REDUCING THE CARBON FOOTPRINT WITHIN FAST-MOVING CONSUMER GOODS SUPPLY CHAINS THROUGH COLLABORATION: THE MANUFACTURERS' PERSPECTIVE

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Within the sustainability arena, CO_2 reduction has emerged as a key challenge for manufacturers in the fast-moving consumer goods industry. This goal needs to be balanced against the competitive priorities of cost and responsiveness. Emissions-reducing efforts are driven by the need to comply with expectations from industry and end customers and by opportunities for energy and cost savings. Manufacturers are now looking beyond their corporate boundaries to find new ways to reduce emissions along the supply chain. There is a need for research to address supplier selection in the face of sustainability challenges and provide insights about the factors affecting the transfer of sustainability skills between the manufacturer and its suppliers. This multiple case study investigates the factors that influence an organization's readiness to engage in a collaborative CO_2 reduction management (CCRM) approach. We find that partner selection for CCRM exhibits path dependency in terms of the manufacturer's maturity level of sustainability; characteristics of key downstream customers, in turn, are shown to also impact this selection.

Keywords: *collaboration; environmental issues; supply chain management; sustainability; multiple case study*

INTRODUCTION

Sustainability is becoming increasingly important for industry in general and end customers in the supply chain in particular (Balagopal et al., 2009; Bansal & Hoffmann, 2012; Boston Consulting Group, 2009; Closs, Speier, & Meacham, 2011; Mann, Kumar, Kumar, & Mann, 2010; McKinsey, 2010). Against the backdrop of increasing world population and global product consumption, carbon footprint reduction (reducing CO_2 emissions) can improve sustainability in two ways (Carbon Trust, 2011): by (1) resulting in more environmentally friendly processes and products and (2) enabling energy savings (Bansal & Hoffmann, 2012). CO_2 reduction entails significant challenges for industries where responsiveness and cost are critical competitive priorities. One industry where the proper balancing of these dimensions plays a key role is the fast-moving consumer goods (FMCG) industry; here, sustainability concerns may induce trade-offs between lowering emissions and emphasis on low cost and responsiveness. To date, many of the FMCG manufacturers lack the necessary skills for enhancing eco-efficiency and sustainability; as the biggest potential for reducing the carbon footprint resides in the supply chain, we shall explore the process of interorganizational collaboration aimed at fostering sustainability. We define collaborative CO_2 reduction management (CCRM) on the basis of Fawcett, Magnan, and McCarter's (2008a: 93) definition of supply chain collaboration as "the ability to work across organizational boundaries to build and manage unique value-added processes to better meet customer needs"; to this, we add that CCRM involves the sharing of resources, that is, CO_2 data, CO_2 management knowledge, people, and assets. The objective of CCRM is to work together to maximize CO_2 reduction in order to better meet customer expectations, mitigate risks related to climate change, lower energy costs, and improve public reputation. To reduce emissions on the supply chain level, two approaches are possible: enforcement or collaboration. A number of studies (e.g., Sharfman, Shaft, & Anex Jr., 2009) suggest that when compared to enforcement, a collaborative approach is more effective at encouraging business partners to engage in environmental management and learn from each other and also more likely to result in such benefits as improved reputation (Kleindorfer, Singhal, & Van Wassenhove, 2005; Carter & Rogers, 2008; Côte, Lopez, Marche, Perron, & Wright, 2008; Fynes, de Búrca, & Mangan, 2008; Sundarakani, de Souza, Goh, Wagner, & Manikandan, 2010). Collaboration offers benefits both for companies lacking in CO_2 mitigation skills as well as for companies whose own skill level is high, but whose supply chain partners are increasing their products' overall CO_2 footprint. Companies may pursue a collaborative approach for several reasons: to gain access to a partner's expertise in CO_2 mitigation, to improve the organization's own reputation by helping a less-skilled partner reduce emissions, or because emissions are a result of a joint process that can better be managed when combining expertise. Specifically, we shall focus on the perceived role played by suppliers in advancing sustainability and how firms manage the triangle of responsiveness, costs, and sustainability; the focal firm in this study will be the manufacturer. We focus on two research questions in particular: (1) How do firms adjust the supplier selection process when sustainability is a key consideration? and (2) What factors affect the transfer of sustainability skills between the manufacturer and its suppliers?

This study directly responds to a recent survey among executives by Bonini and Görner (2011) suggesting that the supply chain is the least integrated area of environmental management. Some companies in the FMCG industry have made initial attempts to improve their carbon output through collaboration with supply chain partners. For instance, Procter & Gamble (2010) began encouraging its key suppliers to measure emissions and develop cleaner products. Within the context of carbon management, Benjaafar, Li, and Daskin (2010: 24) highlight the need for future research on the question of "how collaborative coalitions might form." This is of particular importance as partnerships often fail because they are not well organized (Lambert, Emmelhainz, & Gardner, 1999).

We contribute to the literature by studying the factors that determine the adoption of a CCRM approach among supply chain partners. The selected industry focus allows us to recognize the fact that sustainability cannot be an absolute mandate but a relative one. To date, the existing literature has not offered any insight into this specific area. Our study lays the foundation for future CO_2 reduction practices on the supply chain level by proposing implementation guidelines.

Our examination of the research questions emphasizes the manufacturer's perspective, thus abstracting from the dyadic nature of the relationship. Might it have been more natural to adopt a make-or-buy decision lens when focusing on the manufacturer? Most likely no, because Mantel Tatikonda, & Liao (2006) point out that the make-or-buy decision has grown from a purely transaction cost economics perspective to encompass the notion of core competencies and, more recently, supply risk, hence also relying on a dyadic perspective. We justify the focus on the manufacturer because of its central position in the chain; hence, an analysis based on this perspective provides insights on suitable partners along the entire chain. A similar argument is brought forward by proponents of the theory of supply chain integration, which takes as the focal firm the manufacturer (e.g., Flynn, Huo, & Zhao, 2010). Moreover, CCRM research is still in its development phase; as a result, there is a need to establish even basic information about the factors that influence a company's introduction of a CCRM approach. Taking a single company's perspective at this early stage of research fits well with qualitative research and the need for in-depth studies (Miles & Huberman, 1994). Finally, as end customers increasingly select products based on environmental performance (Georgiadis & Vlachos, 2004; Mann et al., 2010), the initiation of a CCRM program is most likely to occur at the manufacturers' level, as their market share is directly affected by these preferences.

The remainder of the paper is structured as follows. First, we review the literature that relates to CCRM. We then present the relational view (RV) and derive relevant determinants that influence effective supply chain collaboration. This is followed by the collection and analysis of data via a multiple case study methodology. Finally, we develop testable propositions related to the research questions introduced above, summarize the results, and close with managerial implications and limitations of this study as well as important avenues for future research.

LITERATURE REVIEW, THEORETICAL FOUNDATION, AND RESEARCH FRAMEWORK

Giurco and Petrie (2007) find that many opportunities for carbon reduction are overlooked because most reduction approaches focus on the organization itself, rather than on the supply chain. To better understand the life-cycle environmental effects of products and to improve environmental performance, interorganizational approaches along supply chain partners need to be initiated (Sharfman et al., 2009). Similarly, Sundarakani et al. (2010) suggest that measuring CO_2 emissions along each stage of the supply chain is essential for implementing measures to identify and mitigate emissions at crucial points in manufacturing processes. This is of particular importance as firms that are closer to the downstream end of supply chains are increasingly focusing on the carbon footprint of products, which requires a consideration of the entire supply chain (e.g., Jeswani, Wehrmeyer, & Mulugetta, 2008; Scipioni, Manzardo, Mazzi, & Mastrobuono, 2012). In this context, Jeswani et al. (2008) focus on product development as a means to improve the carbon footprint of products; Kolk and Pinkse (2005) suggest that supply chain measures are helpful in reducing emissions both up- and downstream in a firm's chain and Scipioni et al. (2012) emphasize that investments in measures to reduce emissions along the supply chain are needed. Partnership-building offers the benefit of increased creativity and knowledge, and this is important for the development of effective reduction measures (Lozano, 2007). In the same vein, Chiou, Chan, Lettice, and Chung (2011) suggest that addressing environmental issues by working closely with supply chain partners promotes environmentally friendly product innovations, thereby creating advantages (e.g., better product quality) over rivals.

Prior studies in this field suggest that certain interrelated factors influence the formation of effective partnerships. For example, Vachon and Klassen (2008) highlight that an organization's absorptive capacity is relevant to the development of the collaboration-performance relationship. Scholtens and Kleinsmann (2011) find that incentives to encourage supply chain partners to provide information about carbon emissions as well as to adopt reduction technologies differ depending on the geographic location. Lee (2012) suggests that there is a significant relationship between a firm's characteristics, such as size, and its corporate CO_2 strategy. Because firms' individual characteristics (e.g., reduction goals) usually influence the effectiveness of partnerships (Dyer & Hatch, 2004), such findings can have a meaningful impact on the design of a joint CO_2 reduction approach and should be considered in this analysis.

The Relational View

The relational view (RV) forms the theoretical foundation for the present study. Originally, the RV was derived from the resource-based view (RBV), an organization-level theory which defines resources as "all assets, capabilities, organizational processes, firm attributes, information, and knowledge" (Barney, 1991: 101) housed within an organization. More recently, Barney (2012) clarifies that, according to RBV, internally built purchasing and supply chain management capabilities may entail sustained competitive advantages for the firm. Scholars such as Eisenhardt and Martin (2000) argue that due to dynamics in the business environment, competitive advantages can only be maintained when organizations adapt their resources. By integrating supply chain partners, organizations can better respond to shifts in the environment (Teece, Pisano, & Shuen, 1997). Hunt and Davis (2012), in their elaboration of resource-advantage (R-A) theory, point out that supply chain relationships can be conceived of as an intangible resource and hence enable the firm to produce value-enhancing products or services. Such relational resources represent one of seven major categories of resources in R-A theory. Priem and Swink (2012) emphasize that relationship resources established with suppliers and partners enable superior value creation and capture.

The RV, which focuses on the interorganizational level, is one theoretical lens that is well suited to an analysis of CO_2 management in the context of supply chain collaboration. According to Dyer and Singh (1998: 676), "the relational view offers a useful theoretical lens through which researchers can examine and explore value-creating linkages between organizations." Its suitability for examining collaborative structures has been demonstrated by numerous studies (e.g., Cao & Zhang, 2011; Mesquita, Anand, & Brush, 2008; Paulraj, Lado, & Chen, 2008). According to the RV, a collection of several different organizations can obtain mutual benefit by collaborating resources (Duschek, 2004; Dyer & Singh, 1998). Correspondingly, collaboration generates advantages that are not achievable when organizations and partners function independently. Dyer and Singh (1998) identify four potential sources of interorganizational competitive advantages: knowledge sharing, effective governance structures, complementary resources, and relation-specific assets.

In the RV, achievement of these interorganizational competitive advantages is exclusively ascribed to "key subprocesses," respectively relational determinants such as partner-specific absorptive capacity. The RV explains how these determinants influence the generation of effective partnership structures; the influence of an organization's critical resources and characteristics are also taken into account.

Below, we present the determinants relevant for our research, derived from the RV literature and additional sources (e.g., Fawcett, Magnan, & McCarter, 2008b). We disregard any determinants relevant only for existing partnerships, and not for future partnerships, as well as any determinants not influenced by a company's CO_2 management characteristics.

Following Powell, Koput, and Smith-Doerr (1996) and von Hippel (1988), network partners represent the most important source of new ideas and information for innovation. Likewise, knowledge sharing is described by Sheu, Yen, and Chae (2006) as a "key requirement," by Chopra and Meindl (2012) as a "nerve center," and by Min et al. (2005) as an "essential ingredient" of collaborative structures. Learning from a partner through knowledge sharing and thereby improving expertise increases companies' readiness to engage in partnerships. Absorptive capacity, that is, the "ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends," is a critical determinant that influences the result of knowledge-sharing activities (Cohen & Levinthal, 1990: 128). The relevance of incentive alignment and goal congruence is another relevant determinant that is emphasized by a number of studies (e.g., Angeles & Nath, 2001; Cao & Zhang, 2011; Lejeune & Yakova, 2005). Overall, incentive alignment and goal congruence refer to the extent to which an organization achieves its own goals and at the same time satisfies the requirements of the partner. Another important determinant, according to the transaction cost logic inherent in the RV and the conclusions of previous literature reviews (e.g., Hammervoll, 2011), is trust. A partnership will only be pursued when the costs do not exceed the benefits; trust between partners can encourage organizations to engage in partnerships by reducing transaction costs and by reassuring companies that the benefits of knowledge sharing will exceed the costs (e.g., time, coordination). Lack of trust among supply chain partners can thus be a significant implementation barrier to effective supply chain management, especially with respect to investments in relationship-specific resources and knowledge transparency (Fawcett et al., 2008b). Business synergy, "the extent to which supply chain partners combine complementary and related resources" (Cao & Zhang, 2011: 167), has also been shown to be a key factor in producing partnership advantages (Hamel, 1991; Shan, Walker, & Kogut, 1994). Studies suggest that an organization's experience in network management is an essential determinant that influences the outcome of complementary resource combinations and business synergies. The compatibility of organizational systems is also a crucial determinant for the success of collaborations and hence for the readiness of companies to work closely with partners (Chung, Singh, & Lee, 2000). For example, the study of Buono and Bowditch (1989) shows that partnerships failed because partners were not able to use each other's resources. Table 1 summarizes the determinants. Should we expect that sustainability issues fundamentally alter the relational view? An initial response might be that firms view sustainability as a strategic priority to be balanced against other dimensions, for example responsiveness or cost, and hence, the same determinants of relational and collaborative competence, which is key to attain operational and lasting competitive advantages, are at play: effective communication, shared understanding, and shared collaborative values (cf. Schoenherr & Swink, 2012).

In summary, the RV is well suited to explain the formation of effective partnerships and to explore the conditions under which companies engage in partnerships as the overall objective of companies operating in partnerships is to improve their competitiveness. Other theories that might be considered in this context do not examine relational factors in as much detail as the RV. Examples of these less appropriate theories include institutional theory (Jennings & Zandbergen, 1995), the natural resource-based view (Hart, 1995), or the dynamic capabilities view (Teece et al., 1997).

In theory-building research, Miles and Huberman (1994) suggest constructing an initial framework that illustrates the main components to be examined; this approach is followed in the present framework development. The moderating variable *organization characteristics*, which impacts the *determinants of supply chain collaboration*, was included to account for the heterogeneity of the manufacturing organizations as well as their CO_2 management strategies (K. Lee, 2011). Furthermore, this variable was integrated because collaboration studies (e.g., Cao & Zhang, 2011) show that an organization's characteristics as well as strategic priorities significantly influence the relationship between supply chain collaboration and the resulting outcomes and hence the willingness of companies to collaborate. An initial set of CO_2 management characteristics was derived from the literature review and from publicly available sustainability reports from nongovernmental organizations, such as the Carbon Disclosure Project; these characteristics and resources include, for example, CO_2 reduction goals and CO_2 management expertise (Scholtens & Kleinsmann, 2011; Weinhofer & Hoffmann, 2010). The *CCRM factors* were integrated as two pilot case studies suggested that the readiness to partner is influenced by certain CO_2-related factors. The initial framework is graphically depicted in Figure 1.

RESEARCH METHODOLOGY

Research Design

We adopted a multiple case study approach to explore interorganizational CO_2 reduction strategies from the viewpoint of five manufacturers (Barratt, Choi, & Mei, 2011; Yin, 2009). This particular approach is well suited to our purposes for several reasons. For one, case research has a clear advantage over other research techniques, such as surveys, in that it enables direct interaction with subjects—in this case, managers in the FMCG-manufacturing industry (Miles & Huberman, 1994). Case study analysis is also well suited for areas of research that are still in

TABLE 1

Determinants of Effective Supply Chain Collaboration

Determinants	Exemplary Sources in Literature
Absorptive capacity	Dyer and Singh (1998); Cohen and Levinthal (1990); Duschek (2004); Fawcett et al. (2008a, 2008b)
Incentive alignment/ goal congruence	Angeles and Nath (2001); Lejeune and Yakova (2005); Cao and Zhang (2011)
Trust	Sabel (1993); Gulati et al. (2000); Fawcett et al. (2008a, 2008b); Sharfman et al. (2009); Hammervoll (2011)
Experience in network management	Dyer and Singh (1998); Gulati et al. (2000); Duschek (2004)
Compatibility of systems and processes	Buono and Bowditch (1989); Dyer and Singh (1998); Chung et al. (2000)

an exploratory phase, such as ours, because they consider the questions of *why*, *what*, and *how*—questions that can increase our understanding of phenomena that have not yet been examined in a research context, such as the complex links of supply chain-oriented CO_2 management (Meredith, 1998; Voss, Tsikriktsis, & Frohlich, 2002; C.R. Carter, 2011). Finally, with case-based research, it is possible to include multiple data sources, which produces more robust results (Eisenhardt, 1989). We employed a series of approaches to maximize reliability and validity (Gibbert, Ruigrok, & Wicki, 2008). An overview of the measures undertaken for this purpose in the course of our research is presented in Table 2.

Sample Selection

Considering our stated research objective, we chose to employ theoretical sampling consisting of sets of comparable organizations as well as sets of organizations with different characteristics, thereby accounting for heterogeneities such as the level of CO_2 management expertise (Miles & Huberman, 1994; Eisenhardt & Graebner, 2007).

To obtain a sample with a homogenous environment, we focused on a specific range of firms. Geographic location was an important selection criterion, because prior research has shown that external factors such as governmental regulations, legislation, and stakeholder pressure differ among countries, thus influencing the firm's sustainability activity (Zhu, Sarkis, & Geng, 2005; Zhu & Sarkis, 2006; Sarkis, Gonzalez-Torre, & Adenso-Diaz, 2010; Scholtens & Kleinsmann, 2011). Some external factors (e.g., customer expectations and governmental regulations) may differ among countries, thus impacting the comparability of our results (e.g., Zhu et al., 2005; Zhu & Sarkis, 2006). For example, Scholtens and Kleinsmann (2011) show that subcontractors in the Netherlands are mainly driven to report about their CO_2 emissions by regulatory compliance, while British subcontractors are not. Similarly, Weinhofer and Hoffmann's (2010) results indicate that CO_2 strategies differ in the European Union, Japan, and the US. In this context, a study by Habisch, Patelli, Pedrini, and Schwartz (2010) also shows that firms in the US and Germany employ very different approaches to stakeholder dialogue. Similarly, differing environmental legislation and public policies in Germany and the US lead to differences in sustainability initiatives. Thus, we decided to focus on one single country; the present sample only consists of companies headquartered in Germany. Within this initial selection, we further narrowed the sample to include manufacturers that produce two types of representative FMCG products, namely food items and personal/household care

FIGURE 1
Research Framework for Studying Collaborative CO_2 Reduction Management (CCRM)

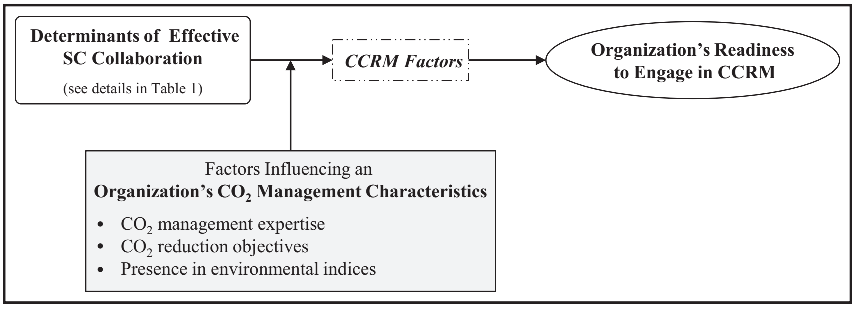

TABLE 2

Validity and Reliability Addressed Throughout the Course of Research[a]

Reliability/Validity Criterion	Research Phase: Design	Research Phase: Case Selection	Research Phase: Data Gathering	Research Phase: Data Analysis
Reliability (demonstrates that the operations of a study can be repeated, with the same results)	Development of case study protocol	Selection based on theoretical sampling	Shared questionnaire for all interviewers; Development and utilization of case study database	Involvement of authors who did not gather data; Coding checks
Internal Validity (establishes a causal relationship, whereby certain conditions are shown to lead to other conditions, as distinguished from spurious relationships)	Theoretical framework (based on RV perspective)	Recording of sampling criteria in case study protocol	Recording of factors that might serve as alternative explanations; Multiple informants; Controlling for social desirability bias	Triangulation of multiple data sources; Pattern matching
Construct Validity (establishes correct operational measures for the concepts being studied)	Adoption of constructs from previous works in the field of carbon dioxide and supply chain management	NA	Multiple sources of information	Interviewees reviewed the draft case report
External Validity (establishes a domain in which the study's findings can be generalized)	Multiple indicators as sampling criteria	Clear description of case firms, contextual factors, and situation	NA	NA

[a]Based on Gibbert et al. (2008); Yin (2009).

products. Within these selection categories, we made a further distinction regarding the brand image of products or companies, as branded FMCG products have additional meaning for end customers in both material and immaterial terms (Riezebos, Kist, & Kootstra, 2003). This differentiation helped to capture the corresponding effects on emissions management strategies.

Another important selection criterion was company resources. As firm size is an exemplary proxy for resources, we included a range of sizes in the sample. Our sample ranged from very small to very large firms and included private as well as public firms. Previous studies suggest that the size of an organization affects the level of environmental management knowledge (Pagell, Yang, Krumwiede, & Sheu, 2004); large firms are in a better position to promote competitive actions and environmental management activities as they have greater human and financial resource availability (Hofer, Cantor, & Dai, 2012; Schumpeter, 1934). The number of plants was taken into account in the selection process as well, as this affects the cost of implementing emissions reduction practices. Overall, the sample includes firms with few plants (fewer than 10), with between 50 and 100 plants, and with a large number of plants (more than 200). The level of CO_2 management expertise was also taken into account in the selection process; it is reflected in a wide spectrum of organizations ranging from unskilled to skilled in this area. To gauge each company's level of expertise in CO_2 management, we rely on sources including sustainability reports, preliminary discussions, commitment to projects such as the Product Carbon Footprint Project (www.pcf-projekt.de), and ratings such as the Down Jones Sustainability Index (www.sustainability-index.com) or Carbon Disclosure Leadership Index (www.cdproject.net/en-us/results/pages/leadership-index.aspx), which track organizations' financial and environmental performance.

Recommendations for the ideal number of cases differ. Following Eisenhardt's (1989) and Voss et al.'s (2002) suggestions, between four and at most seven cases are adequate; other scholars (e.g., Yin, 2009) suggest that data should be collected until saturation is reached, in our case at the fifth case. Examining a sixth case did not provide new relevant information; exemplary studies in supply chain management research support the appropriateness of five cases (e.g., Foerstl, Reuter, Hartmann, & Blome, 2010; Mahapatra, Narasimhan, & Barbieri, 2010). To ensure that the selected case companies are representative of the industry as a whole and appropriate for our research purposes, we sent the sample to GS1 Germany (www.gs1-germany.de) and the Institute for Applied Ecology (www.oeko.de). Both of these organizations confirmed the sample, but recommended that we disregard one particular manufacturer, a large company that produces goods of a lower brand value, as an atypical case. Neither institute noted any negative impacts on the analysis results. A detailed profile of each case company is provided in Table 3. To comply with the condition of anonymity, we assigned fictitious names (e.g., Alpha) to the participating companies and modified company-specific data.

Data Collection

Data were compiled from three sources: (1) semi-structured interviews, (2) write-ups from companies and NGOs, and (3) discussions with experts.

In designing the semi-structured interview program, we used the RV and considered the reviewed literature. Two pilot studies were organized to corroborate our findings; they helped to clarify the results and detect any additions or omissions. We interviewed respondents from a range of managerial levels, including directors of sustainability departments representing the environmental perspective, sustainability agents specifically concerned with topics such as public reporting and effects on product marketing, innovation managers from the sustainability division, and supply chain managers and process improvement managers providing a holistic and more economic view on processes. Purchasing managers were not included in the interviews because these managers did not offer any additional insights during the pretest of the interview program. This is in line with findings of the Carbon Disclosure Project (2012).

The discussions were tape-recorded and later transcribed into written documents. Subsequently, the written reports were sent back to informants, who were asked to verify their correctness (Yin, 2009). All respondents accepted the reports. A total of 14 interviews were conducted, lasting between 1.5 and 2.5 hours.

The inclusion of multiple data types, interviewees, and researchers helped to control for biases. To overcome a potential social desirability bias, that is, interviewees saying what they think we want to hear (Voss et al., 2002), a number of proactive measures were taken: one, interviewees were asked to respond to the questions in writing one week before the meetings and return their answers, which provided us the opportunity to compare the written responses and the corresponding interview data; two, external reports (e.g., from the "Product Carbon Footprint Project") were consulted to ensure objectivity; three, different respondents within the same company were interviewed; and four, critical issues were discussed from different perspectives within the interviews.

To achieve data triangulation, our fieldwork also included analyses of documentary sources from each organization (Kidder & Judd, 1986). Case documents were collected internally and externally. An overview

TABLE 3

Profiles of the Organizations in the Case Sample

Firm	Alpha	Beta	Gamma	Delta	Epsilon
Geographic location of headquarters	Germany	Germany	Germany	Germany	Germany
Basic product portfolio	Personal care, cleaning agent, detergent	Foods	Foods, soft drinks	Personal care, cosmetics	Personal care, cleaning agent, detergent
Size[a]	Very small (0–1)	Small (1–5)	Medium (5–10)	Large (10–50)	Very large (50–100)
Ownership	Private	Private	Private	Public	Public
Number of plant locations worldwide	1–5	5–10	50–100	100–200	200–300
Brand image/ type of supplied retailer	Low/ discounter	Medium/ discounter, nondiscounter	High/ nondiscounter	High/ nondiscounter	High/ nondiscounter
Sustainability expertise and performance[b]	Low	Low–medium	Medium–high	High	Very high
Sustainability report/quantity/ quality[c]	No/–/NA	No (in progress)/–/ NA	Yes/3/NA	Yes/8/high	Yes/11/very high
Participation in sustainable initiatives/ quantity	Yes/2	No/–	Yes/2	Yes/6	Yes/12
Sustainability division	No	Yes	Yes	Yes	Yes
Experience in CO_2 measurement[b,c]	Low–medium	Low	Medium	High	Very high
CO_2 accounting and reporting standard	NA	ISO 14064	NA	Greenhouse Gas Protocol	Greenhouse Gas Protocol
CO_2 measurement level	Corporate level Process level (recently initiated)	Corporate level Process level (recently initiated)	Corporate level Process level Product level (pilot study)	Corporate level Process level Product level (pilot study)	Corporate level Process level Product level (pilot study)
Objective of the CO_2 abatement strategy	Cost savings by lowering Scope 1 emissions	Cost savings by lowering Scope 1 emissions	Cost savings by lowering Scope 1 emissions	Improving the supply chains emissions (Scope 3), cost savings, image	Improving the supply chains emissions (Scope 3), cost savings, image

[a]Size measured as the number of employees worldwide [in 1,000].
[b]Derived from sustainability reports, preliminary discussions, interviews, and documents from NGOs.
[c]Measured on external rankings, ratings, and the level of detail of reported CO_2 emission facts.

of the data sources available at each case company is provided in Table 4. The job positions of the respondents and further characteristics are summarized in Table 5.

Discussions with experts were also conducted to enhance the robustness of our research. One expert from GS1 Germany ("Manager Sustainable Solutions & Processes CPG Industry") and two experts from the Institute for Applied Ecology ("Division Director Environmental Management" and "Associate Director Environmental Management") were consulted. This provided the opportunity to review data collected from the interviews.

A vital piece of information is the nature of relationship between the manufacturing firms and their prospective partners. On the one hand, a pure (sustainability) knowledge transfer might occur as is typically the case in a consulting relationship; on the other hand, selection might be based on product characteristics *and* sustainability knowledge, representing a transfer of knowledge and product. While we did not observe the former, the latter was observed with different priorities: Alpha, Beta, and Gamma sought first and foremost sustainability knowledge transfer, while Delta and Gamma's first priority was on the product, and sustainability performance played a secondary role. This information is summarized in Table 6.

DATA ANALYSIS AND RESULTS

Upon data collection, we proceeded with open coding procedures to structure our information (Voss et al., 2002). The coding was conducted via an incremental and iterative process, thus facilitating the identification and refinement of key categories and related subcategories (Miles & Huberman, 1994). At the beginning of the individual coding procedure, an extensive list of codes emerged from the data. To delimit the number of codes, all codes were systematically reviewed, revealing which codes can be grouped together, that is, determining key categories and subcategories. After each case was individually coded, the results were compared to ensure consistency and to prevent investigator bias. Coding was considered finished when all three authors were aligned with the defined coding scheme. Discrepancies were identified and eliminated in group discussions, thus ensuring inter-rater reliability.

The data analysis itself consisted of two main components: within-case and cross-case analysis (Yin, 2009). We first focused on within-case analysis, which we used to develop individual profiles and become intimately familiar with each of our cases. In line with Miles and Huberman (1994), our within-case analysis consisted of three concurrent flows of activity: (1) data reduction, (2) data display, and (3) drawing conclusions. Our within-case analyses ultimately produced detailed case descriptions for each of the five manufacturers.

Subsequently, cross-case analysis was conducted to compare the findings from each individual case (K.M. Eisenhardt, 1989). To detect similarities and differences across the cases, we applied various tools, such as meta-matrix displays and tabular displays that summarized each of the defined coding categories. This provided us with fresh alternative perspectives and helped us move the data from case-based displays to category-based displays. We furthermore divided the information according to data source to provide additional insight (Bourgeois & Eisenhardt, 1988). Any patterns found in one data source and further supported by results from another source are more robust. When discrepancies were found, on the other hand, we arranged for additional consultation with the corresponding interviewees.

Below, we present the case data analysis process from which the propositions were derived. Findings are supported with representative quotes. An understanding of the following crucial aspects in CCRM is provided: path dependency of partnership selection patterns,

TABLE 4

Overview of the Multiple Data Sources of Evidence for Each Case Company

Firm	Alpha	Beta	Gamma	Delta	Epsilon
Personal/ telephone interviews	x	x	x	x	x
Secondary telephone interviews	x	x	x		x
Annual reports	x	x	x	x	x
Sustainability reports			x	x	x
Presentations	x		x	x	x
Int. process write-ups	x	x	x	x	x
Performance strategies	x	x	x	x	x
Data from company websites	x	x	x	x	x
Conference reports			x	x	x
NGO write-ups				x	x

TABLE 5

Characteristics of the Respondents

Respondent	Firm	Alpha	Beta	Gamma	Delta	Epsilon
1	Function	Director sustainability management	Corporate sustainability manager	Sustainability manager	Head of environmental sustainability and safety	Sustainability manager
	Level	Top management	Middle–top management	Middle management	Middle–top management	Top management
	Years with company	12	10	12	26	16
2	Function	Director supply chain management	Process improvement manager	Supply chain process improvement manager	Supply chain development manager	Sustainability agent
	Level	Top management	Middle management	Middle management	Top management	Assistant of top management
	Years with company	14	6.5	4	13	4.5
3	Function	Innovation manager SC	–	–	Supply chain operator	Global supply chain development manager
	Level	Middle management	–	–	Lower management	Middle management
	Years with company	4.5	–	–	7	8
4	Function	–	–	–	–	Innovation manager of the sustainability department
	Level	–	–	–	–	Middle management
	Years with company	–	–	–	–	9.5

power shifts in the relationship dependent on sustainability-related maturity, and the impact of downstream customer characteristics. In addition, insights on the stages of the CCRM process are obtained.

Path Dependency of Partnership Selection Patterns

In our first proposition, we suggest that the objectives pursued in the CCRM and hence partner selection depend on the manufacturer's maturity with respect to sustainability. A more mature firm is found to emphasize interorganizational CO_2 reduction, while early-stage firms focus on intraorganizational CO_2 reduction approaches. The breadth of the reduction approach can be characterized in terms of emission scopes, of which three types exist, but only Scope 1 and Scope 3 emissions are relevant for our study (Carbon Disclosure Project, 2011). Scope 1 is focused on the company level and includes emissions that result from all activities owned or controlled by an organization itself. Scope 3, which focuses on the supply chain level, contains all emissions that are a

TABLE 6

Type of the Relationship and Exemplary Actions

Firm	Alpha	Beta	Gamma	Delta	Epsilon
Type of the relationship (priorities)	1. Knowledge transfer 2. Product transfer	1. Knowledge transfer 2. Product transfer	1. Knowledge transfer 2. Product transfer	1. Product transfer 2. Knowledge transfer	1. Product transfer 2. Knowledge transfer
Examples for 1st priority type actions	Implementation knowhow related to energy-efficient technologies	Construction of an energy network: use of waste heat of a partner to minimize emissions and energy costs	Reduction of heating costs by improving thermal insulation	Improvement of product compatibility: adaptation of pre- and final products	Transfer of low carbon – footprint packaging materials
Examples for 2nd priority type actions	Modification of waste products for reusability	Impact of switching raw materials on CO_2 footprint and production costs	Certificate requirements for verification of sustainable production methods	Sharing of knowledge associated with carbon measurement techniques	Introduction of a standardized CO_2 accounting standard

consequence of the organization's actions, but cannot be controlled by the company itself (e.g., emissions of supply chain partners). Typically, all emissions that belong to Scope 3 for one company fall within Scope 1 and Scope 2 for another organization. Scope 2 emissions are not taken into account as they are caused by the organization's consumption of electricity and cannot be influenced directly.

Delta and Epsilon can be considered to be mature companies in terms of sustainability by a number of measures: participation in numerous sustainability initiatives (Delta in six, Epsilon in twelve, Alpha and Gamma in two each, and Beta in none); inclusion of both companies in the Carbon Disclosure Leadership Index; and a considerably high level of experience with both process- and product-related measuring activities. The level of detail of their sustainability reports—especially the section concerning carbon dioxide emissions—is also indicative of their expertise. These two manufacturers are contemplating extending their carbon abatement strategy on the supply chain level to exploit reduction potentials—also a reason for their particularly strong interest in our study. This extension of the CO_2 strategy on the supply chain level is analogous to findings reported by Westphal, Gulati, and Shortell (1997). The authors found that first movers—in our study Delta and Epsilon—are more likely to extend their total quality management system than late movers, who are primarily driven by customer pressure. Both Delta and Epsilon are moving beyond their respective boundaries to better meet the requirements of stakeholders. Indeed, the head of environmental sustainability and safety of Delta states: "The next step is to make the supply chain more efficient, because we are already efficient and climate-friendly." In contrast, the late movers, and hence less experienced in CO_2 management, Alpha and Beta are primarily interested in improving their own corporate emissions, reflected, for example, in the statement of Alpha's director of sustainability: "the focus is exclusively on the mitigation of Scope 1 emissions."

Given the scope of both Delta's and Epsilon's emission reduction efforts, both manufacturers seek partners with high potential for lowering CO_2 emissions. The primary reason is that the reduction in major CO_2 sources along the supply chain provides more effective opportunities to pursue the overall goal of emissions reduction compared to the effects of jointly developing and improving a product, which is considered to be less effective and even more costly as it requires a higher degree of interaction. A skilled organization, such as Delta or Epsilon, does not demonstrate readiness to collaborate with an expert partner. The main reason that was observed is that major reduction levers are usually not present in partners that have already optimized their Scope 1 emissions.

Our first proposition is thus:

Proposition 1: CCRM partner selection exhibits path dependency: manufacturers at a more mature stage in terms of sustainability pursue the objective of interorganizational CO_2 reduction and hence select partners with high emission reduction potential. Early-stage manufacturers, by contrast, emphasize intraorganizational CO_2 reduction approaches leading them to partner with suppliers well versed in sustainability.

Relative Power Shifts in the Relationship as a Result of the Manufacturer's Maturity in Sustainability

Mature manufacturers are found to be better able to gauge suppliers' claims and capabilities in terms of CO_2 reduction. In contrast to Alpha, Beta, and Gamma, Delta and Epsilon already measure supply chain emissions (Scope 3), which are more difficult to calculate than a company's own emissions (Scope 1). When collaborating with a company that uses the same carbon accounting standard, the partner's process- and product-related emission values can be used as a reference. According to an executive at Delta, this contributes to the improvement of Scope 3 measuring activities.

In contrast to the other sample organizations, Delta's and Epsilon's readiness to adopt a partner's CO_2 guidelines is extremely low, due to their extensive experience in emissions accounting and reporting. A manager from Epsilon stated: "We provide the know-how; the partner introduces our reporting standard." This statement is indicative of a power shift in the relationship between manufacturer and supplier as the manufacturer attains higher levels of maturity in terms of sustainability. The manufacturer is thus not only in a position to "dictate" the setting within which the reduction efforts are to occur, but also, by forcing the reporting standard on the supplier, to lower the cost of monitoring of that supplier's environmental performance. In addition, the global production network of both companies is another factor. If the company introduced a new standard at only one single plant, it could not conduct company-internal benchmarking with other plants around the world, thus could not calculate a reliable carbon footprint for the entire company, and in turn would be unable to take part in ratings such as the Carbon Disclosure Leadership Index. For early-stage companies such as Alpha and Beta, influencing power with respect to the framing of the collaborative reduction approach is significantly less pronounced. The costs associated with adopting another company's CO_2 accounting standard are regarded as low by Alpha and Beta. A process improvement manager at Beta explains why the implementation of a "new" standard is not considered a burden: "We only have five plants and all of them are located in Germany. First, this is a manageable size. Second, it is not necessary for us to pay attention to different governmental requirements which typically differ among countries." At Gamma, however, the introduction of a partner's standard is considered difficult—despite the fact that no CO_2 accounting standard is in use so far—because Gamma's plants are located worldwide. Consequently, Gamma requires a CO_2 accounting standard that is globally applicable or at least recognized in most countries (e.g., the GHG protocol [www.ghgprotocol.org]). This limits the set of possible partners as power is, similar to Alpha and Beta, lower.

We therefore propose:

Proposition 2: Relative power shifts in the relationship: more mature manufacturers gain greater relative power in their relationships as they are better able to gauge suppliers' claims and capabilities and to leverage already established frameworks.

The Downstream Customer's Characteristics Drive the CCRM Partner Selection

Our final proposition concerns the degree to which competitive priorities of the downstream customers affect the manufacturer's sustainability strategy and hence partnership selection. The major external factors driving manufacturers to increase environmental sustainability are end-customers' present and future expectations as well as the requirements of industry customers, and not primarily governmental regulations. Among the case companies, Alpha and Beta are unique in that they supply discount chains. Alpha and Beta further pointed out that they are restricted in financial and human resources in pursuing their sustainability objectives. As the discount chains' key competitive priority is to offer low prices, the manufacturer is induced to focus on a narrow set of sustainability measures that entail primarily cost savings. Other sustainability measures, where cost savings are not or to a lesser extent to be expected, will be traded off against greater cost efficiency. As a consequence, partner selection in the CCRM process is driven by focusing on suppliers whose capabilities are aligned with this cost saving priority. Alpha's director of sustainability stated: "The overall goal is to enhance our own production processes by learning from more experienced partners, ultimately in order to achieve cost savings."

We thus propose:

Proposition 3: Characteristics of key downstream customers drive CCRM partnership selection. For instance, if the key customers prioritize low price, then the manufacturers focus on a narrow set of sustainability measures emphasizing cost reduction, which favors partners willing to transfer pertinent knowledge.

The following six stages of the CCRM implementation process are proposed based on the case analysis.

Stage 1: Definition of Goals and Initial Assessment of Potential Partners. As indicated in the discussion leading up to Proposition 1, the objectives of the partnership are determined by the manufacturer's maturity in terms of sustainability. Companies that are versed in CO_2 reduction approaches seek interorganizational improvements focusing on Scope 3 emissions and suppliers with high emission reduction potential. Early-stage companies, by contrast, concentrate on Scope 1 emissions emphasizing knowledge transfer from their partners.

Stage 2: Identification of Potential Supply Chain Partners. The second phase consists of narrowing the field of potential partners by evaluating which candidates display the highest potential for successful collaboration.

The informants indicate that participation in environmental initiatives is considered a reliable indicator of which potential partners will generate the greatest partnership value, as this indicates commitment. The sample's behavior can be explained using insights from signaling theory, a perspective that emerged from the study of information economics (Spence, 1974). In this context, an organization's commitment in environmental initiatives is the signal which informs other companies about the organization's incentives, motives, and goals. In response to this signal, such organizations are preferred partners, as this information allows other companies to better estimate the future value of a partnership. Second, this indicates skills in interorganizational communication and collaboration. Third, by engaging in collaborative activities, companies learn how to assimilate received information as well as how to successfully transfer experiences across organizational boundaries. "Emission reductions along supply chains can only be achieved when partners are able to acquire CO_2 knowledge" (Director Supply Chain Management, Alpha).

Stage 3: Interorganizational Communication Building. The third stage of initiating an emissions-reduction partnership is establishing interorganizational communication. Based on interviewee statements, we found that intercompany exchange of data regarding CO_2 sources, volumes, and knowledge is essential for success. All interviewees highlighted the need for a uniform standard to initiate an effective partnership.

For one, the understanding of each partner's measuring techniques is considered to help increase visibility along supply chain processes and to detect CO_2 hot spots. Another reason, emphasized by Delta and Epsilon, is that a joint standard allows participating organizations to follow and monitor a partner's CO_2 performance, define realistic reduction targets based on prior experience, and provide support when the target volume of emissions reduction was not realized. A number of prior studies (e.g., Dyer & Nobeoka, 2000; Dyer & Singh, 1998; Williamson, 1985) have shown that transaction costs are an important factor influencing whether partners participate in collaborative initiatives. Effective communication was highlighted as an essential component to save workforce and thus costs.

Stage 4: Interfacing with Partners. Interfacing with partners is conceptualized as the organization's willingness to adopt another supply chain partner's CO_2 accounting standard. Data incompatibility is considered obstructive to effective cooperation and lowers understanding of a partner's processes and hence also the opportunity to implement appropriate reduction measures.

To date, Alpha and Gamma have not introduced a CO_2 accounting standard. According to executives, both Alpha and Gamma are willing to adopt a partner's CO_2 accounting guideline provided that the partner is an expert in carbon management. Delta and Epsilon, by contrast, have a more powerful position in their relationships derived from the maturity in terms of sustainability which allows them to mandate the standards and frameworks, as discussed in Proposition 2.

Stage 5: Driving the Relationship. Once partners have been identified, interorganizational communication is established, and a common standard is in place, the partners continue to monitor whether the partnership is developing in a beneficial way; this is the fifth stage. Our analysis shows that organizations attach particular importance to input measures such as trust, incentive alignment, innovation potential, and the quality of adaptability to monitor and hence drive the partnership's evolution forward. Output measures including quantitatively measurable factors such as cost savings and CO_2 reduction volumes are not considered to be an indicator of progress within the partnership-formation process. An executive stated: "The formation of a successful partnership needs time to create relationship-specific routines." Another respondent noted, "A suitable relationship base is a necessary condition for creating partnership-value." These findings can be explained by insights from social capital theory, which indicates that relational capital such as interorganizational trust is a crucial component in the generation of effective partnerships and performance improvements; it consequently plays an important role in driving the partnership's evolution (Krause, Handfield, & Tyler, 2007).

Stage 6: Measuring Success. The sixth and final stage consists of analyzing the extent to which the desired goals of a partnership are met and applies only to established and mature partnerships. In this stage, relationship-specific routines, such as interorganizational communication mechanisms and trust building, are usually fully established. We thus assume that performance indicators shift from input- (i.e., qualitative) to output (i.e., quantitative)-oriented measures. None of companies in our sample (and also other companies in industry) have reached this advanced stage of the process, as a supply chain-focused approach to increasing sustainability is relatively new to their company practice. As such, the interviewees were unable to specifically comment on this stage. Future research is required to assess the success of emissions-reducing partnerships.

CONCLUSION

In this paper, we examined the factors that influence a manufacturing organization's readiness to engage in a CCRM approach with a supply chain partner. Using a multiple case-based approach, we elaborated on our empirical findings and developed a set of propositions that provide an understanding of the role of maturity in terms of sustainability, shifts of power as a result of sustainability-related maturity and competitive priorities of the downstream customer. To frame our research, we initially drew on the RV literature and derived determinants that facilitate effective supply chain collaboration. However, during the analysis process, we recognized the need for and benefit of adopting a multitheory perspective (e.g., signaling theory, transaction cost economics, social capital theory), as no one theory is able to explain all aspects of the observed behavior. One issue that has not been dealt with in our study is the fact that most collaboration projects have a finite time horizon; industry evidence suggests that contract (and hence project) durations tend to become shorter thus entailing greater flexibility, whereas sustainability is by its very nature a longer term concept and hence might require longer time frames such that partners fully reap the benefits of collaboration.

The contributions of our article are multifaceted. First, our study provides an overview of the current state of literature on CO_2 management collaboration. Second, the scope of our study is focused on the transition to supply chain-oriented CO_2 reduction. While we address the manufacturer's perspective, it would be worthwhile to adopt a dyadic perspective in line with the RV lens or even a triadic one, including the key downstream customers, which would allow us to further examine value creation in addition to value capture through sustainable supply chain management (cf. Priem & Swink, 2012). This would also enable a stronger bridge between the existing literature of environmental management (e.g., Klassen & McLaughlin, 1996) and strategic management (e.g., Gulati, Nohria, & Zaheer, 2000). Third, our study provides a framework along with a set of propositions on organizations' CO_2 management characteristics, including factors that may influence a company's readiness to adjust to a partner's CO_2 management. The identified CO_2 management characteristics provide a fresh perspective on carbon management strategies. Fourth, CCRM characteristics uncovered in this study have repercussions on quantitative supplier selection methods for environmental collaboration based, for example, on the analytic network process (Theißen & Spinler, 2014).

Our study also has important implications for practice. For one, our study provides practitioners with case data that can be used as a benchmarking tool to better estimate their organization's current position within the market. According to our findings, understanding an organization's own CO_2 management characteristics is essential to determine the requirements for potential partners. Moreover, and based on the previous findings, the results may help organizations limit the set of potential supply chain partners. This is of particular importance as partnerships often fail because they are not well organized (Lambert et al., 1999). Finally, the study may also be valuable for nongovernmental organizations by providing companies with guidelines to design more effective CO_2 strategies by integrating partners.

The present study also suggests interesting directions for future research aside from the aforementioned system-wide analysis. The propositions developed should be tested with a deductive empirical method such as a survey. It would also be interesting to examine CCRM in light of heterogeneous industrial sectors or viewpoints (e.g., suppliers) to further refine the framework illustrated in Figure 1.

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