices across the supply chain: the impact of upstream and downstream integration. International Journal of Operations & Production Management 26, 795-821.
Vachon, S., Klassen, R.D., 2007. Supply chain management and environmental technologies: The role of integration. International Journal of Production Research 45, 401-423.
Vachon, S., Klassen, R.D., 2008. Environmental management and manufacturing performance: The role of collaboration in the supply chain. International Journal of Production Economics 111, 299-315.
Van Den Bosch, F.A., Volberda, H.W., De Boer, M., 1999. Coevolution of firm absorptive capacity and knowledge environment: Organizational forms and combinative capabilities. Organization Science 10, 551-568.
Van Plaggenhoef, W., 2007. Integration and self regulation of quality management in Dutch agri-food supply chains : a cross-chain analysis of the poultry meat, the fruit and vegetable and the flower and potted plant chains. Wageningen Academic Publishers, Wageningen.
Van Tatenhove, J.P.M., Leroy, P., 2003. Environment and Participation in a Context of Political Modernisation. Environmental Values 12, 155-174.
Van Wijk, R., Jansen, J.J., Lyles, M.A., 2008. Inter- and intra-organizational knowledge transfer: A meta-analytic review and assessment of its antecedents and consequences. Journal of Management Studies 45, 830-853.
Vermeulen, S.J., Campbell, B.M., Ingram, J.S., 2012. Climate change and food systems. Annual Review of Environment and Resources 37, 195-222.

Vermeulen, W., Kok, M., 2012. Government interventions in sustainable supply chain governance: Experience in Dutch front-running cases. Ecological Economics.
Volberda, H.W., Foss, N.J., Lyles, M.A., 2010. Perspective-absorbing the concept of absorptive capacity: How to realize its potential in the organization field. Organization Science 21, 931-951.
Waddock, S.A., Bodwell, C., Graves, S.B., 2002. Responsibility: The new business imperative. The Academy of Management Executive 16, 132-148.
Wagner, M., 2007. Integration of Environmental Management with Other Managerial Functions of the Firm: Empirical Effects on Drivers of Economic Performance. Long Range Planning 40, 611-628.
Walker, H., Di Sisto, L., McBain, D., 2008. Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors. Journal of Purchasing and Supply Management 14, 69-85.
Walley, N., Whitehead, B., 1994. It's not easy being green. The Earthscan reader in business and the environment, 36-44.
Walton, S.V., Handfield, R.B., Melnyk, S.A., 1998. The Green Supply Chain: Integrating Suppliers into Environmental Management Processes. International Journal of Purchasing and Materials Management 34, 2-11.
WCED, U., 1987. Our common future. Oxford University Press.
Wernerfelt, B., 1984. A resource-based view of the firm. Strategic management journal 5, 171-180.
Williams, L.J., Hartman, N., Cavazotte, F., 2010. Method variance and marker variables: A review and comprehensive CFA marker technique. Organizational research methods 13, 477-514.
Williander, M., 2007. Absorptive capacity and interpretation system's impact when ‘going green’: An empirical study of ford, volvo cars and toyota. Business strategy and the Environment 16, 202-213.
Wold, H., 1982. Soft modelling: the basic design and some extensions. Systems Under Indirect Observation, PartII, 36-37.
Wong, C.W., 2013a. Leveraging Environmental Information Integration to Enable Environmental Management Capability and Performance. Journal of Supply Chain Management 49, 114-136.
Wong, C.W.Y., Lai, K.-h., Shang, K.-C., Lu, C.-S., Leung, T.K.P., 2012. Green operations and the moderating role of environmental management capability of suppliers on manufacturing firm performance. International Journal of Production Economics 140, 283-294.
Wong, S.K.S., 2013b. Environmental requirements, knowledge sharing and green innovation: Empirical evidence from the electronics industry in China. Business strategy and the Environment 22, 321-338.
Wu, G.C., Ding, J.H., Chen, P.S., 2012. The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan’s textile and apparel industry. International Journal of Production Economics 135, 618-636.
Wu, Z., Pagell, M., 2011. Balancing priorities: Decision-making in sustainable supply chain management. Journal of Operations Management 29, 577-590.
WWF, Global footprint network, Zoological Society of London, 2012. Living planet report.
Yang, C.-S., Lu, C.-S., Haider, J.J., Marlow, P.B., 2013. The effect of green supply chain management on green performance and firm competitiveness in the context of container shipping in Taiwan. Transportation Research Part E: Logistics and Transportation Review 55, 55-73.
Ye, F., Zhao, X., Prahinski, C., Li, Y., 2013. The impact of institutional pressures, top managers' posture and reverse logistics on performance—Evidence from China. International Journal of Production Economics.
Zahra, S.A., George, G., 2002. Absorptive capacity: A review, reconceptualization, and extension. Academy of management review 27, 185-203.
Zhu, Q., Geng, Y., 2013. Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers. Journal of Cleaner Production 40, 6-12.
Zhu, Q., Geng, Y., Lai, K., 2010. Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. Journal of Environmental Management 91, 1324-1331.

Zhu, Q., Geng, Y., Sarkis, J., Lai, K.-h., 2011. Evaluating green supply chain management among Chinese manufacturers from the ecological modernization perspective. Transportation Research Part E: Logistics and Transportation Review 47, 808-821.
Zhu, Q., Sarkis, J., 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management 22, 265-289.
Zhu, Q., Sarkis, J., 2007. The moderating effects of institutional pressures on emergent green supply chain practices and performance. International Journal of Production Research 45, 4333-4355.
Zhu, Q., Sarkis, J., Cordeiro, J.J., Lai, K., 2008a. Firm-level correlates of emergent green supply chain management practices in the Chinese context. Omega 36, 577-591.
Zhu, Q., Sarkis, J., Geng, Y., 2005. Green supply chain management in China: pressures, practices and performance. International Journal of Operations & Production Management 25, 449-468.
Zhu, Q., Sarkis, J., Lai, K.-h., 2007. Green supply chain management: pressures, practices and performance within the Chinese automobile industry. Journal of Cleaner Production 15, 1041-1052.
Zhu, Q., Sarkis, J., Lai, K.-h., 2008b. Confirmation of a measurement model for green supply chain management practices implementation. International Journal of Production Economics 111, 261-273.
Zhu, Q., Sarkis, J., Lai, K.-h., 2012. Examining the effects of green supply chain management practices and their mediations on performance improvements. International Journal of Production Research 50, 1377-1394.
Zhu, Q., Sarkis, J., Lai, K.-h., 2013. Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. Journal of Purchasing and Supply Management 19, 106-117.
Zhu, Q., Sarkis, J., Lai, K., 2008c. Green supply chain management implications for "closing the loop". Transportation Research Part E: Logistics and Transportation Review 44, 1-18.
Zutshi, A., Sohal, A., 2004. Environmental management system adoption by Australasian organisations: part 1: reasons, benefits and impediments. Technovation 24, 335-357.

REFERENCES

ABOUT THE AUTHOR

Katja Grekova was born on November 25, 1985 in Orel (Russia). In 2008, she received a bachelor degree cum laude in Accounting, Analysis and Audit from the Orel State Agrarian University (OSAU). Since 2008, she joined a master program in Management, Economics and Consumer studies offered by Wageningen University. She completed the program cum laude in 2010. Her graduate thesis won the WUF-KLV Best Thesis Award as the best master thesis in Social Science at Wageningen University in 2010. After graduation, she started a doctoral research in the Department of Business Administration at Wageningen University. She has worked as a guest researcher in Michigan State University (Broad College of Business). A part of the PhD project was conducted under the auspices of Quarisma project from the European Community's Seventh Framework Programme FP7/2007-2013. Her research interest concerns determinants and business performance implications of environmental innovation and of green supply chain management.

Katja Grekova

Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Writing a PhD research proposal	WASS	2010	6
Advanced econometrics	AEP 60306	2011	6
Quantitative data analysis: multivariate techniques	YRM 60806	2010	6
Institutional economics and economic organizational theory	AEP 20806	2010	6
Executive course on sustainable development diplomacy	Fletcher School of Law and Diplomacy, WUR, EL&I, Sustainability Challenge Foundation	2012	2.2
Atlas.ti, a hands-on practical	WASS	2012	0.5
Comprehensive PLS seminar	PLS-School	2013	6
Systematic approach to reviewing literature	WASS	2013	3.7
B) General research related competences			
"An empirical study of environmental innovation: determinants and performance"	23rd IFAMA World forum and symposium, Atlanta, USA	2013	1
"The relationships between environmental and business performance. An empirical study conducted in the Dutch food and beverage industry"	2nd Agrimba-AVA congress, Wageningen, the Netherlands	2011	1
Techniques for writing and presenting scientific papers	WASS	2011	1.2
Scientific writing	WASS	2011	1.8
C) Career related competences/personal development			
Teaching: Corporate financial management and Financial business management		2010-2011	2.4
Total			43.8

*One credit according to ECTS is on average equivalent to 28 hours of study load

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