Ensuring Suppliers' and Sub-Suppliers' Compliance with Corporate Sustainability Standards in Supply Chains

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Für meine Eltern

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List of abbreviations

BSCI	Business Social Compliance Initiative
CSF	Critical success factor
CSR	Corporate social responsibility
CSS	Corporate sustainability standards
DEMATEL	Decision making trial and evaluation laboratory
EICC	Electronic Industry Citizenship Coalition
HP	Hewlett-Packard
ISO	International Organization for Standardization
NGO	Non-governmental organization
OEM	Original equipment manufacturer
P	Proposition
RQ	Research question
SAI	Social Accountability International
SSCM	Sustainable supply chain management
WBCSD	World Business Council for Sustainable Development
WCED	World Commission on Economic Development

Summary

External stakeholders (e.g. non-governmental organizations, media, consumers, etc.) hold firms responsible for any social or environmental misbehavior in the firms' supply chains. Thereby, stakeholders do not differentiate whether misbehaviors occur at the suppliers' or sub-suppliers' sites. Firms are increasingly incorporating their commitment to sustainability into their corporate sustainability standards (CSS) and issuing these as contractual elements (e.g. codes of conduct) to their suppliers. However, they still face the uncertainty of whether the suppliers will comply with the issued CSS and will also pass underlying sustainability requirements to their own suppliers (i.e. firms' sub-suppliers). Outsourcing and globalization trends have increased the length and complexity of supply chains, making it even more challenging to consistently implement CSS and ensure compliance throughout supply chains, including sub-suppliers, up to the raw materials.

Building on four exploratory research studies on ensuring suppliers' and sub-suppliers' compliance with CSS, the research at hand investigates the necessary organizational capabilities, (sub-)supplier management practices, and related critical success factors (CSFs). The research provides further grounding of organizational theories within the field of sustainable supply chain management (SSCM) by applying the theoretical lenses of institutional entrepreneurship theory and the resource-based view (in an eclectic approach), and the theory of critical success factors.

The results indicate five key capabilities that are positively related to the successful implementation of the CSS reflected by suppliers and sub-suppliers' compliance. These capabilities are inter-firm dialogue, risk management, stakeholder collaboration, cross-functional integration, and continuous improvement. Furthermore, the findings outline the feasibility of managing sub-suppliers to ensure their compliance with CSS. Feasible sub-supplier management practices can be distinguished by the two dimensions of assessment and collaboration. The present research highlights the related influential and enabling factors as well as differences compared to traditional supplier management approaches. In addition, it identifies 14 CSFs to the management of sub-suppliers for CSS compliance. These CSFs can be classified into (1) focal firm-related, (2) relationship-related, (3) supply chain partner-related, and (4) context-related CSFs. Finally, an initial structural model highlighting the inter-relationships of CSFs is developed.

Zusammenfassung

Die vorliegende Dissertation beschäftigt sich mit der zentralen Fragestellung, wie fokale Unternehmen sicherstellen können, dass möglichst nicht nur ihre direkten Lieferanten sich an definierte soziale und ökologische Nachhaltigkeitsstandards halten, sondern auch vertraglich ungebundene Unterlieferanten diese Nachhaltigkeitsstandards einhalten. Anhand von vier explorativen Fall- und Feldstudien wurden in diesem Kontext insbesondere organisationale Fähigkeiten, relevante Managementpraktiken und kritische Erfolgsfaktoren erforscht. Eine wesentliche Besonderheit der Dissertation ist es, dass der Untersuchungsfokus nicht auf dyadische Geschäftsbeziehungen beschränkt ist, sondern vielmehr Triaden zwischen fokalen Unternehmen, direkten Lieferanten und indirekten Unterlieferanten untersucht werden. Mittels Fallstudienforschung konnte hierbei die Bedeutung von fünf spezifischen organisationalen Fähigkeiten verdeutlicht (Studie 1) sowie das Konzept des Unterlieferantenmanagements initial umrissen werden (Studie 2). Eine darauf aufbauende Feldstudie identifizierte 14 kritische Erfolgsfaktoren für das Management von Unterlieferanten (Studie 3). Unter Anwendung der DEMATEL-Methode wurde in der Folge ein Kausalmodel entwickelt, welches sowohl die Beziehungen zwischen den Erfolgsfaktoren als auch deren Einfluss auf das Unterlieferantenmanagement illustriert (Studie 4).

1. Introduction

The present research concerns the focal firms' objective to ensure suppliers' and sub-suppliers' compliance with their corporate sustainability standards (CSS) throughout their entire supply chains. Section 1.1 highlights the managerial and theoretical relevance of the research. In relation to the stated managerial and theoretical objectives, section 1.2 presents the resulting research questions. Finally, section 1.3 outlines the structure of the present research, ultimately aiming to answer the aforementioned research questions.

1.1 Relevance of the research on ensuring compliance with corporate sustainability standards in supply chains

Managerial relevance

The term "sustainability" is omnipresent in today's discussions in the fields of politics, business practice, and academia. The industrialization of our economy led to the exploitation of scarce resources and raw materials, and to the recognizable destruction of the environment. Further, globalization has contributed to such negative effects and shifted production to developing countries – often with questionable working conditions (Bansal, 2005; Carter and Easton, 2011; Dyllick and Hockerts, 2002). In light of the world's rising overpopulation, resource scarcity, global climate warming, and natural catastrophes, the focus on "sustainable development" is indispensable. The World Commission on Economic Development (WCED) phrased sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" (WCED, 1987, p. 8). Due to this awareness, firms are increasingly pressured by external stakeholders, such as governmental authorities, non-governmental organizations (NGOs), media, and consumers, to engage in "corporate sustainability" and to extend it to their supply chains (Kudla and Stölzle, 2011; Sarkis et al., 2010).[1]

A growing number of firms are publicly reporting their sustainability activities (Etzion and Ferraro, 2010). In many cases, they even make claims about the environmental or

[1] For a detailed explanation of *corporate sustainability*, see section 2.1.

societal performance of their offerings, thereby communicating their corporate sustainability standards (CSS) (Kolk, 2010). CSS commonly go beyond the minimum standards defined by national law and may simultaneously address social, environmental, and economic dimensions (Kolk and Tulder, 2002; Tulder and Kolk, 2001). CSS seek "to influence behavior so that it is recognizable and reproducible in order to improve the sustainability performance of the organisations to which it is applied. This includes both auditable standards as well as broad guidelines, codes of conduct, charters, investment screening mechanisms and benchmarks" (WBCSD, 2004, p. 4).[2]

While firms toil to improve their own operations to meet their CSS, they frequently struggle to get their supply chain members aligned. Well-known cases highlight the reputational risk that firms face if the public becomes aware of supply chain partners not complying with their CSS (Foerstl et al., 2010; Reuter et al., 2010). For example, Nike was and still is accused of dealing with suppliers that operate sweatshops in developing countries, which has damaged the brand value and sparked consumer boycotts (Locke, Qin, et al., 2007). Thus, to achieve its goal of doing sustainable business and to preserve its credibility and reputation, a firm must ensure[3] a high degree of compliance[4] with CSS by the parties involved in its global supply chain.

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[2] For a detailed explanation of *corporate sustainability standards*, see section 2.3.

[3] The term "ensure" is a central notion within the research at hand, as reflected by the thesis title. In the present context, ensuring thereby comprises all activities, practices, and measures that are initiated by the focal firm to assure suppliers' and sub-suppliers' adherence to the principles, requirements, and criteria that might be anchored within the CSS. Relevant activities, practices, and measures can be found in the literature on sustainable supply chain management (SSCM) and are introduced in the conceptual background of the present research (see sections 2.2–2.5). It should be noted that ensuring "100 percent compliance with CSS" by all supply chain partners is a task that might be only partially achievable, as discussed later.

[4] The term "compliance" commonly refers "to the conformance to a set of laws, regulations, policies or best practices" (Silveira et al., 2010, p. 208). In the corporate context, compliance issues (i.e. non-compliance) can be rooted in various corporate functions and comprise areas such as false accounting, bribery, corruption, or cartel infringement (Grüninger, 2010). For example, the cases of Enron (accounting scandal led to bankruptcy) or Siemens (bribery scandal led to fines exceeding 1 billion US dollars) document the tremendous legal, financial, and reputational consequences of non-compliance (Lichtblau and Dougherty, 2008).

Distinctive to the present research context, these compliance issues are mainly rooted in and under the influence of the focal firms' own organizational boundaries. Therefore, the respective *compliance management measures* include all activities and structures that ensure that the focal firm, its organizational units, and its employees comply with the relevant requirements. These measures affect the internal structures and correspond to the corporate governance of the focal firm (Wieland, 2010): A firm might codify its values and objectives in so-called codes of conduct, which can be transferred into the firm's operational processes by policies, procedures, or working instructions. Compliance management instruments, such as training, whistle blowers, incentives, sanctions, and internal audits (German translation: "interne Revision") subsequently seek to influence the compliance with relevant requirements. To anchor the compliance management measures within the organizational structure, firms might establish a responsible compliance

This is especially the case for firms that rely on their strong brands and reputation (Barnett and King, 2008).

However, maintaining control over suppliers and sub-suppliers to ensure that they comply with the issued CSS requires comprehensive knowledge about supply chain structures and sustainability factors. As trade becomes increasingly global, firms interact in their supply chains with partners worldwide. The large number of supply chain partners as well as the organizational and geographical distance between the firm and its suppliers and between these suppliers and their sub-suppliers restrain the firm from exerting complete control over the supply chain partners' sustainability practices (Choi and Linton, 2011; Roth et al., 2008). For example, a simple 3-tier-staged supply chain with each organization having 100 direct suppliers adds up to a supply chain comprising 1 million organizations. Moreover, many supply chain partners operate in different regulatory contexts. Thus, further threats arise when supply chain partners are located in developing countries, since the local legal standards may not fulfill the firm's requirements with respect to its CSS (Awaysheh and Klassen, 2010; Toffel et al., 2012).

For many firms, this makes compliance costly, time consuming, or even impossible due to a lack of organizational resources (Foerstl et al., 2010; Reuter et al., 2010). Introducing CSS beyond the firm's own boundaries is a particular challenge, as the focal firm might not be able to exercise power over its supply chain partners, and legally independent organizations must be convinced by the firm about the benefit of complying with them (Mena et al., 2013).

The overarching challenges that the focal firm faces to ensure suppliers' and sub-suppliers' compliance with CSS can be summarized and categorized as follows:

1. Low transparency of supply chains due to multi-tier structures (Roth et al., 2008):
   - Large number of involved suppliers and sub-suppliers

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office(r) or committee (Wieland and Grüninger, 2000; Wieland, 2010). As the discourse of the research at hand is continuous, overlaps could be identified between the general conceptual ideas of the aforementioned "internal" compliance management measures and the later discussed approaches concerning external sustainability compliance issues in supply chains. However, past research has not indicated significant opportunities for informing each other (e.g. Brammer et al., 2011; Egels-Zandén, 2007; Jiang, 2009a; Millington, 2008; Oehmena et al., 2010), which might be rooted in largely differing contexts and control influences (e.g. internal vs. external firm boundaries).

- Usually no knowledge about sub-suppliers' identity, since suppliers are often not willing to disclose their own supply base or due to frequent sub-supplier changes
- Regional and cultural distance between the focal firm and its suppliers and/or sub-suppliers

2. Lack of organizational resources and capabilities (i.e. budget, manpower, skills, etc.) to implement appropriate supplier management practices (e.g. supplier audits or supplier development programs) to cover the entire supply chain consistently, including sub-suppliers (Foerstl et al., 2010; Reuter et al., 2010).

3. Limited power over supply chain partners to enforce their sustainability performance in line with requested CSS (Delmas and Montiel, 2009; Jiang, 2009a):

   - CSS compliance not relevant to the supplier, if the supplier's share of turnover with customers is relatively low
   - Limited resources of suppliers to implement the requested changes (low business model fit) (Ciliberti et al., 2008; Perez-Aleman and Sandilands, 2008)
   - No contractual relationship with sub-suppliers or basis for collaboration

Consequently, the objective of the present research is to give business practice further guidance to overcome some of these challenges and to successfully ensure suppliers' and sub-suppliers' compliance with CSS.

Theoretical relevance

The present research is positioned within the field of sustainable supply chain management (SSCM), which commonly concerns the improvement of sustainability performance in supply chains (Carter and Rogers, 2008; Kudla and Stölzle, 2011).[5] Although the literature on SSCM has extensively discussed sustainability challenges in supply chains, three particular aspects to which the present research seeks to contribute can be identified.

[5] For a detailed explanation of *sustainable supply chain management*, see section 2.2.

First, the sustainability and SSCM literature indicates that extensive research has been conducted on the establishment and content of CSS for supply chains (Kolk and Tulder, 2002; Tulder and Kolk, 2001). However, further research is required that examines the subsequent CSS implementation in supply chains and whether supply chain partners do in fact comply with the issued CSS (Egels-Zandén, 2007, 2013; Hoejmose and Adrien-Kirby, 2012; Millington, 2008). In particular, the existing literature concerning compliance issues with CSS in supply chains has mainly focused on direct supplier relationships[6] (Millington, 2008) and neglected to consider *sub-suppliers*[7] beyond the tier-1 supplier level (e.g. Egels-Zandén 2007; Jiang 2009b). By referring to Svensson (2007), Gimenez and Tachizawa (2012, p. 532) acknowledged that "second and n-order supply chains should be considered in order to enhance sustainability, most of the recent literature on supply chain CSR practices has focused on (...) mechanisms which extend CSR practices to [direct] suppliers." Although other literature has highlighted the importance of considering indirect sub-suppliers (Choi and Linton, 2011; Lee, 2008; Millington, 2008; Vermeulen and Ras, 2006), to the best of the author's knowledge, no research has explicitly focused on sustainability issues beyond the tier-1 supplier level or has examined practices that ensure sub-suppliers' compliance with CSS. Therefore, the present research explicitly seeks to focus on ensuring CSS compliance beyond the tier-1 supplier level.[8]

Second, past SSCM research has tended to emphasize environmental challenges in the supply chain: "Numerous authors have explored the linkage between existing best practices in supply chain management and environmental (with almost no coverage of the social component) practices and outcomes" (Pagell and Wu, 2009, p. 38). These findings are further supported by recent literature reviews in the field of SSCM (Hutchins and Sutherland, 2008; Kudla and Stölzle, 2011; Seuring and Mueller, 2008a). Consequently, the present research considers CSS that also covers *environmental and social requirements*.[9]

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[6] For a review of supplier management practices that seek to ensure suppliers' compliance with CSS, see section 2.4.

[7] Synonyms that are used for "sub-supplier" include some of the following terms: sub-contractor, sub-vendor, second-tier supplier, tier-2 supplier, higher tier supplier, etc. Commonly, no contractual direct relationships between the focal firm and its sub-suppliers exist.

[8] For the current state of the research concerning managing sub-suppliers in the field of SSCM, see section 2.5.

[9] For an explanation of the *corporate sustainability standards* that are the focus of the present research, see section 2.3.

Third, a wide body of SSCM literature does not ground or explain its research by applying the perspectives of *organizational theories*, although various researchers have suggested that the research might highly benefit from newly introducing organizational theories to the SSCM context (Brammer et al., 2011; Carter and Easton, 2011; Sarkis et al., 2011). In order to support the findings of the present research as well as to contribute to existing theories, multiple organizational theories are introduced, as outlined in the following.[10]

a) The first exploratory research study adopts the lenses of *institutional entrepreneurship* (IE) theory and the *resource-based view* (RBV) in an eclectic approach. IE theory acknowledges that firms (i.e. institutional entrepreneurs) can implement new institutions and change actors' behavior in line with the established institution; in the present context, this is reflected by the focal firm's objective to achieve supply chain partners' compliance with CSS. Moreover, IE theory is one of the few theories that address actors beyond dyadic business relationships (e.g. sub-suppliers). However, scarce research has introduced IE theory to SSCM or even general supply chain management (Peters, 2010; Peters et al., 2011). Although the resources and capabilities of an institutional entrepreneur are considered to be especially important for achieving the targeted change (Battilana and Leca, 2009; Battilana et al., 2009), little research has systematically examined the capabilities that are particularly important for achieving the final change: "The primary focus of much of this research, however, has been to elaborate the characteristics of, and the conditions that produce, institutional entrepreneurs. Somewhat less evident in the accounts are detailed descriptions of precisely what it is that institutional entrepreneur do" (Lawrence and Suddaby, 2006, p. 220). Consequently, the present research seeks to identify the capabilities that enable focal firms to ensure supply chain partners' compliance with CSS.

b) Whereas the first study aims to advance the existent IE theory, the second exploratory research study starts without a specific theoretical lens in a grounded theory approach and explores an initial concept for managing sub-suppliers to ensure their compliance with CSS. To subsequently increase the validity of the study's findings, the derived research propositions are supported by referring to

[10] For a detailed discussion of the theoretical positioning or the present research, see section 3.

the existing literature on *relational view theory, institutional theory, information theory, and resource-dependence theory*.

c) Finally, the third and fourth exploratory research studies address the unique challenges of ensuring CSS compliance at sub-supplier sites, which has received little attention in the research. Compared to "traditional" supplier management practices, these challenges might exist due to missing contractual relationships with indirect sub-suppliers, no opportunities to directly wield power over sub-suppliers, the voluntariness of suppliers' and sub-suppliers' involvement, little transparency about sub-suppliers' identities, etc. (cf. Choi & Linton 2011). Therefore, the research is positioned within the *theory of critical success factors* and examines the factors that might enable the successful management of sub-suppliers, ultimately addressing the aforementioned challenges and ensuring sub-suppliers' compliance with CSS. Although the theory of critical success factors has proved its applicability in the fields of strategic management and information systems management (Dinter, 2013; Leidecker and Bruno, 1984), it has yet to be applied to the field of SSCM. Consequently, it will be introduced to the SSCM field, highlighting the factor idiosyncrasies that are specific to the present research context.

Figure 1 summarizes the preceding discussion concerning the managerial and theoretical relevance. The described relevance and associated research objectives consequently reflect the basis for the research questions, which are presented in the following section.

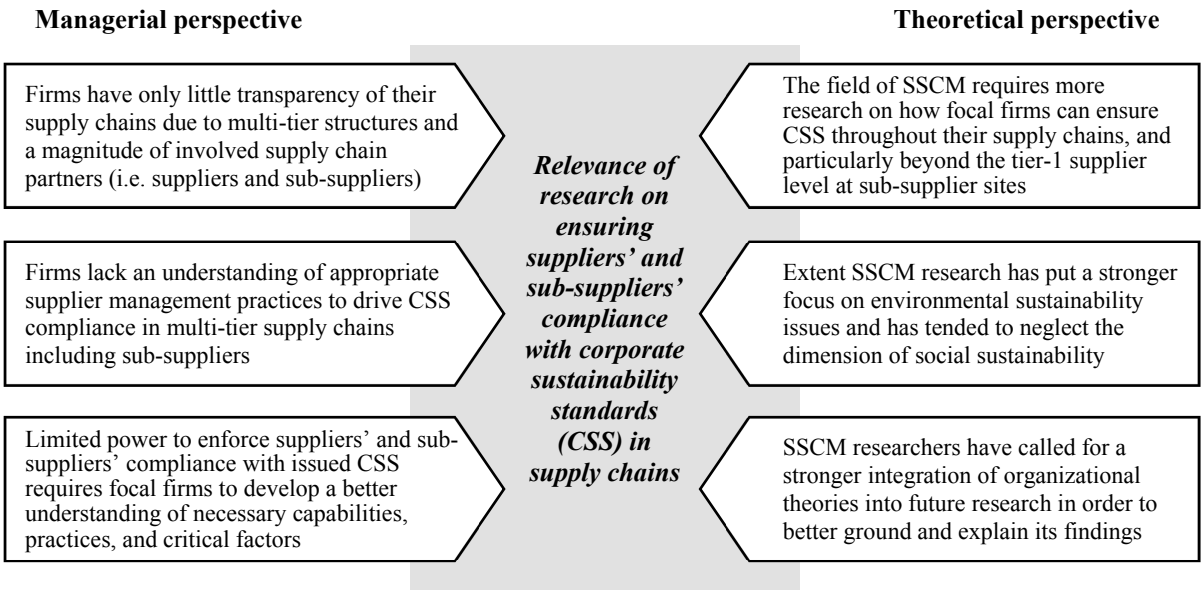

Figure 1. Relevance of research on ensuring compliance with corporate sustainability standards in supply chains

1.2 Research questions

Building on the prior outlined managerial and theoretical relevance, the present research seeks to increase our understanding of successfully ensuring compliance with CSS in multi-tier supply chains. Particularly, indirect sub-suppliers within a firm's endeavor to ensure CSS compliance throughout its entire supply chains are considered. Consequently, the overall guiding research question (RQ) is as follows:

RQ: *How can a focal firm ensure its suppliers' and sub-suppliers' compliance with corporate sustainability standards (CSS) in its supply chains?*

To comprehensively address the guiding research question, in line with the previously outlined research objectives (see section 1.1), five subordinate research questions (RQ1–RQ5) are derived.

The first sub-question (RQ1) relates to the focal firm's endeavor to implement CSS in its supply chain and to subsequently strive for supply chain partners' compliance with the issued CSS. To be successful in such an endeavor, past research has acknowledged that focal firms require organizational "meta-capabilities" that enable more structural resources and necessary supplier management practices (Bowen et al., 2001; Das and Narasimhan, 2000; Lintukangas et al., 2010; Locke, Qin, et al., 2007; Makadok, 2001). Accordingly, an IE theory perspective can be applied to this research context, as IE

theory explains how an *institutional entrepreneur* (i.e. the focal firm) introduces *new institutions* (i.e. CSS) and changes the behaviors of *actors* in the institutional field (i.e. supply chain partners) in accordance with these institutions (DiMaggio, 1988; Powell, 1988). The literature on IE has called for a more systematic identification of the capabilities that enable the full institutionalization of targeted institutions (Battilana and Leca, 2009; Battilana et al., 2009; Lawrence and Suddaby, 2006)—in the present context, this is supply chain partners' compliance with CSS.

RQ1: *What capabilities does a focal firm (i.e. the institutional entrepreneur) require to successfully implement (i.e. institutionalize) previously defined CSS in supply chains and to ensure suppliers' and sub-suppliers' compliance with the CSS?*

The second sub-question (RQ2) exclusively focuses on firms' indirect relationships beyond the tier-1 supplier level. Both business practice and academia acknowledge that firms need to develop the ability to manage such *indirect relationships with sub-suppliers* in order to achieve higher levels of CSS compliance throughout their entire supply chains (Choi and Linton, 2011). Yet few firms indicate profound experiences with managing sub-suppliers (Choi and Linton, 2011; Schaltegger and Harms, 2010; Spence and Bourlakis, 2009; Wolf, 2011). Consequently, RQ2 aims to gain a deeper understanding of feasible "sub-supplier management practices" in the context of SSCM.

RQ2: *Under which circumstances and to what extent do firms manage their sub-suppliers in order to ensure that these sub-suppliers comply with the firms' CSS?*

The third, fourth, and fifth sub-questions (RQ3–RQ5) are closely connected with each other and address the *unique challenges* of managing indirect relationships with sub-suppliers. First, the critical factors that determine the success of managing sub-suppliers in terms of CSS compliance should be explored (RQ3). Hereby, the theory of *critical success factors* highlights how the factors might contribute to a firm's success in managing its sub-suppliers. Second, complex inter-relationships amongst the factors and sub-supplier management practices are expected (RQ4). Third, since the management of sub-suppliers commonly encompasses supply chain partners from

different tiers (i.e. focal firm, direct supplier, and sub-supplier), the different perceptions of these critical factors are examined (RQ5).

RQ3: *What are the critical success factors (CSFs) for the management of sub-suppliers to ensure their compliance with the CSS in supply chains?*

RQ4: *What are the inter-relationships among the identified CSFs and their influence on sub-supplier management?*

RQ5: *What are the different perceptions of various players (i.e. focal firm, supplier, and sub-supplier) in the multi-tier supply chains related to these CSFs?*

In summary, the presented exploratory research questions collectively address how focal firms can ensure suppliers' and sub-suppliers' compliance with CSS by (1) exploring the organizational capabilities that positively contribute to the successful implementation of CSS and ultimately ensure compliance in supply chains, (2) exploring the ability to manage sub-suppliers (i.e. indicating feasible sub-supplier management practices and influential factors), and (3) exploring critical success factors for managing sub-suppliers and determining their inter-relationships. Besides the targeted theoretical contributions, the empirical insight gained could provide guidance for (1) developing important organizational capabilities, (2) establishing appropriate (sub-)supplier management practices, and (3) influencing/investing in critical success factors in order to tackle CSS compliance issues consistently throughout supply chains.

1.3 Outline of the thesis

As illustrated by Figure 2, the present research is divided into five chapters.

Chapter 1 introduces the research topic by outlining the managerial and theoretical relevance, highlighting the targeted contributions, and presenting the derived research questions that should be answered.

Chapter 2 provides the conceptual background for the research phenomena and therefore outlines the state of the literature. First, the underlying understanding of corporate sustainability is provided (section 2.1). This is followed by an outline of how firms might extend the notion of corporate sustainability into their supply chains

through the concept of SSCM (section 2.2). This leads to the presentation of the "vehicles" for this extension, namely, CSS *for supply chains* (section 2.3) and the respective supplier management practices for ensuring compliance with CSS in supply chains (see section 2.4). Finally, the current state of the research concerning management practices that target sub-suppliers' compliance with CSS is highlighted (section 2.5).

Chapter 3 introduces the theoretical perspectives adopted in the present research. Therefore, the chapter reflects on the characteristics of the present research context, discusses the requirements for suitable organizational theories, and consequently presents their selection (section 3.1). The selected theories – *institutional entrepreneurship theory*, the *resource-based view*, and *the theory of critical success factors* – are subsequently presented in more detail (sections 3.2, 3.3, and 3.4, respectively).

Chapter 4 begins by outlining the derived research framework on the basis of the conceptual and theoretical aspects discussed earlier, and provides an overview of the methodology applied in the following exploratory studies on ensuring CSS compliance in supply chains (section 4.1). For each of the four studies, the respective research design is refined and the key findings and contributions are presented (sections 4.2, 4.3, 4.4, and 4.5). The information pertaining to all four studies is included in the appendix.

Chapter 5 provides the overall conclusion by outlining the theoretical (section 5.1) and managerial contributions (section 5.2). Furthermore, the limitations of the present research as well as the future research directions are highlighted (section 5.3).

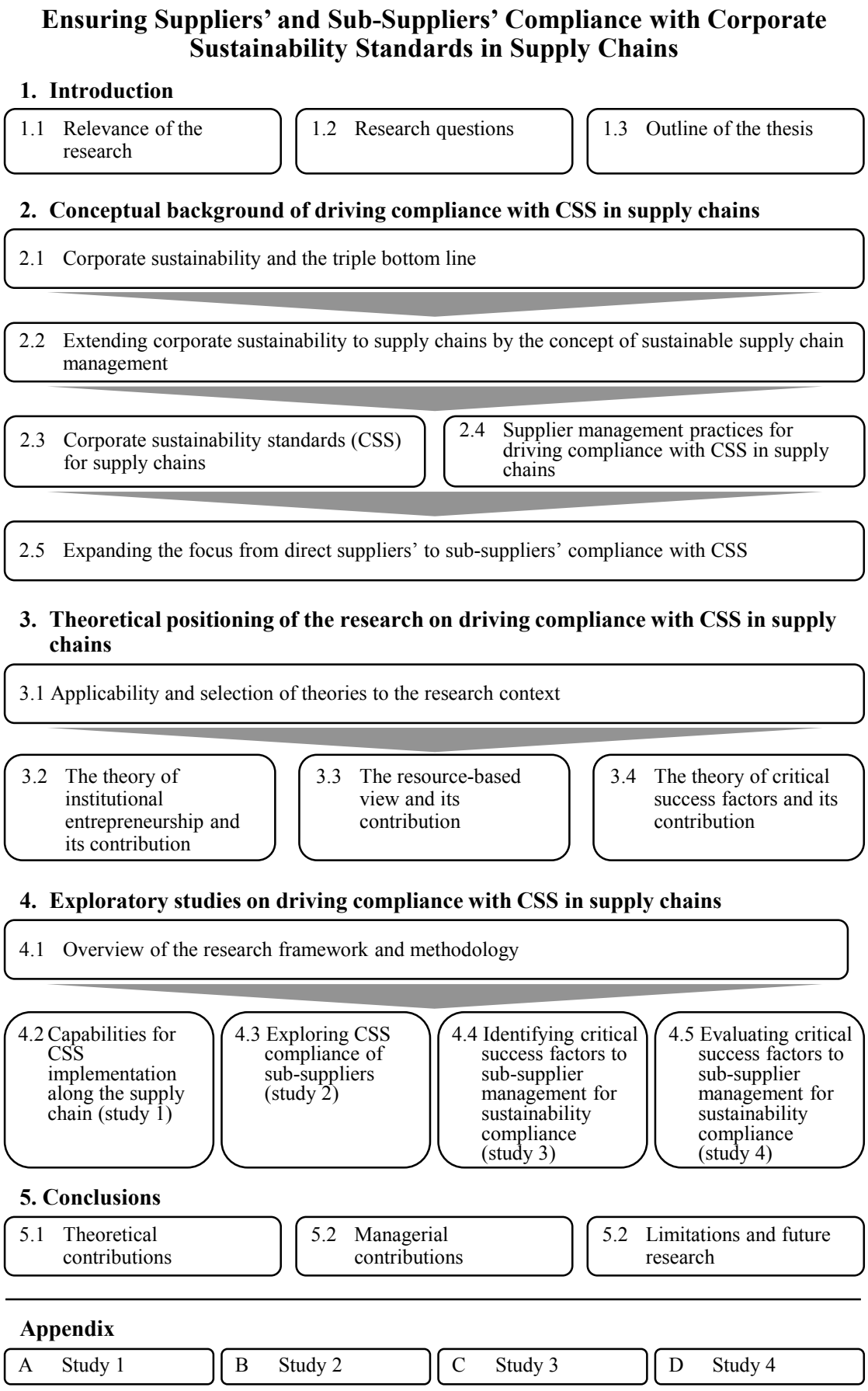

Figure 2. Structure of the thesis

2. Conceptual background of ensuring compliance with corporate sustainability standards in supply chains

The following sections provide the conceptual background of the present research and therefore outline the state of the literature. First, corporate sustainability is defined (section 2.1) and how firms extend the notion of corporate sustainability into their supply chains through the concept of SSCM is discussed (section 2.2). Consequently, the vehicles for this extension are presented, namely, CSS for supply chains (section 2.3) and the respective supplier management practices for ensuring compliance with CSS in supply chains (see section 2.4). Finally, the current state of the research with respect to management practices aiming for sub-suppliers' compliance with CSS is outlined (section 2.5).

2.1 Corporate sustainability and the triple bottom line

Sustainability has become a buzzword in the last decade. Yet different weightings are given to the concept and its underlying motivations. Tracing back, the term "sustainable development" is rooted in the so-called Brundtland Report, "Our Common Future," of the World Commission on Economic Development (WCED) and phrased as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" (WCED, 1987). Although this definition was partially criticized for being "anthropocentric," "indefinite," and "non-guiding" (Starik and Rands, 1995, p. 909), it appears to be the most commonly used reference for defining sustainability. Transferred to business practice, "corporate sustainability can accordingly be defined as meeting the needs of a firm's direct and indirect stakeholders (such as shareholders, employees, clients, pressure groups, communities etc.), without compromising its ability to meet the needs of future stakeholders as well" (Dyllick and Hockerts, 2002, p. 131).

Referring to *corporate sustainability*, the literature indicates a broad range of differing terms, definitions, and foci that exist in academia as well in business practice (Kudla, 2012; Peters, 2010). Some frequently used terms are "(corporate) sustainable development" (e.g. Bansal, 2005; Searcy et al., 2008), "(corporate) social

responsibility" (e.g. Matten and Moon, 2008; McWilliams and Siegel, 2001), or "(corporate) ecological sustainability" (e.g. Shrivastava, 1995; Starik & Rands, 1995). Besides the differing interpretations of sustainability, it is widely acknowledged that sustainability comprises three distinct but often inter-related dimensions: an economic, a social, and an environmental dimension. Elkington (1997) framed these three dimensions as the triple bottom line. Referring to this concept, a firm only operates in a sustainable manner, if it "contributes to sustainable development by delivering simultaneously economic, social, and environmental benefits" (Hart and Milstein, 2003, p. 56). Thus, sustainability lies in the intersection of all three dimensions, as illustrated in Figure 3.

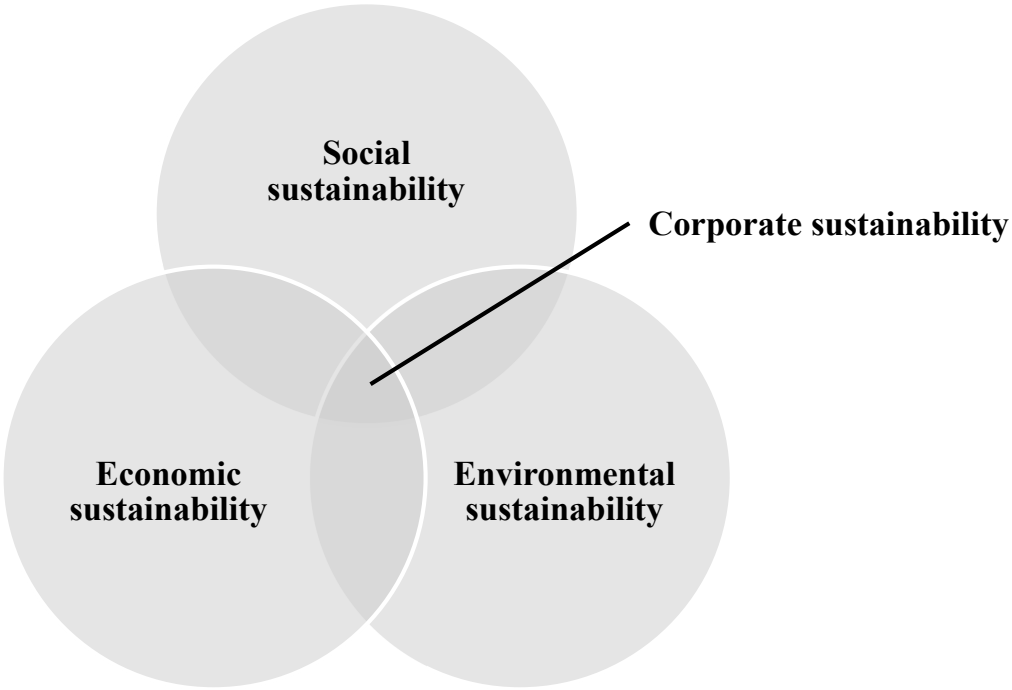

Figure 3. The three dimensions of corporate sustainability (adapted from Bansal, 2005; Dyllick and Hockerts, 2002; Elkington, 1997)

The *social* sustainability dimension considers the impact of corporations on the society and aims for the "equal access to resources and opportunities. (…) Human needs not only include basic needs such as food, clothing, and shelter, but also include a good quality of life such as health care, education, and political freedom" (Bansal, 2005, p. 198). With respect to social sustainability, Dyllick and Hockerts (2002) further distinguished two types of social capital: human capital and societal capital. Whereas the former considers essential factors such as "skills, motivation and loyalty of

employees and business partners" that relate to more directly linked stakeholders, latter covers "the quality of public services, such as a good educational system, infrastructure or a culture supportive of entrepreneurship" from a broader societal perspective (Dyllick and Hockerts, 2002, p. 134).

The *environmental* sustainability dimension concerns the impact of corporations on the environment (Shrivastava, 1995). Thereby, Bansal (2005) focused on the protection of "land," "air," and "water resources" in the focus of environmental sustainability that she framed as "environmental integrity." Starik and Rands (1995) further considered the "carrying capacity" of the environment and stated that organizations' environmentally sustainable activities "would not alter physical, chemical, and biological factors (or political, economic, social or cultural conditions) such that the carrying capacity for otherwise sustainable entities would be dramatically reduced or eliminated" (Starik and Rands, 1995, p. 909). However, the impact on the environment is not only determined by business practices themselves but also by succeeding end consumers and their consumption patterns (Shrivastava, 1995).

Finally, the *economic* dimension reflects the traditional cornerstone of business. To sustain its competitiveness, an organization must create economic value by producing goods or delivering services that generate revenue exceeding the organization's respective costs (Peteraf and Barney, 2003). Thereby, an organization's value creation is interlinked with the customers' perceived value resulting from the benefits they receive by purchasing the product and the accompanying sacrifices (i.e. costs) (Eggert and Ulaga, 2002; Ulaga and Chacour, 2001). Beyond the creation of value, an economically sustainable organization needs to ensure consistent positive cash flows (i.e. liquidity) and satisfactory returns for its shareholders (Dyllick and Hockerts, 2002). From a macro-oriented perspective, an organization's economic sustainability should contribute to increasing living standards and quality (Bansal, 2005).

While an exclusive focus on economic aspects might be beneficial in the short term, it is widely acknowledged that neglecting social and/or environmental aspects does not lead to sustainable development in the long term (Dyllick and Hockerts, 2002; Shrivastava and Hart, 1995). However, Kudla and Stölzle (2011) recently indicated

that organizations tend to either focus on one single dimension of sustainability or take all these dimensions holistically into account.

2.2 Extending corporate sustainability to supply chains by the concept of sustainable supply chain management

The above discussion on sustainability and sustainable development mainly took the perspective of a single firm and focused on its responsibilities within its own organizational boundaries. However, the literature as well as business practice recognize that firms need to expand their sustainability efforts to their entire supply chains (Carter and Rogers, 2008; Sarkis et al., 2010; SustAinability et al., 2008; Vachon and Klassen, 2008): "Companies can do everything possible to improve their environmental and social impacts within their operations, but their absolute measure of sustainable performance depends upon the actions of suppliers, distributors and all other members of their value chains [i.e. supply chains]" (Network for Business Sustainability, 2013, p. 11).

In the following, the scope of supply chains, to which the concept of corporate sustainability will be extended, is outlined. Then the respective "vehicle" for this extension is presented, namely, the concept of *SSCM*.

Scope of supply chains

Mentzer et al. (2001, p. 4) defined the supply chain as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer." Taking the perspective of the firm, the downstream supply chain describes the flow from the firm to the end consumer, whereas the perspective of the upstream supply chain is directed from the firm all the way up to the raw material suppliers. Moreover, the literature indicates a refined typology for supply chain that is determined by the number of, and inter-relational structure of, supply chain members, that is, the scope of supply chains. For example, Essig, Hofmann, and Stölzle (2013) distinguished between (1) the basic supply chain, (2) the extended supply chain, and (3) the ultimate supply chain, as illustrated by Figure 4.

The *basic supply chain* centers on the focal firm and additionally considers a direct supplier and a direct customer, which inter-relate through product, services, information, and financial flows. The *extended supply chain* takes a broad perspective of the basic supply chain by additionally considering the next tier-levels, that is, the supplier's supplier and the customer's customer. Overall, the *ultimate supply chain* takes into consideration all parties involved from the raw material down to the end consumer. Thus, the actual supply chains do not necessarily describe a single, linear chain, but rather are reflected by entire supply networks in which various linkages between supply chain members exist (Essig et al., 2013).

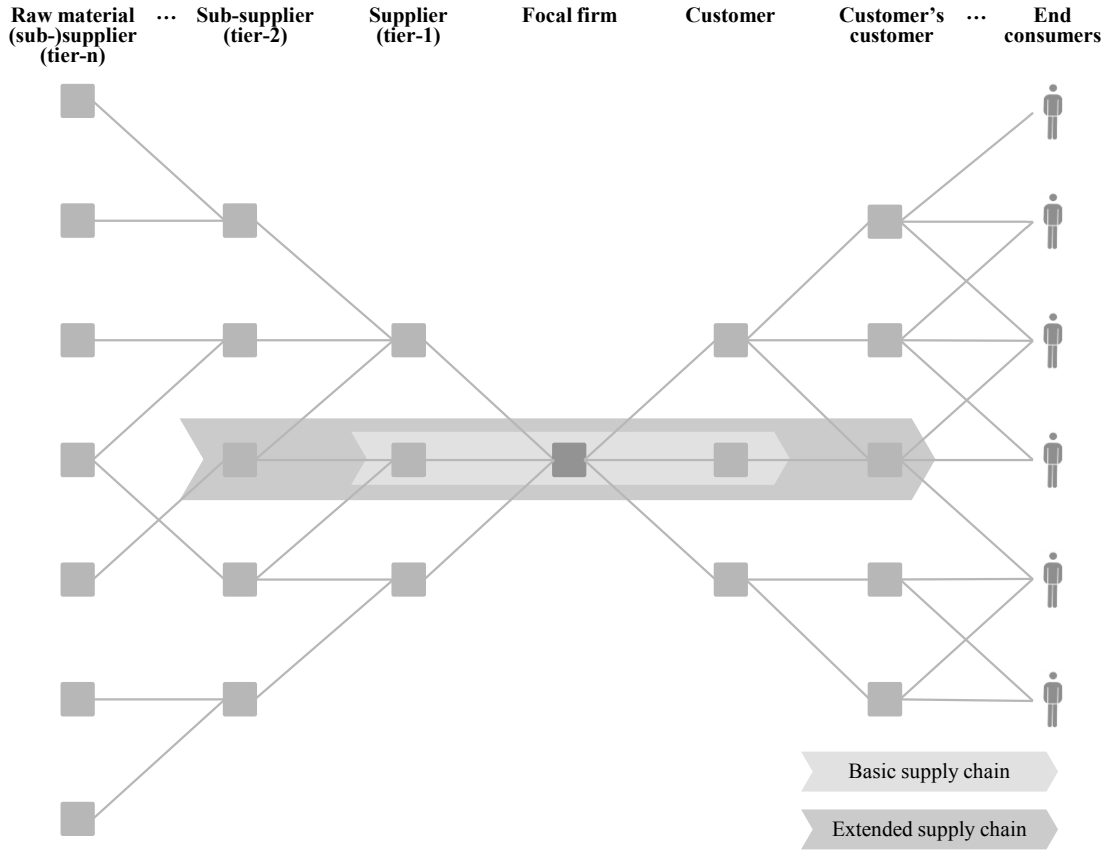

Figure 4. Supply chain typology (adapted from Essig et al., 2013)

As these three supply chain types refer the inter-organizational relationships of the focal firm with external business partners, they can be classified as *external* supply chains. In contrast, the *internal* supply chain of the focal firm describes the "flows of products, services, finances, and/or information" (Mentzer et al., 2001, p. 4) that are within the organizational boundaries of the focal firm (Harland, 1996). Furthermore, Figure 4 indicates how supply chain partners can be distinguished depending on their

level within the (external) supply chain. The direct suppliers of a focal firm are commonly considered as *first-tier* or *tier-1 suppliers* to whom the focal firm maintains direct contractual relationships. The *second-tier* or *tier-2 level* includes the suppliers of the suppliers – all the way up to the raw material suppliers.[11] These indirect suppliers (tier-2 to tier-n), which do not have any contractual relationships with the focal firm, are referred to as *sub-suppliers* in the present research.

Essentially, the present research concerns sustainability challenges (i.e. the implementation of, and compliance with, CSS) throughout the focal firm's ultimate upstream supply chain including all direct suppliers and indirect sub-suppliers. However, due to reasons of complexity, the subsequent exploratory studies can only partially achieve this objective and are somewhat restricted to research settings, which only cover extended upstream supply chains. In fact, firms only know a small portion of their indirect sub-suppliers beyond the tier-1 level, as is discussed later in the exploratory research studies.

Sustainable supply chain management

Shifting the focus back to supply chain sustainability, the literature acknowledges that an organization can only be as sustainable as its supply chains (Krause et al., 2009). A supply chain is considered to be sustainable, if the supply chain – encompassing all corporate supply chain members involved in producing a good and/or delivering a service – shows high performance outcomes along the three dimensions of the triple bottom line (Pagell and Wu, 2009). All managerial practices and activities that intend to achieve sustainable supply chains consequently form the concept of SSCM (Pagell and Wu, 2009; Seuring and Mueller, 2008a). Similarly, Carter and Rogers (2008, p. 368) defined SSCM "as the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains."[12] Thus, SSCM

[11] Note that for the sake of completeness, other literature might align the tier-rankings with the type of delivered goods (e.g. system supplies, component supplies, commodities supplies, raw material supplies) without distinguishing the contractual relationships (Choi and Linton, 2011).

[12] As the definition by Carter and Rogers (2008) indicates the characteristics of "interorganizational business processes," SSCM itself is rooted in the supply chain management field. The latter concerns "the systemic,

describes how organizations actively expend the concept of corporate sustainability from their intra-organizational boundaries into their supply chains (Sarkis, 2012a).

Further terminologies and varying foci can be found in the literature concerning sustainable development in supply chains, as the following terms articulate: [13]

- Green supply chain management (Sarkis, 2003; Srivastava, 2007)
- Green purchasing (Min and Galle, 2001; Rao and Holt, 2005)
- Green logistics (Murphy and Poist, 2003)
- Life-cycle-management (Sánchez et al., 2004)
- Sustainable/responsible sourcing (Pagell et al., 2010; Schneider and Wallenburg, 2012)
- Sustainable supplier management (Foerstl et al., 2010; Reuter et al., 2010)

This thesis closely follows the understanding of the aforementioned definition of Carter and Rogers (2008); however, it further focuses on firms' relationships with upstream supply chain partners (i.e. suppliers and sub-suppliers) and their management from a social and environmental perspective, ultimately seeking to ensure compliance with CSS in supply chains.

The SSCM literature further outlines various motivations as to why firms aim for sustainable supply chains (Brammer et al., 2011, p. 25):

- Responding to stakeholder pressures (e.g. by regulatory authorities, NGOs, media, or consumers) (Delmas and Montiel, 2009; Sarkis et al., 2010)
- Protecting brand and reducing the risks of reputational losses (Foerstl et al., 2010; Reuter et al., 2010)
- Ensuring long-term supply and avoiding supply disruptions (Alvarez et al., 2010)
- Following moral obligation (cf. Hemingway and Maclagan, 2004; Wycherley, 1999)

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strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer et al., 2001). For a detailed introduction to the field of supply chain management, see Essig et al. (2013) and Christopher (2011).

[13] For a discussion on the differing terminologies, see Pagell and Wu (2009) and Bai and Sarkis (2010b).

- Increasing customer retention/satisfaction and attraction (Kogg, 2004; Trowbridge, 2001)
- Improving productivity/efficiency and reducing costs (Ageron et al., 2012; Carter and Dresner, 2001; Walker et al., 2008)
- Gaining market access (Ras and Vermeulen, 2009)

These motivational factors can be assigned to (1) reactive and compliance-oriented or to more (2) proactive sustainable supply chain strategies (Bansal and Roth, 2000; Sharma and Vredenburg, 1998).

First, reactive or compliance-oriented strategies seek to maintain legitimacy by responding to stakeholder demands and fulfilling regulatory requirements. Stakeholders, such as regulators, NGOs, media, and consumers, require firms to take full responsibly for pursuing corporate sustainability throughout their supply chains (Sarkis et al., 2010). If any unsustainable practices are revealed in a supply chain, these might lead to legal consequences (e.g. fines, suspension of deliveries, or product recalls), media campaigns, or consumer boycotts – all ultimately causing the reputational losses of the focal firm and its brand (Locke, Qin, et al., 2007; Wagner et al., 2009). Thus, reactive/compliance-oriented SSCM strategies mainly seek to minimize the risks associated with unwanted supply chain practices (Orsato, 2006, 2009).

Second, proactive strategies go beyond mere compliance and seek to gain competitive advantages by voluntarily exceeding stakeholder requirements. Consequently, the improved sustainability performance in supply chains might enable efficiency gains ("lean and green") or a differentiation amongst competitors (Pagell and Wu, 2009). Furthermore, past research has underlined that organizations might pursue various elements of both strategies simultaneously and a clear distinction cannot always be drawn (Orsato, 2006, 2009).

Although the present research incorporates the term "compliance", it can be linked to both strategic approaches. Regardless of whether a firm merely commits to fulfilling the fundamental regulatory requirements or its commitment proactively exceeds further sustainability criteria, the research at hand concerns how firms can ensure that their supply chain partners adhere to (i.e. comply with) any targeted sustainability commitment.

In line with the two aforementioned strategic approaches and central to the present research, the concept of SSCM commonly comprises two pillars of managerial practices that enable transferring a firm's sustainability commitment to its supply chain (Gimenez and Tachizawa, 2012; Hoejmose and Adrien-Kirby, 2012). Initially, the firm might specify its sustainability requirements by means of corporate sustainability standards and issue those as contractual elements to its supply chain partners. Subsequently, the firm might implement various supplier management practices (e.g. supplier assessment and selection, supplier auditing and monitoring, and supplier development), aiming for supply chain partners' compliance with the issued corporate sustainability standards. Both pillars are detailed in the two following sections 2.3 and 2.4.

2.3 Corporate sustainability standards for supply chains

Organizations increasingly formalize their commitment to sustainable development in the forms of policies, guidelines, or codes of conduct (Hoejmose and Adrien-Kirby, 2012), to which this research refers as *CSS*. CSS can be either directed at the public, the firm's employees, or the supply chain and business partners (Oehmena et al., 2010). The present research will subsequently focus on CSS that focal firms issue to their upstream supply chain partners, that is, to suppliers and indirectly to sub-suppliers.

Although the understanding of corporate sustainability includes three dimensions (see chapter 2.1), such CSS usually concern social and environmental sustainability challenges (Jiang, 2009a, 2009b). Thus, CSS comprise statements that comply with legal regulations and voluntarily include further social and/or environmental requirements, which exceed the aforementioned legal requirements (Bansal and Hunter, 2003; Barnett and King, 2008). Furthermore, firms increasingly incorporate contractual elements in their CSS that require their supplier to pass the CSS on to the supplier's suppliers (i.e. the focal firm's sub-suppliers) (e.g. BSCI, 2011a).

In order to increase legitimacy as well as efficiency, organizations might join established voluntary sustainability initiatives and link their CSS to those initiatives' codes of conduct (Barnett and King, 2008; Carter and Rogers, 2008; Hoejmose and Adrien-Kirby, 2012; Peters et al., 2011). In fact, past research observed the tendency

to adopt established standards instead of defining more isolated and individual CSS (Dolan and Humphrey, 2004). For example, the Swiss Retailer Migros joined the Business Social Compliance Initiative (BSCI) and adopted the BSCI Code of Conduct as its CSS.[14] Voluntary sustainability initiatives, such as the BSCI, underline the fact that social and environmental sustainability issues are omnipresent, as these initiatives comprise large leading brands from various industries, such as the electronic, fashion, food, or retail industry, all of which face similar sustainability issues. Most observed sustainability issues are similar across industries and are partially rooted in cultural contexts or supply chain partners' opportunistic behaviors (Chatterji and Levine, 2006; Schneider and Schwerk, 2010). Addressing these sustainability issues, Table 1 exemplifies the social and environmental criteria of a sample CSS by referring to the aforementioned BSCI Code of Conduct.[15]

Table 1. Sustainability criteria of the Business Social Compliance Initiative Code of Conduct (adapted from BSCI, 2011a, 2013a)

	Sustainability criteria	**Objectives**
1.	Legal Compliance	All applicable laws and regulations, industry minimum standards, ILO and UN Conventions, and any other relevant statutory requirements; whichever requirements are more stringent are adhered to
2.	Freedom of Association and the Right to Collective Bargaining	The freedom of association and the right to collective bargaining are respected
3.	Prohibition of Discrimination	No discrimination is practiced
4.	Compensation	Legal minimum and/or industry standard wages are paid
5.	Working Hours	Working hours are compliant with national laws and do not exceed 48 hours plus 12 hours overtime
6.	Workplace Health and Safety	The workplace is safe and healthy
7.	Prohibition of Child Labor	Child labor is prohibited
8.	Prohibition of Forced and Compulsory Labor and Disciplinary Measures	There is no forced labor and disciplinary measures
9.	Environment and Safety Issues	The environment is respected
10.	Management Systems	There is a policy for social accountability as well as a policy for anti-bribery and anti-corruption

[14] The Business Social Compliance Initiative (BSCI) is a multi-stakeholder initiative that was established to improve social conditions in global supply chains. In line with ILO Conventions, the BSCI defined its own code of conduct that comprises ten criteria as illustrated in Table 1.

[15] It should be noted that within this example, a higher weight is given to social criteria.

The literature provides various reasons why suppliers may not comply with a firm's CSS. First, suppliers might simply not be willing to comply and not see the necessity to do so. Since the suppliers are often smaller or less publicly known, they are less pressured by other stakeholders to comply with any sustainability standards (Hall, 2000). Furthermore, suppliers embedded in different cultural contexts may not perceive the same relevance of the CSS (Awaysheh and Klassen, 2010). Second, suppliers might not be able to comply with CSS due to less developed capabilities and missing resources to take the necessary corrective actions (Ciliberti et al., 2008; Perez-Aleman and Sandilands, 2008). Third, suppliers find it difficult to comply with CSS that are not properly designed (e.g. lacking clear requirements or concrete criteria) or appropriately communicated and introduced by the issuing firm (Peters et al., 2011; Schneider and Schwerk, 2010). Fourth, suppliers could be confronted with a magnitude of different (and potentially conflicting) standards by different stakeholders (Smith, 2008).

Thus, having issued CSS as a contractual element to their suppliers, organizations still face the uncertainty of whether their suppliers will comply with them or hide any social or environmental misbehaviors (Egels-Zandén, 2007; Jiang, 2009a, 2009b; Kolk and Tulder, 2002; Millington, 2008). The next chapter discusses supplier management practices that seek to ensure suppliers' CSS compliance.

2.4 Supplier management practices for ensuring compliance with corporate sustainability standards in supply chains

Buying companies have difficulty identifying social or environmental non-compliance with CSS in their supply chains due to a lack of transparency and the fact that sustainability issues associated with the supplied products, such as sweatshops, child labor, corruption, or carbon emissions, are not directly measureable at the products as compared to product specifications in quality management (Koplin et al., 2007; Locke, Qin, et al., 2007). As the present research concerns the objective of ensuring compliance with CSS in supply chains, it is positioned within the field of SSCM (Carter and Rogers, 2008; Jiang, 2009a). The literature on SSCM outlines *supplier management practices* that increase sustainability in supply chains and contribute to ensuring suppliers' compliance with focal firms' CSS. Although the literature might

employ slightly different terms, the main supplier management practices commonly include (1) *supplier selection*, (2) *supplier communication*, (3) *supplier auditing*, (4) *supplier development*, and (5) *re-auditing* and *supplier monitoring* (Brammer et al., 2011; Gimenez and Tachizawa, 2012; Jiang, 2009a).[16]

Supplier evaluation and selection

In line with the previous discussion on corporate sustainability, organizations increasingly consider social and environmental sustainability criteria – as part of their CSS – when making sourcing decisions (Kudla and Klaas-Wissing, 2012; Schneider and Schwerk, 2010).[17] Thus, bidding suppliers need to provide information concerning these criteria besides any traditional operational and economic offers. This enables the focal firm to evaluate potential suppliers' sustainability performance and select those suppliers that already provide the resources and capabilities to comply with the firm's requested CSS. Within this selection process, social or environmental certifications (e.g. SA8000[18] or ISO14001[19]) can be a signaling mean, indicating the suppliers' current sustainability performance (Delmas and Montiel, 2009). To increase the efficiency of the screening process (i.e. reducing transaction costs and information asymmetry), only those suppliers that previously obtained any social or environmental certification may be short-listed. The underlying rationale of the supplier selection routines imposes the selection of the right suppliers up front and reducing the risk that any hidden social or environmental misbehavior at the supplier sites might be revealed at later phases (Foerstl et al., 2010; Reuter et al., 2010). However, during the selection phase, a firm might not be able to get full proof of a supplier's CSS compliance or even contract suppliers that already possess the necessary resources and capabilities for compliance. Furthermore, economic pressures might have led suppliers to only pretend to comply with CSS (Ciliberti et al., 2008; Perez-Aleman and Sandilands, 2008). In such cases, the following supplier management practices gain even higher importance.

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[16] For a discussion on how these supplier sustainability management practices have their origins in the field of general supply chain management, ultimately improving operational outcomes, see Pagell and Wu (2009).

[17] Further synonyms for the phase in which suppliers are newly contracted include tenders, requests-for-proposals (RFP), or requests-for-quotations (RFQ).

[18] SA8000 is an auditable social sustainability standard based on the conventions of the International Labour Organization, the United Nations, and national laws (SAI, 2012).

[19] ISO14001 specifies requirements for an auditable environmental management system (ISO, 2012).

Supplier communication (CSS introduction)

Despite having issued CSS as a contractual element, suppliers might not see the relevance of implementing CSS or might even fail to understand the content (i.e. requirements and criteria) including the actions necessary to achieve CSS compliance (see section 2.3). The literature stresses the importance of properly introducing the CSS with suppliers, for example, by personnel communication, in order to establish a common understanding and a joint vision, and finally to achieve the suppliers' acceptance (Lund-Thomsen, 2008; Wolf, 2011). Appropriate communication means gaining further importance when cultural distances and language gaps exists between the supply chain partners (Awaysheh and Klassen, 2010; Schneider and Schwerk, 2010). These elements and aspects are closely linked with the supplier development practices discussed below.

Supplier audits

Audits in the context of sustainability are formal routines to evaluate a supplier's performance against defined social and/or environmental criteria. Depending on who processes the audit, the terminology distinguishes between *first party audits* (i.e. self-assessments processed by the supplier itself), *second party audits* (i.e. by the buying firm), and *third party audits* (i.e. by an independent, accredited auditing company) (Darnall and Carmin, 2005). They allow a firm to detect non-compliance with its issued CSS (Foerstl et al., 2010; Reuter et al., 2010). "A typical audit process is composed of: a physical inspection, a documentation inspection, and interviews with workers" (Ciliberti et al., 2008, p. 1580). If an audit reveals non-compliance at a supplier site, supplier development programs can be implemented to remedy deficiencies, as discussed in the next section. More strictly, non-compliance might lead to sanctions or even contract termination with the respective supplier (Ciliberti et al., 2008; Maignan et al., 2002).

As the literature highlights, auditing and monitoring procedures may raise issues in the relationship between the focal firm and audited supplier. Reported issues include reduced trust and commitment (Boyd et al., 2007) and also increased coordination efforts and costs for the supplier (Stigzelius and Mark-Herbert, 2009).[20] Establishing

[20] For an in-depth discussion of the negative effects of supplier auditing and monitoring, see also Heide et al. (2007).

long-term relationships (e.g. through committed sourcing volumes and contracts) and relation-specific investments (e.g. supplier development, see below) by the firm might outweigh these issues (Simpson et al., 2007). Furthermore, there is constant discussion on how accurate and trustful audit results are, since various studies indicate suppliers' deceit in hiding non-compliance as well as poorly executed audits (Locke, Kochan, et al., 2007; Mueller et al., 2009; O'Rourke, 2000, 2003; Welford and Frost, 2006). Making use of unannounced audits, if accepted, could prevent suppliers from hiding their misbehaviors (Egels-Zandén, 2013); making use of accredited auditing companies with high credibility suggest that audits are processed more accurately (O'Rourke, 2003; Teuscher et al., 2006).

Supplier development

Whereas supplier audits generally partially provide a snap shot of the current sustainability performance in supply chains, supplier development programs provide the means for improving the sustainability performance (Pagell and Wu, 2009). Especially smaller suppliers and suppliers located in developing countries (with less strict local regulations) might not have the capacity and capability to comply with the firm's CSS (Awaysheh and Klassen, 2010; Ciliberti et al., 2008). Therefore, supplier development programs seek to close any identified gaps by providing support and developing suppliers' necessary knowledge as *corrective actions* (Vachon and Klassen, 2006, 2008). Potential practices to subsequently improve a supplier's sustainability performance include *training, workshops, transfer of employees*, or even *investment in equipment and infrastructure* (Bai and Sarkis, 2010a; Lu et al., 2012).[21] However, to implement such supplier development programs, the focal firm must provide significant resources. In particular, smaller organizations might not possess these resources and need to set different priorities (Ciliberti et al., 2008).

Re-auditing and continuous supplier monitoring

Re-auditing is a follow-up practice to verifying initial audit results (Foerstl et al., 2010). If the first audit detected non-compliance, a re-audit checks whether corrective actions were successfully executed (either independently by the supplier or with the

[21] For a comprehensive overview and detailed discussion of existing supplier development practices, see Bai and Sarkis (2010a) and Lu et al. (2012).

support of the focal firm's supplier development initiatives). In turn, if the first audit was successfully completed, re-audits have the purpose of reconfirming their results and ensuring that sustainable practices are truly anchored in daily routines and were not "faked" during previous audits. For example, the formal process of the BSCI foresees a re-audit after twelve months, in case of any revealed non-compliance, or after three years, if the audit was completed without detecting anything (BSCI, 2013b). Re-audits further allow "for incremental improvement, and the ability to adapt to and incorporate the constantly changing expectations of various stakeholders" (Foerstl et al., 2010, p. 125).

Since audit results reflect only a snap shot of the conditions at supplier sites at that time, firms need to find further ways to keep track of a supplier's sustainability performance. Thereby, supplier monitoring refers to the more informal type of auditing with the objective of continuously observing and measuring suppliers' performance (Brammer et al., 2011). A continuous supplier monitoring might encompass tangible and intangible input resulting from information technology interfaces, supplier meetings, and other interactions with suppliers (Talluri and Sarkis, 2002).

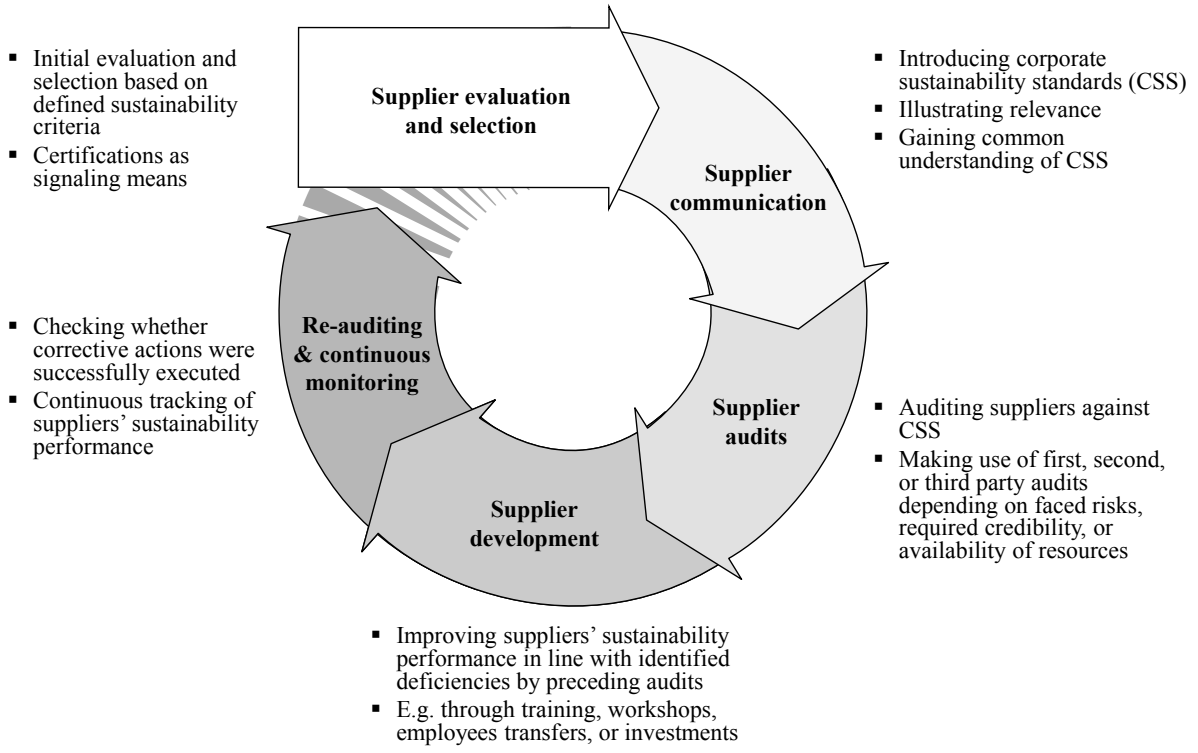

Figure 5. Potential re-occurring sequential process of supplier management practices for ensuring compliance with corporate sustainability standards in supply chains

Figure 5 summarizes the above discussed supplier management practices together with their main characteristics in a potential re-occurring sequence (cf. Brammer et al., 2011). Although the general applicability and efficacy of these practices are widely acknowledged, the SSCM literature highlights that a firm's resources (i.e. budget, time, or manpower) are limited for driving and ensuring full CSS compliance throughout its supply chain. Many firms still have to develop their own resources before they can effectively integrate and execute the aforementioned supplier management practices within their general sourcing and supply chain management approach (Reuter et al., 2010; Wu and Pagell, 2011). Furthermore, the literature highlights that these supplier management practices have been mainly studied within the context of direct supplier relationships with tier-1 suppliers: "managers admit that they find it difficult to do much more than deal with the first tier of suppliers," although they recognize the sustainability issues in the further upstream supply chain (Welford and Frost, 2006, p. 170). More knowledge is required about how to deal with indirect sub-suppliers to whom no direct contractual relationships exist.

Therefore, the subsequent literature review traces back to past research that indicated supplier management practices directed toward sub-suppliers beyond the tier-1 supplier level.

2.5 Expanding the focus from direct suppliers' to sub-suppliers' compliance with corporate sustainability standards

Past cases have demonstrated how the reputation of strong brands, such as Nike, Nestlé, Mattel, or IKEA, suffered due to social and environmental issues at sub-supplier sites (Choi and Linton, 2011; Locke, Qin, et al., 2007; Roosevelt, 2011; The Economist, 2010; Wolf, 2013). In some of those cases, public debates and media campaigns caused strong reputational losses, eventually resulting in declining sales. Recalls of contaminated products, legal proceedings, investor relationship issues, or unfavorable financial ratings reflect further negative consequences. However, approaching sub-suppliers is a new task for many firms and thus their experience in such efforts is limited (Choi and Linton, 2011; Wognum et al., 2002). Practitioners acknowledge that they find it difficult to handle sub-suppliers beyond the tier-1 supplier level. Complexity, low transparency, new contexts, and limited resources are

common examples used to describe these difficulties (Welford and Frost, 2006). The following provides an overview of the current knowledge of how and in what context firms approach their sub-suppliers.[22]

A recent survey of publicly traded German corporations indicated that only a small portion of those firms (less than 15%) directly consider the sustainability performance of sub-suppliers (Schaltegger and Harms, 2010). Often, this consideration is limited to formal proof by means of signed CSS or the availability of sustainability certifications (e.g. ISO14001 or SA8000).

Yet, if at all, many firms still rely on their direct suppliers to ensure the CSS implementation at sub-supplier sites in the further upstream supply chain. Firms that are concerned about sustainability tend to motivate or even pressure their tier-1 suppliers to pass on their issued CSS (Lee and Klassen, 2008) or try to select only those direct suppliers that have appropriate supplier management programs to control their own suppliers (i.e. focal firms' sub-suppliers) (Schneider and Schwerk, 2010; Spence and Bourlakis, 2009). Similarly, past research findings have underlined that an organization that has adopted certain certifications also tends to pass on similar sustainability requirements within its own supply chain (Gonzalez et al., 2008). Some certifications, such as the social standard SA8000, even formally require SA8000-certified organizations to select their supply chain partners on the basis of the underlying principles and requirements, enabling a "cascading strategy" of social sustainable practices in multi-tier supply chains (Ciliberti et al., 2009). Consequently, selecting SA8000-certified tier-1 suppliers can be an indirect approach to managing the social compliance of sub-suppliers. However, there is no proof of the efficacy of such an approach (Ciliberti et al., 2009). Choi and Linton (2011, p. 113) accentuated that "a heavy reliance on first-tier suppliers is dangerous for OEMs [focal firms] (…) and makes it difficult to ensure that their [sub-]suppliers are operating in a socially and environmentally sustainable fashion."

Voluntary sustainability initiatives and strong partnerships that comprise the stakeholders of all supply chain tiers could be an appropriate means for enabling closer collaborations and increasing the level of compliance with CSS throughout entire

[22] For a more detailed discussion on the current state of approaching sub-suppliers within the field of SSCM, see the background and literature review of *study 2* (Appendix B).

supply chains including sub-suppliers (Peters et al., 2011; Teuscher et al., 2006). However, the literature describing direct interactions with sub-suppliers is very limited. It is recognized that supply chain mapping, when completed effectively, is a first step toward identifying each entity at each supply chain level that is involved in the manufacturing of the final product. Such mapping can help firms acquire data on each partner in the supply chain, from which audits can be completed to evaluate the sustainability performance and particularly the compliance with CSS (Boyd et al., 2007). Recent research describes cases where focal firms explicitly requested information about the sustainability factors (e.g. carbon emissions) applied to all members along a multi-tier supply chain. However, the interactions between the focal firm and respective sub-suppliers, besides those for information gathering, were limited (Wolf, 2011).

Overall, little research has examined the interactions or relationships between firms and their sub-suppliers within the sustainability context. Although other supply chain management fields have a long tradition of considering multi-tier (or multi-echelon) supply chains related to production, inventory, or distribution dynamics, they have mainly focused on modeling and simulation approaches and not on describing "a 'hands-on' approach or direct management by the buying firm" (Gimenez and Tachizawa, 2012, p. 533) for effectively managing sub-suppliers (Mena et al., 2013). A comprehensive concept of, or approach for, managing sub-suppliers has yet to be developed (cf. Choi and Linton, 2011; Choi and Wu, 2009; Lee, 2008; Mena et al., 2013; Millington, 2008). Moreover, although many firms still rely on their tier-1 suppliers to manage the sub-suppliers (Gonzalez et al., 2008; Lee and Klassen, 2008; Spence and Bourlakis, 2009), various stakeholder pressures will increasingly require those firms to directly manage the sub-suppliers in the context of sustainability (Choi and Linton, 2011; Mena et al., 2013).

3. Theoretical positioning of the research on ensuring compliance with corporate sustainability standards in supply chains

The following sections introduce the theoretical lenses employed within the research at hand. Section 3.1 reflects on the characteristics of the present research context, establishes the requirements for suitable organizational theories, and discusses their respective selection. The selected theories are subsequently presented in sections 3.2, 3.3, and 3.4.

3.1 Applicability and selection of theories to the research context

Organizational theories can be defined "as a management insight that can help explain or describe organizational behaviors, designs, or structures" (Sarkis et al., 2011, p. 2). The present research context is characterized by the firm's objective to ensure suppliers' and sub-suppliers' compliance with CSS. Thus, the focal firm not only tries to directly influence the contracted supply chain partners but might extend its interactions to indirect sub-suppliers. Accordingly, the present research seeks to integrate the theoretical lenses that contribute to explaining the practices and outcomes in inter-organizational business settings beyond dyadic relationships and toward triadic relationships—in simplified cases consisting of the focal firm, a direct supplier, and a sub-supplier. In such a triad, no contractual direct relationship between the focal firm and the targeted sub-supplier exists. The requirements for applicable organizational theories are summarized for the present research context as follows:

- An applicable theory provides a theoretical framework that acknowledges and explains how firms can change supply chain partners' practices in accordance with the requested CSS.
- An applicable theory is not restricted to dyadic relationships.
- An applicable theory explains additional key factors that positively contribute to the firm's objective of changing practices.

Analyzing well-established organizational theories highlights a major shortcoming with respect to their applicability to the present research phenomena, as they mainly provide explanations for behaviors and outcomes in dyadic relationships (Mena et al.,

2013).[23] As an exception, *institutional theory* can be identified as a promising avenue due to its broader focus on *institutional fields*, whereas multi-tiered supply chains can be considered as a part of such institutional fields (Hamprecht, 2006; Peters et al., 2011). Especially within the sustainability context, institutional theory is a dominant theory that "has been widely used to analyse and explain corporate responses to environmental and social issues" (Hahn et al., 2010, p. 221). Institutional theory not only concerns how organizations are influenced by external pressures, but also describes how organizations influence others (DiMaggio and Powell, 1983). Concerning the latter aspect and evolving out of institutional theory, the stream of *institutional entrepreneurship* (IE) theory is particularly considered, as it explains how institutional entrepreneurs introduce *new institutions* and change behaviors in accordance with these institutions (DiMaggio, 1988; Powell, 1988). An appropriate fit is reflected by the linkage that can be drawn between "corporate sustainability standards" and "institutions," which are considered as rules, norms, or values that constrain and guide actors' behavior within the institutional field (Hargrave and Van De Ven, 2006; Lawrence and Suddaby, 2006).

Building on IE theory and its explanations to change actors' behavior within the institutional field (in accordance with defined institutions), the present research particularly strives to identify the capabilities of a focal firm (i.e. institutional entrepreneur) that are necessary to achieve this change (i.e. suppliers' and sub-suppliers' compliance with CSS).[24] As a framework for identifying "important and effective" capabilities, the research at hand draws on the *resource-based view* (RBV). The RBV literature pinpoints the capabilities that have proved successful for strategy implementation and achieving a competitive advantage (Barney, 1991).[25]

As the present research progresses, the ability to manage sub-suppliers for CSS compliance becomes apparent and will be explored and framed as a distinctive concept.[26] Compared to "traditional" supplier management (of direct suppliers), the sub-supplier context reveals unique challenges that need to be addressed by the focal

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[23] For a broad overview of the applied organizational theories in the SSCM field, see Sarkis et al. (2011) and Kudla (2012). Furthermore, Stölzle (1999) provides a comprehensive discussion of theories' contributions to explain industrial relationship patterns between firms and their (direct) suppliers.

[24] For the discussion concerning the related research gap and respective research question, see section 1.2.

[25] For the application of IE theory and RBV, see the first exploratory study in section 4.2.

[26] For more details, see the second exploratory study in section 4.3.

firm in order to successfully achieve the sub-suppliers' compliance. Thus, a critical factor lens is adopted to comprehensively identify and evaluate these challenges. The present research consequently draws on the *theory of critical success factors* (Daniel, 1961; Dinter, 2013; Rockart, 1979) to highlight and explain how firms might establish structures with specific resources by which the supply chain is effectively approached.[27]

After providing a brief overview of the selection process for the applied organizational theory, the aforementioned organizational theories and their contributions are outlined in more detail.

3.2 The theory of institutional entrepreneurship and its contribution

IE is rooted in institutional theory (DiMaggio, 1988; Powell, 1988), which addresses how organizations maintain legitimacy and their position within the organizational field (Scott, 2007). Institutions refer to schemes, norms, or formal sets of rules, and the members of the institutional field are expected to comply with these (Greenwood et al., 2008). Institutions' stability is commonly explained by "cultural-cognitive, normative, and regulative elements" (Scott, 2001, p. 48) that influence (or constrain) actions and behavior and lead to isomorphism. However, researchers have criticized the static view within the institutional theory, tending to focus on the persistence and the homogeneity of institutions. Institutional change has been predominantly explained by exogenous "shocks," thereby neglecting endogenous factors as explanations (Dacin et al., 2002). Building on institutional theory, the concept of IE consequently stresses the role of actors as key drivers for institutional change (DiMaggio, 1988; Powell, 1988).

Institutional entrepreneurs are actors following strategies that "include actions that influence legislative or regulatory frameworks, affect cultural norms or values, or establish some structures or processes as taken-for-granted" (Lawrence, 1999, p. 168). Both organizations and individuals can act as institutional entrepreneurs (Lawrence, 1999). Thus, two aspects are commonly reported that qualify an institutional entrepreneur: (1) the initiation of change to "break with the institutionalized template

[27] For the application of the critical success factor theory, see the third and fourth exploratory study in sections 4.4 and 4.5, respectively.

for organizing within a given institutional context" and (2) the active participation in the change process for which the institutional entrepreneur must "actively mobilize resources to implement change" (Battilana et al., 2009, pp. 68–69).

The types of institutions can be classified into practices, standards, and policies (Pacheco et al., 2010), whereas an institutional entrepreneur's motivation to change or newly create those institutions may result from functional, economic, political, or social factors (Oliver, 1992). For example, organizations share common non-physical resources, such as reputation. Scholars have argued that a "firm's error can harm other firms in its industry and thus cause all firms in the industry to share a pooled risk" of losing reputation and legitimacy (Barnett and King, 2008, p. 1150). In order to overcome this risk, it can be observed that firms (i.e. institutional entrepreneurs) create institutions that constrain harmful business practices with governing rules and standards (Ostrom, 1990; Prakash and Potoski, 2006). In the present research context, these institutions are frequently represented by the formal definition of CSS (Berchicci and King, 2007). The institutional entrepreneur (i.e. focal firm) seeks to break with business practices in its supply chain, which it considers as unsustainable (e.g. health and safety conditions or child labor). Therefore, the institutional entrepreneur establishes CSS and issues those to its supply chain partners. However, according to Lawrence et al. (2002, p. 283), the CSS must become a "full-fledged" implemented institution with "structures or processes as taken-for-granted" (Lawrence, 1999, p. 168) that is reflected by value chain partners' compliance with the CSS. To ensure this compliance, the institutional entrepreneur may develop its own capabilities and processes for supplier management practices to change supply chain partners' behavior in accordance with the previously issued CSS (Grimm et al., 2011; Peters, 2010).

The process followed by institutional entrepreneurs can be described by three generic phases (cf. Hargrave and Van De Ven, 2006; Peters, 2010) and projected to the present research context (see Figure 6). In the *emergence phase*, the institutional entrepreneur recognizes the need to break with certain practices within its institutional field (Battilana, 2006) and engages in framing its proposed approach to make it comprehensible for others. Subsequently, the institutional entrepreneur undertakes activities to "gain others' support for and acceptance of new routines" (Battilana et al., 2009). A new institution might be formally established at the end of the phase, for example, CSS with the objective of influencing social and environmental factors in

supply chains. Finally, this institution is considered to be *institutionalized*, if its underlying norms, rules, and routines are accepted by the institutional field (Matten and Moon, 2008), which is reflected by the compliant behavior of the affected field members, such as supply chain partners (Peters, 2010).

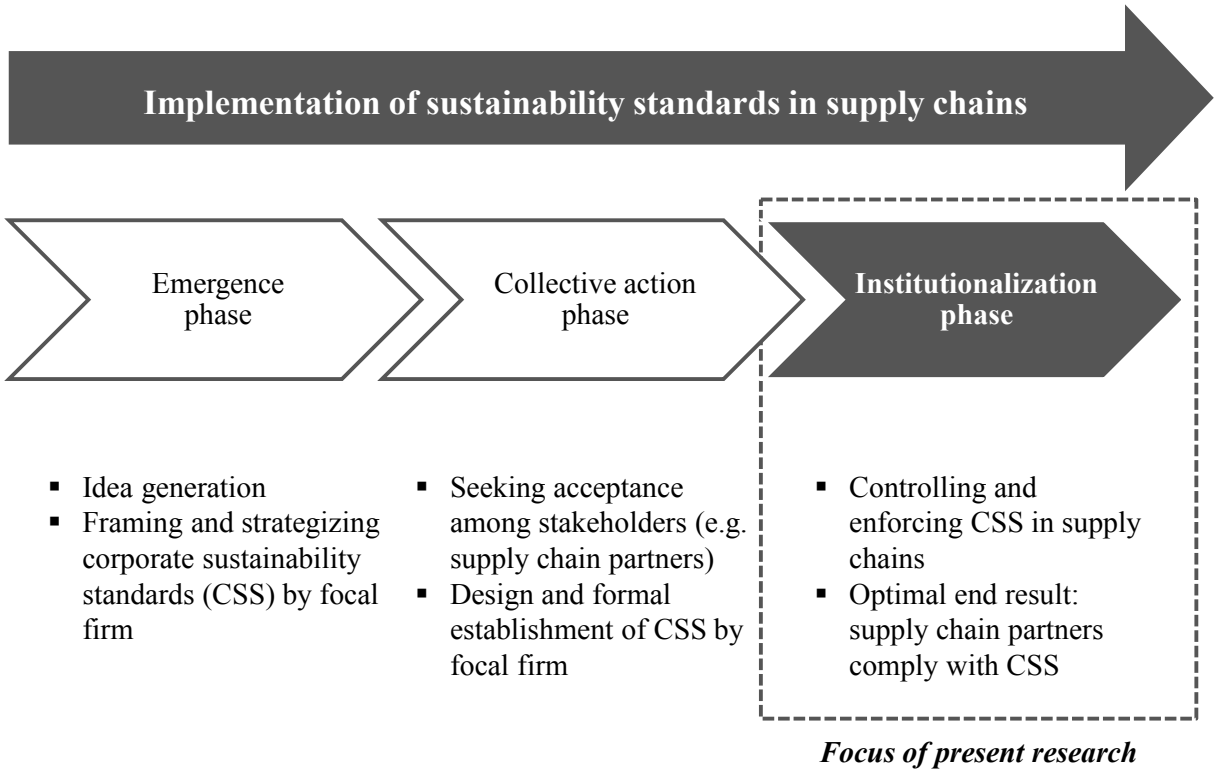

Figure 6. Institutional entrepreneurship phases specific to the research context

Past IE research focused more sharply on the first two phases (i.e. emergence and creation of new institutions) than on the maintenance of institutional fields after having established new institutions (Wijen and Ansari, 2007). However, maintaining full institutionalization is crucial for long-term institutional survival. Consistent with the present research context, the literature on IE suggests enforcement, auditing, and monitoring practices to achieve the change and to ensure other actors' compliance with the newly established institutions (Guler et al., 2002; Lawrence and Suddaby, 2006). Yet explanations as to why change occurs in some cases but not in others must be further explored (Battilana et al., 2009). IE resources and capabilities are expected to be essential to overcome any reluctance within the institutional field (Battilana and Leca, 2009; Dacin et al., 2002; Lawrence, 1999; Peters et al., 2011). However, the systematic examination of resources and capabilities that an institutional entrepreneur requires for a successful endeavor tends to be described on a generic level (Battilana and Leca, 2009; Battilana et al., 2009; Lawrence and Suddaby, 2006). For example,

identified "financial resources and resources related to (…) formal authority and social capital" (Battilana et al., 2009, p. 83) pinpoint important factors, but they contribute little to the research at hand, that is, the successful implementation of CSS in multi-tier supply chains.[28]

More closely related to the present research context, Peters, Hofstetter, and Hoffmann (2011) and Peters (2010) recently examined which organizational capabilities are specifically needed to efficiently develop voluntary sustainability initiatives for supply chains. However, from a process perspective, these considerations come to an end with the formal definition of CSS and cover mainly the first phases of an institutional entrepreneur's endeavor, namely, the emergence and collective action plan phases (Hargrave and Van De Ven, 2006; Peters et al., 2011). Yet after having formally established a voluntary sustainability initiative including the definition of CSS, it remains unclear what further capabilities are required to control CSS in terms of the supply chain partners' compliance.

Although the research has provided insight about relevant supplier management practices, such as supplier evaluation and development (see section 2.4), which could be framed as "IE capabilities" (cf. Guler et al., 2002; Lawrence and Suddaby, 2006), such capabilities still require further examination in the context of sustainability (Foerstl et al., 2010; Reuter et al., 2010), and more research that extends beyond the tier-1 supplier level and considers further levels of indirect relationships (see section 2.5). Moreover, the literature suggests that such supplier management practices require organizational meta-level capabilities to successfully process the more formal and structural routines of the supplier management practices (Bowen et al., 2001; Das and Narasimhan, 2000; Lintukangas et al., 2010; Locke, Qin, et al., 2007; Makadok, 2001).

In summary, the IE theory contributes to the present research context by acknowledging that a firm's resources and capabilities play a critical role in achieving change (i.e. CSS compliance) throughout entire supply chains beyond dyadic relationships. In turn, the research at hand seeks to contribute to the literature on IE by identifying the capabilities that are necessary for institutional entrepreneurs aiming to successfully implement "new" institutions in supply chains, ultimately influencing behaviors in supply chains, reflected by supply chain partners' compliance with these

[28] For an extensive discussion of IE capabilities, see Peters (2010).

institutions (i.e. CSS). This contribution is especially pursued in the first exploratory research study (see section 4.2).

3.3 The resource-based view and its contribution

The RBV explains how the specific resources of a firm contribute to the firm's achievement of a competitive advantage (Barney, 1991; Peteraf, 1993).[29] These resources may "include all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm" (Barney, 1991, p. 101), whereas the present research predominantly focuses on and makes use of the term "capability."[30]

To enable competitive advantage, capabilities must fulfill four characteristics: (1) valuable, (2) rare, (3) imperfectly imitable, and (4) non-substitutable (Barney, 1991).[31] *Valuable* capabilities allow the "firm to conceive of or implement strategies that improve its efficiency and effectiveness" by exploiting opportunities and neutralizing "threats in a firm's environment" (Barney, 1991, p. 106). *Rare* capabilities imply that no (or at least few) other organizations possess the same capabilities that might erode the firm's advantage. Capabilities that are difficult to *imitate* cannot be easily developed by other organizations to achieve similar competitive positions. Finally, *non-substitutability* is given if there are "no strategically equivalent valuable resources [capabilities] that are themselves either not rare or imitable" (Barney, 1991, p. 111).

Having outlined the RBV model, it is evident that it can provide an appropriate means for systematically exploring the capabilities that an institutional entrepreneur needs for successfully implementing new institutions. In the context of IE theory, the capability *value* indicates the efficiency and effectiveness of a capability to ensure the targeted institutional change (Peters, 2010; Peters et al., 2011). In line with the original RBV model, necessary IE capabilities must simultaneously be rare, difficult to imitate, and difficult to be substituted in order to preclude other organizations from pursuing

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[29] Thereby, the RBV takes an internal view of the firm to explain competitive advantage compared to more externally oriented frameworks, such as Porter's five forces model (Porter, 1980, 1985), describing the characteristics of beneficial industry settings (Barney, 1991).

[30] The terms "resources" and "capabilities" are often synonymously used. Although the two concepts are closely intertwined, a distinction between resources and capabilities can be described as a firm's (latent) capabilities that facilitate the utilization of the firm's (more observable) resources (Grant, 1991; Makadok, 2001).

[31] For a detailed discussion of these required attributes, see the original work of Barney (1991).

competing strategies (Barney, 1991), that is, more specifically, precluding other organizations acting as institutional entrepreneurs from driving institutional change in an undesired direction (Peters, 2010; Peters et al., 2011).

The full institutionalization of new institutions usually requires collective action on the part of various organizations besides the actual institutional entrepreneur (Hargrave and Van De Ven, 2006). Thus, in addition to *internal capabilities*, necessary IE capabilities "may span firm boundaries and may be embedded in interfirm resources and routines," leading to a *rational view* (Dyer and Singh, 1998, p. 660). According to Dyer and Singh (1998, pp. 660–669), such capabilities can be categorized into relation-specific assets (i.e. "specialized in conjunction with the assets of an alliance partner"), knowledge-sharing routines (i.e. "interactions that permit the transfer, recombination, or creation of specialized knowledge" between organizations), complementary capabilities (i.e. collective capability bundle of various alliance partners), and effective governance (i.e. third party enforcement of agreements and self-enforcing agreements, such as trust).

In summary, the RBV's contribution to the present research is twofold. First, it provides the initial framework for systematically examining IE capabilities within the first exploratory research study (see section 4.2). Second, by analyzing the identified IE capabilities against the background of past RBV research, the RBV literature might further pinpoint the capabilities that allow the firm to achieve or maintain its competitive position (Barney, 1991; Peteraf, 1993) and explain the (higher) success rates of institutional entrepreneurs.

3.4 The theory of critical success factors and its contribution

In accordance with the major focus of the present research on indirect relationships beyond the tier-1 supplier level, the relevance of exploring the management of sub-suppliers within SSCM was discussed. It was highlighted that this research context reveals unique challenges (see sections 1.1 and 2.5). The third and fourth exploratory research studies accordingly examine and evaluate the key influential factors for managing a sub-supplier's compliance with CSS (see sections 4.4 and 4.5). An organizational theory that can explain the higher success rates when facing such challenges is the theory of critical success factors (Dinter, 2013).

The theory of critical success factors (CSF) is well anchored in strategy research (Daniel, 1961; Dinter, 2013; Rockart, 1979) and explains "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" (Rockart, 1979, p. 85). It acknowledges that the non-consideration or poor alignment of CSFs most likely leads to lower performance outcomes. Hence, CSFs determine "the areas in which good performance is necessary to ensure attainment of those goals" (Rockart, 1979, p. 85).

After identifying the CSFs, they should be continuously monitored to enable accurate and beneficial management decisions. The definition and measurement of appropriate key performance indicators that describe the CSFs might support management decisions. Furthermore, the linkages between CSFs, required actions, and the targeted performance outcome should be clear, thus positively influencing causal relationships (Kaplan and Norton, 1992, 1996).

Besides theory's anchor in strategy research and its contribution to explaining a firm's competitive advantage, the CSF theory has also been applied to research in more operational fields, such as project management and information systems management (Belassi and Tukel, 1996; Poon and Wagner, 2001; Shenhar et al., 2002; Zwikael and Globerson, 2006). The research findings similarly suggest that the existence of specific CSFs leads to higher success rates of project implementations, eventually increasing the overall organizational performance (Dinter, 2013).

The literature on CSFs highlights that factors are commonly specific to the context in which they are embedded; thus, idiosyncrasies exist in the fields of study. Moreover, each context might bring unique challenges to identifying and determining the relative importance of CSF's contribution to success (Leidecker & Bruno, 1984). The adopted perspective further determines the understanding of success and the targeted performance outcome (Chan et al., 2002). Hence, the CSF theory acknowledges strategic and organizational contingencies.

Referring to the present research context, the focal firm is deemed successful if the sub-supplier management practices[32] lead to its compliance with the focal firm's CSS. Therefore, the focal firm must identify and get access to the sub-supplier in order to

[32] The exploration of such sub-supplier management practices is the subject of the second research study. See section 4.3.

assess the sub-supplier's current compliance level, and if deficiencies are revealed, it must collaborate with the sub-supplier on compliance issues. Ultimately, the identification of the related CSFs might significantly contribute to the positive outcome of sub-supplier management practices in terms of the sub-supplier's CSS compliance.

Thus, shifting the focus to CSF-related SSCM research, various researchers have recently acknowledged the need to specifically examine the enablers of and barriers to SSCM initiatives, which can be referred to as critical factors (e.g. Ageron et al. 2012; Walker & Preuss 2008). Although their research is not explicitly positioned within the theory of CSFs, that research provides an appropriate starting point for the present research and can be linked to the theory under discussion.

The identified critical factors are commonly categorized as internal and external to the focal firm, as illustrated in Table 2. Internal factors mainly refer to a firm's resources and the capabilities that it uses or may evolve for its SSCM initiatives. External factors describe relational aspects (e.g. power, commitment, or trust), supply chain partner specific aspects (e.g. their competence), and context aspects (e.g. cultural and geographical distance). However, all reported critical factors mainly refer to the general SSCM settings or are settled within a "traditional" supplier management context, which initially makes only a small contribution to explaining multi-tier supply chain settings. Firms facing the unique challenges of approaching sub-suppliers to ensure their compliance with CSS would profit from more detailed insights about critical factors. Thus, within the framework of the CSF theory, the present research aims to identify and evaluate the factors that contribute to the management of sub-suppliers in order to successfully ensure their CSS compliance.[33]

[33] For the identification of related CSFs, see section 4.4, and for the subsequent evaluation of their inter-relationships, see section 4.5.

Table 2. Critical factors to sustainable supply chain management (Grimm et al., 2012; Grimm, Hofstetter, et al., 2013)

Critical factors to SSCM	**Sources**
Internal critical factors	
Costs, lack of financial resources	(Ageron et al., 2012; Hervani et al., 2005; Min and Galle, 1997, 2001; Walker et al., 2008; Wycherley, 1999)
Investment reluctance (defining the scope and evaluating the return-on-investment)	(Ageron et al., 2012; Peters et al., 2011; Walker et al., 2008)
(Lack of) competences and skills	(Bowen et al., 2001)
(Lack of) personnel commitment	(Cooper et al., 2000; Walker et al., 2008)
Trainings	(Bowen et al., 2001; Carter and Dresner, 2001; Cooper et al., 2000)
Top management support	(Carter and Dresner, 2001; Zhu et al., 2008)
External critical factors	
(Lack of) power	(Ciliberti et al., 2008)
Stakeholder partnerships (e.g. with NGOs, suppliers or industry fellows)	(Granek and Hassanali, 2006; Grimm et al., 2011; Pesonen, 2001; Walker and Preuss, 2008)
Stakeholder pressures (e.g. regulatory incentives, NGO pressures, or customer demands)	(Argenti, 2004; Peters et al., 2011; Seuring and Mueller, 2008b)
(Lack of) commitment and trust between supply chain partners	(Jenkins, 2006; Walker et al., 2008; Wycherley, 1999)
(Lack of) supplier competences	(Ageron et al., 2012)
(Lack of) information and transparency	(Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
Cultural and language differences	(Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
Geographical distance	(Awaysheh and Klassen, 2010)

4. Exploratory studies on ensuring compliance with corporate sustainability standards in supply chains

Based on the discussed objectives, the conceptual background, and theoretical positioning of the present research, this chapter introduces the overall research framework (section 4.1) and subsequently presents the research design and the key findings of the four exploratory research studies (sections 4.2–4.5). The full scope of the studies can be found in the Appendix.

4.1 Overview of the research framework and methodology

The integration of the previously discussed conceptual and theoretical aspects into one research framework provides an overall understanding of the focused research phenomena and guidance for the subsequent exploratory research approach. Figure 7 illustrates the derived research framework, including the broad concepts relevant to the research phenomena. It further assigns the addressed research questions to the framework elements and highlights the foci of the exploratory research studies.

The research framework indicates a simplified multi-tier upstream supply chain consisting of the focal firm, a direct supplier (tier-1), and an indirect sub-supplier (tier-2). Through this upstream supply chain, the focal firm might source products (i.e. materials and/or services) that serve to fulfill the downstream supply chain demand. To constrain the social and environmental misbehaviors associated with the production of the products at supplier or sub-supplier sites, the focal firm issues CSS to its supplier(s) (see section 2.3). These CSS should ideally be adopted by the supplier and passed on to indirect sub-suppliers.[34] To ensure a supplier's compliance with the issued CSS, the focal firm might implement various supplier management practices, such as supplier audits or development programs (see section 2.4). The direct supplier should similarly ensure its own supplier's compliance (i.e. firm's sub-supplier); however, shortcomings might lead the focal firm to directly approach the sub-suppliers (see section 2.5).

[34] Thereby, the direct supplier may make any modifications to the focal firm's CSS and issue its own corporate sustainability standards to its suppliers (i.e. focal firm's sub-suppliers). Figure 7 indicates these potential modifications as CSS, which are issued by the direct supplier.

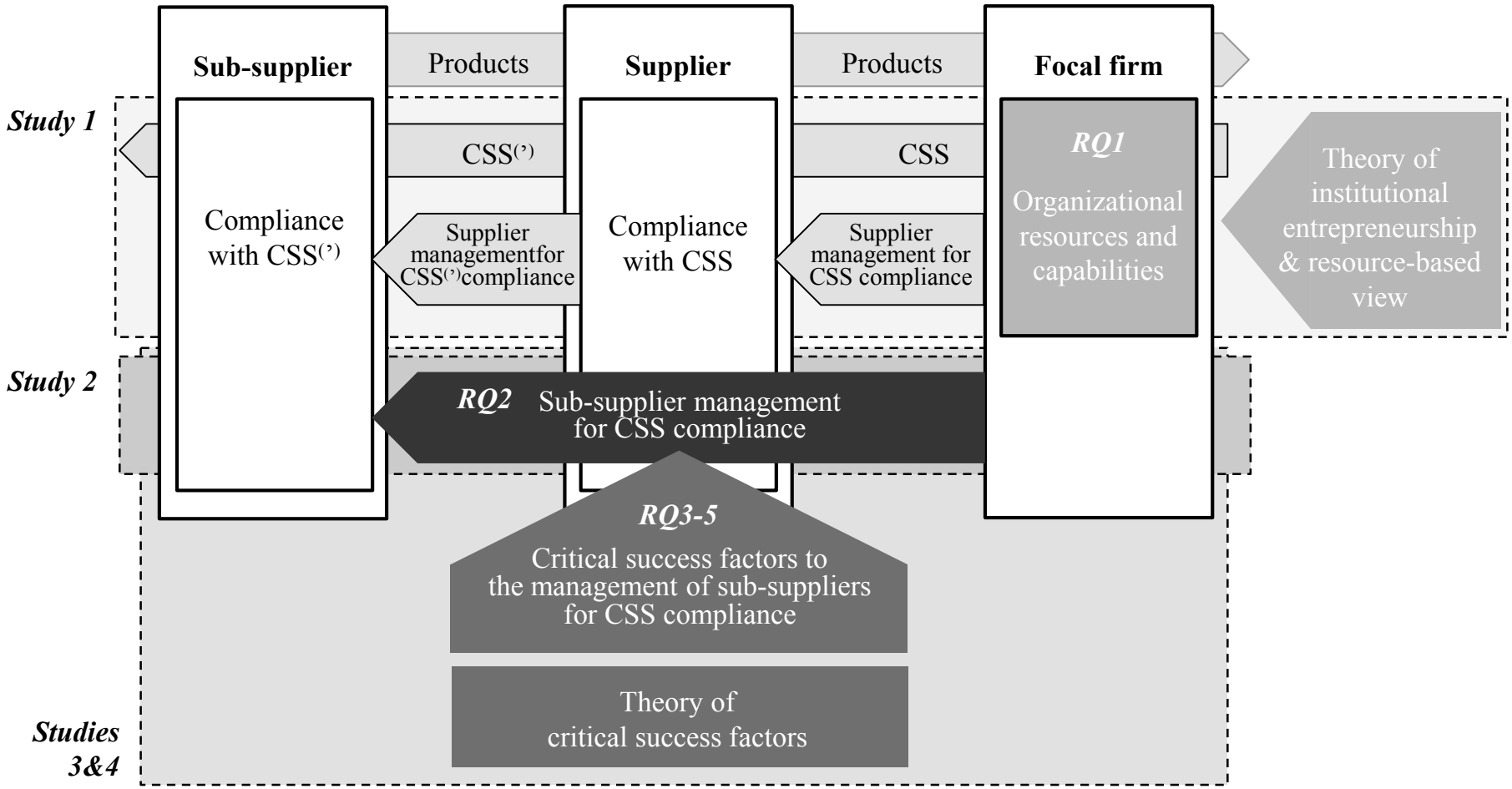

Figure 7. Framework and structure of the present research

Overall, little research has considered the consistent implementation of CSS in multi-tier, and it has neglected to focus on whether suppliers and sub-suppliers really comply with these CSS after they are issued. Thus, the studies conducted for this research seek to contribute toward answering the primary research question:

How can a focal firm ensure its suppliers' and sub-suppliers' compliance with corporate sustainability standards (CSS) in its supply chains?

The primary research question is addressed by four exploratory research studies. The subordinate research questions, applied methodology, and theoretical positioning are summarized in Table 3.

The successful implementation of CSS, which comprises (1) establishing CSS, (2) issuing them to supply chain partners, and (3) ensuring the partners' CSS compliance, can be matched to the general concept of IE. In particular, ensuring CSS compliance consistently throughout the supply chain (i.e. institutionalization) is a challenging task, and the systematic identification of necessary organizational capabilities has received little attention thus far *(RQ1)*. Therefore, *study 1* takes the theoretical lens of IE theory and examines the organizational capabilities that are necessary to successfully implement CSS (i.e. institutionalization of CSS). For the systematic examination of such capabilities, the RBV framework is applied.[35]

Subsequently, *study 2* particularly focuses on ensuring sub-suppliers' compliance with CSS. It examines the circumstances that lead firms to directly approach their sub-suppliers and investigates applicable sub-supplier management practices *(RQ2)*. Although this exploratory study starts without taking a particular theoretical lens, the discussion of the derived research propositions is supported by explanations of institutional theory, information theory, and resource dependence theory.

As the objective of managing sub-suppliers for CSS compliance indicates unique challenges compared to "traditional" supplier management (e.g. due to missing contractual relationships with sub-suppliers), *studies 3* and *4* further explore the critical factors to the successful management of sub-suppliers. First, s*tudy 3* seeks to identify the CSFs *(RQ3)*. Second, *study 4* examines their inter-relationships as well as

[35] For a detailed discussion of the theoretical positioning, see sections 3.2 and 3.3.

their influences on the sub-supplier management practices *(RQ4)*. Both studies are therefore positioned within the theory of CSFs.

Given the immaturity and complexity of the field in which the targeted studies are settled, all four studies adopt an exploratory case study or field study research approach (Stuart et al., 2002). This is especially appropriate for examining multi-level phenomena that are embedded within the inter-relationships of the focal firm, its suppliers, and sub-suppliers (Mena et al., 2013). Furthermore, the applied case and field study methodologies could provide deeper insights and "render (…) rich explanations to the [individual] study's research questions that would not likely be possible through the use of a more quantitative method" (Carter and Dresner, 2001, p. 14).

The following sections present details on the specific research design of the four exploratory studies and outline their respective key findings and contributions.

Table 3. Overview of the four exploratory research studies

Study	Research questions	Methodology	Theoretical positioning
1	*Capabilities for corporate sustainability standards institutionalization along the supply chain*		
	RQ1: What capabilities does a focal firm (i.e. the institutional entrepreneur) require to successfully implement (i.e. institutionalize) previously defined CSS in supply chains and to ensure suppliers' and sub-suppliers' compliance with the CSS?	Case studies of six focal firms ▪ Literature review ▪ Semi-structured interviews ▪ Archival data	IE theory and RBV
2	*Exploring sustainability compliance of sub-suppliers*		
	RQ2: Under which circumstances and to what extent do firms manage their sub-suppliers in order to ensure that these sub-suppliers comply with the firms' CSS?	Case studies of two focal firms ▪ Literature review ▪ Semi-structured interviews ▪ Archival data	Supporting the derived research propositions with the theoretical lenses of institutional theory, information theory, and resource dependence theory, where applicable
3	*Identifying critical success factors to sub-supplier management for sustainability compliance*		
	RQ3: What are the critical success factors (CSFs) for the management of sub-suppliers to ensure their compliance with the CSS in supply chains?	Field study within two multi-tier supply chains including a focal firm, a supplier, and sub-supplier ▪ Literature review ▪ Workshops ▪ Semi-structured interviews ▪ Archival data	Theory of critical success factors
4	*Evaluating critical success factors to sub-supplier management for sustainability compliance*		
	RQ4: What are the inter-relationships among the identified CSFs and their influence on sub-supplier management? RQ5: What are the different perceptions of various players (i.e. focal firm, supplier, and sub-supplier) in the multi-tier supply chains related to these CSFs?	Field study within a multi-tier supply chain including a focal firm, a supplier, and sub-supplier ▪ Literature review ▪ Structured DEMATEL interviews	Theory of critical success factors

4.2 Capabilities for corporate sustainability standards institutionalization along the supply chain (study 1)

4.2.1 Research design

CSS are considered to be successfully implemented (i.e. institutionalized) when the affected supply chain partners take them for granted and ultimately comply with the issued CSS. The first study seeks to identify the organizational key capabilities that a firm (i.e. institutional entrepreneur) requires to successfully implement CSS (see *RQ1* in Table 3). To achieve this objective, the study takes a qualitative case study approach and examines six focal firms within the retail, paper, medical textile, and information technology industries. Thereby, the research integrates IE theory and the RBV to help explain the research phenomenon that is observable in the case studies. While IE theory explains how firms can drive institutional change, the RBV outlines the criteria for organizational capabilities that allow the focal firm (i.e. the institutional entrepreneur) to achieve the targeted institutional change (i.e. the institutionalization of CSS).

All six case study firms were selected because they possessed the characteristics of an institutional entrepreneur. First, they had initiated "institutional change" by defining and issuing CSS for their supply chains. Second, they actively sought to ensure the change process (Battilana et al., 2009) by following supplier management practices in their supply chains.

The data collection consisted primarily of semi-structured interviews with key personnel responsible for the CSS implementation (including sustainability and purchasing managers). To identify the targeted key capabilities, a three-order data analysis approach was chosen (Sharma and Vredenburg, 1998): the first-order schemes reflect the quotations retrieved from the initial data collection; the second-order schemes summarize the respective quotations; and the final schemes further abstract the second-order schemes and represent the linkage to the existing IE and RBV literature (see Table A - 3 in Appendix A.3.2). Furthermore, the identified capabilities are analyzed with respect to the RBV framework and its criteria in order to further pinpoint those capabilities that allow the "firm to conceive of or implement strategies that improve its efficiency and effectiveness" in the present research context (Barney,

1991, p. 106). Finally, this leads to the identification of five organizational key capabilities that support the firm in its endeavor, as discussed in the following section.

4.2.2 Key findings and contributions

This study was one of the first to apply IE in the SSCM context and provide explanations for how practices within supply chain might be changed. It particularly examined how capabilities enable the firm to successfully implement its previously defined CSS throughout its supply chain. Thereby, five key capabilities were identified, contributing to the institutional change: (1) inter-firm dialogue, (2) risk management, (3) external stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement. The identification of these capabilities in the present research context resulted in the formulation of five corresponding research propositions (P1-5):

P1-5: The capability of (1) inter-firm dialogue, (2) risk management, (3) stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

In summary, the capabilities' value can be phrased as follows: the capability of inter-firm dialogue allows the firm to build up a common understanding about the CSS among the affected supply chain partners. The risk management capability enables the efficient usage of limited resources by identifying, prioritizing, and controlling CSS non-compliance. The capabilities of stakeholder collaboration and cross-functional integration may resolve the issues/challenges arising during the CSS implementation in a collaborative way (i.e. either supported by external stakeholders or cross-functional units internally) – in which complementary resources and knowledge are bundled. Finally, the continuous improvement capability ensures that the practices and processes concerning the CSS implementation are constantly advanced.

These capabilities can specifically support the execution of supplier management practices and consequently account for a higher level of supply chain partners' compliance with the CSS, reflecting the successful CSS implementation (i.e. institutionalization) (see Figure A - 2 in Appendix A.4). By having reviewed and analyzed these capabilities against the background of the RBV framework, this approach suggests that firms – having built up the capabilities – can further gain an

advantage against competing supply chains. Overall, the study provides further grounds that IE theory and RBV are appropriate theoretical lenses within the field of SSCM.

4.3 Exploring sustainability compliance of sub-suppliers (study 2)

4.3.1 Research design

The second study sought to explore how firms might manage sub-suppliers beyond the tier-1 supplier level in order to ensure the sub-suppliers' compliance with the issued CSS (see *RQ2* in Table 3). By making use of an exploratory case study approach, this paper investigated the sub-supplier management practices and related circumstances of two focal firms (i.e. Hewlett-Packard and Migros) in the electronics and retail industries.

Both case study firms are industry leaders with respect to SSCM and two of the pioneering firms that demonstrably approach sub-suppliers in order to increase their level of CSS compliance. Focusing on two firms and their multi-tier supply chains enabled an in-depth analysis of the complex research settings as well as comparisons by means of a cross-case analysis.

The data collection was based on a broad variety of sources (e.g. interviews, audit statistics, project reports including verbatim quotations of sub-suppliers, presentations, etc.), enabling the triangulation of primary and secondary data. The data analysis followed open coding and pattern matching procedures. First, the cases were individually analyzed before the two cases were compared in order to identify the differences and common patterns. Multiple measures were implemented throughout the research process to ensure the quality of the present research study, as illustrated by Table B - 1 in Appendix B.4 (Yin, 2003, p. 33). Consequently, the present research design enabled the identification of feasible sub-supplier management practices leading to a higher level of sub-suppliers' compliance with CSS, influential factors to the management of sub-suppliers (i.e. moderating effects), as well as the circumstances (i.e. antecedents) under which the focal firms approach sub-suppliers in the present research context.

4.3.2 Key findings and contributions

The second study highlights that focal firms can directly approach sub-suppliers and might positively influence their sustainability performance in terms of achieving a higher level of CSS compliance. The respective practices toward the sub-suppliers can be summarized by two dimensions of sub-supplier management for CSS compliance – assessment and collaboration practices – which are rooted within "traditional" supplier management (cf. Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008). The observed sub-supplier assessment practices are based on many kinds of audit types (i.e. first to third party audits), informal site visits, and assessments via public available data sources (e.g. company, media, or NGO reports, or risk indices). Sub-supplier collaboration practices include corrective action plans, training, awareness-raising workshops, and experience-exchange workshops with sub-suppliers (see Table B - 4 in Appendix B.6).

The study further proposes that (1) public attention, (2) perceived risks, and (3) channel power are antecedents to sub-supplier management. First, public attention on the focal firm – especially on its brands and products – is a main trigger for the firm to consistently approach its supply chain partners beyond the tier-1 supplier level. Second, anticipating potential social and environmental misbehaviors at sub-supplier sites prompts the firm to manage questionable sub-suppliers, lowering the risk of any major non-compliance, which might result in public allegations. Third, the focal firm's power over its direct suppliers allows the firm to identify and to get in contact with respective sub-suppliers. In situations where the firm has little to no power over its direct suppliers, the latter may only voluntarily disclose the identities of the sub-suppliers, making the focal firm dependent on the direct suppliers to engage in managing the sub-suppliers. An absence of power between a direct supplier and its own supplier (i.e. the firm's sub-supplier) makes the firm's endeavor increasingly difficult and pronounces the voluntariness of the focused sub-supplier.

Although the observed practices for managing sub-suppliers turned out to be similar to the traditional supplier management practices of assessment (e.g. audits, site-visits, supplier questionnaires) and collaboration (e.g. training, workshops, corrective action plans), the study indicated that by further involving strategic business partners in these practices, the focal firms seem to achieve better sustainability performance

improvements at the sub-supplier sites (i.e. higher level of CSS compliance). Whereas the traditional supplier management context might not require any participation of further business partners, approaching and managing sub-suppliers should not be conducted without the involvement of the firm's direct supplier (i.e. sub-supplier's direct customer). The findings suggest that direct supplier involvement (1) accelerates the development of mutual trust between the focal firm and the sub-supplier, (2) avoids the direct supplier having the impression of being ignored and the fear of being by-passed (i.e. potentially losing business), and (3) maintains the direct supplier's awareness of its responsibility.

Overall, the research findings indicate that there are unique challenges within the sub-supplier context compared to traditional supplier management. These challenges might exist due to a lack of transparency about sub-suppliers' identities, missing contractual relationships with sub-suppliers, a lack of opportunities to directly wield power over sub-suppliers, and partial dependence on the voluntariness of suppliers' and sub-suppliers' involvement.

In line with the previous argumentation, the study formulated the following research propositions:

P1: The management of sub-suppliers for CSS compliance consists of two dimensions: assessment and collaboration.

P2: The greater the sustainability assessment and collaboration of a focal firm with its sub-suppliers, the greater the increase of the sub-suppliers' compliance with CSS.

P3a: The involvement of additional strategic business partners in the management of sub-suppliers amplifies (moderates) the effect of assessment and collaboration on sub-suppliers' CSS compliance.

P3b: Second and third party audits have similar effects on sub-suppliers' compliance with CSS.

P4: The greater the public attention on a firm, the more the firm seeks additional collaboration with and assessment of its sub-suppliers.

P5: The higher a focal firm's perceived risk of social or environmental misbehaviors in its supply chains, the greater its engagement in assessment and collaboration with sub-suppliers, in addition to its engagement with first-tier suppliers.

P6: The higher a focal firm's channel power, the greater the assessment and collaboration practices with sub-suppliers.

Finally, the proposed framework of sustainability compliance in sub-supplier management is illustrated by Figure B - 1 (in Appendix B.7.1).

4.4 Identifying critical success factors to sub-supplier management for sustainability compliance (study 3)

4.4.1 Research design

As the preceding study pinpointed the unique challenges and characteristics of managing sub-suppliers to ensure their compliance with CSS, the third study consequently sought to identify the critical factors that might influence the success of sub-supplier management for CSS compliance (see *RQ3* in Table 3). Facing the immaturity of sub-supplier management research and the complexity of multi-tier supply chains and inherent interactions, the present study followed an exploratory, qualitative research approach to accomplish the aforementioned objective. Thus, the present study was conducted within a one-year field study in two multi-tiered food supply chains. Each supply chain consisted of a focal firm, a direct supplier, and a sub-supplier. More specifically, a chocolate/sugar and a fruit/juice product supply chain were examined. In each selected supply chain, the two focal firms sought to ensure CSS compliance throughout their entire supply chains including sub-suppliers.

The data collection was based on group setting interactions within the field study and complemented by semi-structured interviews with individual representatives of each supply chain and at all supply chain levels. Additionally, site visits were conducted. The data analysis comprised three main steps. First, a content analysis (including open coding and pattern matching procedures) of the transcribed interviews and further collected data was conducted by two researchers to identify the initial evidence of the CSFs in the management of sub-suppliers for CSS compliance. Second, inter-rater agreement and refinement of the identified CSFs were accomplished by multiple iterative discussions between the two researchers. Third, the identified CSFs were validated with the field study participants.

4.4.2 Key findings and contributions

The present study identified 14 CSFs that might raise the success rates of sub-supplier management practices for CSS compliance. The 14 CSFs are summarized together with a definitional description in

Table 4 and can be categorized along four characteristics:

- Internal focal firm-related CSFs (C6),
- Relationship-related CSFs (C1, C2, C3, C4, C5, C9, C10, and C11),
- Supply chain partner-related CSFs (C7 and C12), and
- Context-related CSFs (C8, C13, C14).

Whereas the focal firm might be able to directly control its internal CSFs, other CSFs are less measurable (e.g. trust between the supplier and sub-supplier) and potentially beyond the sphere of influence. However, being aware of the importance of these CSFs, a focal firm should take them into consideration in any sub-supplier initiative. Furthermore, the study indicated many inter-relationships amongst CSFs, which require further investigation (see study 4 in section 4.5).

Past research highlighted a lack of knowledge about CSFs within the SSCM context (Ageron et al., 2012), while predominantly focusing on more general SSCM settings with dyadic direct supplier relationships. Therefore, the present research contributes to a better understanding of CSFs especially in sub-supplier management settings. By introducing a CSF theory lens to the field of SSCM, this study takes a further step toward developing a stronger theoretical foundation for multi-tier supplier management (cf. Mena et al., 2013). Since not all identified CSFs were specific to the SSCM context, the study findings may also inform other fields, such as quality or inventory management, in which critical sub-suppliers might need special considerations too. Furthermore, several important inter-relationships between CSFs were observed. These inter-relationships will need further investigation, as targeted by study 4.

Table 4. Critical success factors to the management of sub-suppliers for compliance with corporate sustainability standards (adapted from Grimm et al., 2012; Grimm, Hofstetter, et al., 2013)

	Critical success factors	Description
C1	Trust between focal firm and direct supplier	The trust between a buying firm and its direct supplier can be described by the relationship in which the two parties perceive each other as credible and benevolent (Doney and Cannon, 1997). Trust is critical for strategic supply chain partnerships (Handfield and Bechtel, 2002).
C2	Trust between direct supplier and sub-supplier	Similar to the focal firm–direct supplier relationship, trust between the supplier and sub-supplier is considered a critical factor. Trust in this situation is defined in the same way as in C1.
C3	Focal firm's buyer-power (over direct supplier)	The focal firm's buyer-power over its direct supplier is determined by a direct supplier's dependence on the focal firm for valued resources (e.g. revenue) (Cox, 2001).
C4	Direct supplier's buyer-power (over sub-supplier)	Similar to trust as a double-link factor, buyer-power can be defined in a similar context. Whereas C4 enables the focal firm to reveal a sub-supplier's identity (i.e. disclosure of sub-suppliers due to focal firm pressure), a direct supplier's buyer-power is an important factor that allows for greater focal firm–sub-supplier access for direct interactions. The joint approach of a focal firm's CSS requirements and direct suppliers' assistance combined with buyer power will result in higher response rates by sub-suppliers.
C5	Committed long-term relationship between direct supplier and sub-supplier	Well-established business relationships that partners consider so important that they require significant effort and resources, exemplify committed long-term relationships (Ganesan, 1994; Morgan and Hunt, 1994).
C6	Supply know-how of focal firm	The supply know-how of the focal firm reflects the firm's comprehensive knowledge of its supply chain—including knowledge of procured products, related processes, and characteristics of sourcing markets (e.g. cultural specificities).
C7	Direct supplier's willingness to disclose sub-suppliers	C7 describes the willingness of the direct supplier to reveal its sub-suppliers to the focal firm.
C8	Involvement of direct supplier	The involvement of the direct supplier reflects a direct supplier's active mediating role in the sub-supplier management activities. The coordination and processing of the sub-supplier management initiative is not left to the focal firm itself; rather, the direct supplier's support is required.
C9	Perceived value for direct supplier	C9 focuses on the direct supplier's perceived value from the execution of sub-supplier management activities or from further aspects in sub-supplier related activities with the focal firm. Value can be described as a trade-off between the benefits and sacrifices and includes both monetary and non-monetary elements (Walter and Ritter, 2003; Walter et al., 2001).
C10	Perceived value for sub-supplier	The sub-supplier's perceived value in being involved in its customers' initiatives can be defined similarly to C9. It can be the direct or indirect benefits that it perceives or accrues, but a cost/benefit evaluation is probably needed.
C11	Low risk of supplier by-passing	The risk of supplier by-passing is the risk that the focal firm will terminate a business relationship with the direct supplier and start to source directly from the sub-supplier. This activity has also been defined as disintermediation in the literature (Rossetti and Choi, 2008; Spekman et al., 2002).
C12	Sub-supplier's capability to comply with requested sustainability standards	C12 focuses on a sub-supplier's sustainability performance and its ability to fulfill a focal firm's sustainability standards (e.g. working hours, wages, or biodiversity).
C13	Little geographical distance between supply chain partners	C13 refers to the geographical (physical) proximity between the locations of a focal firm, direct supplier, and sub-supplier.
C14	Little cultural distance between supply chain partners	The culture and society in which the supply chain partners are embedded play important roles in the sustainability compliance dimensions (Awaysheh and Klassen, 2010; Hofstede, 1980).

4.5 Evaluating critical success factors to sub-supplier management for sustainability compliance (study 4)

4.5.1 Research design

Building on the results of the previous study, study 4 investigated the inter-relationships, including their relative strengths, amongst the 14 identified CSFs (see

Table 4) and their further influence on the sub-supplier management dimensions' assessment and collaboration (see *RQ4&5* in Table 3).

Embedded in a field study methodology in a multi-tier supply chain consisting of a focal firm, a supplier, and a sub-supplier, a structured DEMATEL ("decision making trial and evaluation laboratory") analysis was completed to evaluate the CSFs and sub-supplier management dimensions. DEMATEL is a structural causal mapping approach that allows for quantifying cognitive information within structured interview settings (Fontela and Gabus, 1976; Gabus and Fontela, 1973).[36] Specifically, it considers the inter-relationships within a set of system components – in this study, a set of CSFs – and the sub-supplier management dimensions assessment and collaboration (to ensure the sub-supplier's compliance with CSS). For this set, the inter-relationships were evaluated pairwise by a respondent from each field study company in the multi-tier supply chain. Therefore, interviews were conducted with the most experienced manager concerning the management of the sub-supplier and respective challenges.

Within the DEMATEL analysis, the respondents' input was matched with linguistic scales and transferred into an initial matrix reflecting the direct relationships between the considered components (i.e. CSFs and the two sub-supplier management dimensions). Subsequent mathematical operations determined the *total-relation matrices* (including the direct and indirect relations) and *the cause/effect relationships* between the components as well as their relative strengths. Based on these calculations, *DEMATEL prominence-causal diagrams* were derived for the graphical illustration of the results. The study considered both the individual perspectives of the multi-tier supply chain members and the aggregated results. An additional dimension to DEMATEL analysis was introduced, not seen in any other DEMATEL publications,

[36] Interpretative Structural Modeling (ISM) or the Analytic Hierarchy Process (AHP) are comparable structural causal mapping approaches that focus on hierarchical structures. Compared to those, DEMATEL allows for the derivation of more network-oriented results (Tzeng et al., 2007; Zhu et al., 2011).

by incorporating Euclidean distance calculations to measure differences between informants' CSFs evaluation. Based on this Euclidean distance calculation, the different perceptions of the respondents are discussed.

4.5.2 Key findings and contributions

Study 4 highlights that important relationships between the CSFs exist, and it proposes an initial structural model (see Figure D - 5 in Appendix D.6.2). In contrast to most of the extant literature on general and sustainable supply chain management, inherent concepts such as power and trust were not solely analyzed from an aggregated and general perspective, but were differentiated for each dyadic business relationship within the multi-tier supply chain (firm vs. supplier vs. sub-supplier).[37]

The overall results show that collaboration and assessment practices with sub-suppliers are particularly influenced by three specific CSFs: (1) the focal firm's buyer-power over the direct supplier, (2) the committed long-term relationship between the direct supplier and sub-supplier, and (3) the involvement of a direct supplier (see Figure D - 6 in Appendix D.6.2). Consequently, firms should be particularly conscious of these CSFs when they initiate or conduct respective sub-supplier management practices. In turn, sub-supplier assessment and collaboration practices significantly influence a set of CSFs, indicating a feedback loop (see Figure D - 7 in Appendix D.6.2). Whereas assessment practices significantly influence only two CSFs, collaboration practices strongly influence seven CSFs. The greater importance of collaboration practices could be explained through their more interactive and relational characteristics, with a subsequent impact on the CSFs.

Comparing the CSF perceptions of the respondents representing the different multi-tier supply chain members by adopting a Euclidean distance approach reveals that depending on the position within the supply chain, the members put different foci on the CSFs, as illustrated in Figure D - 8 (in Appendix D.6.3). The results suggest the tendency that supply chain members with a direct contractual relationship (i.e. less organizational distance) will perceive the effects and importance of CSFs more similarly compared to parties without a contractual relationship (i.e. firm vs. sub-supplier). The differing perceptions should be taken into account when sub-supplier

[37] As an exception, see Cox et al. (2001) and Watson (2001) who consider different power relationships at different supply chain tiers.

management initiatives are being set up. Where common perceptions exist, the taken improvements might be similarly acknowledged for the success of the sub-supplier management initiative.

5. Conclusions

The last chapter concludes the overall contribution of the present research. Therefore, it summarizes the theoretical (section 5.1) and managerial contributions (section 5.2). Finally, it acknowledges the limitations of the research and provides an outlook for future research directions (section 5.3).

5.1 Theoretical contributions

Firms face huge challenges in ensuring CSS compliance consistently throughout their upstream supply chains. As a matter of fact, it seems to be an unachievable endeavor to ensure 100 percent compliance due to fragmented, complex, and globe-spanning supply chain characteristics; however, it is business practice's responsibility to strive for continuous supply chain sustainability improvements. Therefore, the present research pinpointed various important areas that contribute toward increasing the level of compliance with CSS in supply chains, as outlined and discussed in the previous chapter. The introductory part of the present research stated three main aspects concerning its relevance and the respective objectives to which the overall contributions are subsequently related from an overall perspective (besides the discussed individual contributions of the four exploratory research studies described in chapter 4).

First, the extent literature on sustainability and SSCM predominantly concerns the establishment and content of CSS for supply chains, but neglects the compliance issues at supplier sites or restricts the consideration to the dyadic relationships with direct suppliers. Complementarily, the present research focused on the challenges of ensuring suppliers' and sub-suppliers' CSS compliance within multi-tier supply chains. In this context, it explored the necessary organizational capabilities, sub-supplier management practices, and related CSFs. Consequently, the findings highlighted the value of the identified capabilities, demonstrated the feasibility of managing sub-suppliers for CSS compliance, and outlined the importance of considering the related CSFs and their inter-relationships.

Second, past research suggested an increased consideration of the social dimension within the field of SSCM (Hutchins and Sutherland, 2008; Kudla and Stölzle, 2011; Pagell and Wu, 2009; Seuring and Mueller, 2008a). The research at hand consequently

considered CSS, which includes environmental *and* social sustainability requirements. Thus, the research findings correspond to both the environmental and social challenges in supply chains and suggest that they are equally valid.

Third, researchers in the field of SSCM have called for a stronger integration of organizational theories in future research (Brammer et al., 2011; Carter and Easton, 2011; Sarkis et al., 2011). Following this call, the present research demonstrated that IE theory together with the RBV (as an eclectic approach), and the theory of CSFs are effective lenses for the explored research phenomena. Thereby, the present research might also have contributed to the future development of a "theory of multi-tier supply chain management" (Mena et al., 2013).

5.2 Managerial contributions

The present research concerned firms' objective to ensure suppliers' and sub-suppliers' compliance with issued CSS throughout entire supply chains. Without CSS compliance in supply chains, for example, firms could face high reputational risks, lose revenue, or even completely lose business in certain markets and regions.

First, the present research acknowledged the current state of the research and business practices within SSCM and highlighted the limited focus of the related supplier management practices at the tier-1 supplier level. Furthermore, it outlined the relevance of organizational capabilities, which might enable the successful implementation of CSS (reflected by supply chain partners' compliance) by contributing to existing structures and supplier management practices. The research findings of the first exploratory study consequently identified five key capabilities: (1) inter-firm dialogue, (2) risk management, (3) external stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement. Business practice should be aware of the contribution of these capabilities (see section 4.2.2 and Appendix A) and evaluate their extant capabilities against the background of the present research findings.[38]

The second research study particularly examined firms' possibilities of approaching sub-suppliers beyond the tier-1 level and the circumstances that lead firms to manage

[38] For a detailed recommendation for building up these capabilities, see Grimm et al. (2011, pp. 189–190).

such indirect sub-supplier relationships. The unique challenge lies in the fact that a firm does not have any contractual relationship with sub-suppliers and may not be able to exert direct pressure over the sub-suppliers. First, a firm needs to identify and get in contact with critical sub-suppliers. However, this depends on the direct suppliers' willingness to disclose their suppliers (i.e. sub-suppliers). If a firm gains access to sub-suppliers, the research findings show that the execution of assessment (i.e. audits and monitoring) and collaboration (i.e. supplier development, trainings, workshops, etc.) practices with sub-suppliers are feasible and can be compared to those known from traditional supplier management. However, firms should generally involve the respective direct supplier, which positively influences the relationship dimensions in a mutual direction. The additional involvement of business partners, such as specialized consulting or auditing companies, can further improve the outcome of the assessment and collaboration practices, if the focal firm is not familiar with the sub-suppliers' processes due to the long organizational distance.

Especially firms that rely on their (strong) brands should actively address social and environmental issues, which are potentially hidden beyond the tier-1 supplier level at sub-supplier sites, to protect the credibility of their brands. The scope and complexity of supply chains as well as capacity constraints require firms to develop comprehensive risk management capabilities in order to efficiently use scarce organizational resources by consistently identifying, assessing, prioritizing, and controlling the risks of non-compliance throughout their supply chains. Furthermore, the positive effect of channel power (i.e. firms' power over suppliers and the suppliers' power over sub-suppliers) in managing sub-suppliers' compliance with CSS was highlighted. Thus, firms that do not possess enough channel power should consider participating in roundtables or other voluntary sustainability initiatives with industry peers (e.g. BSCI, EICC, etc.) in order to bundle forces and collectively request compliance with respective sustainability standards.

Finally, the findings of the third and fourth research studies pinpointed 14 CSFs that should be considered when setting up any sub-supplier management initiative to ensure sub-suppliers' compliance with CSS. Improving the conditions with respect to the individual CSFs suggests higher success rates of any sub-supplier management initiative. Business practice should be aware of the CSF characteristics and set up the resources necessary for the management of sub-suppliers in line with the identified

CSFs. Within the real word context, managers might first measure the actual presence of CSFs and compare their results with the present research findings. Thereby, managers can assess whether the investment in specific CSFs is necessary. The explored inter-relationships amongst the 14 CSFs and the resulting structural model highlight synergies between the CSFs, suggest how the CSFs can be indirectly influenced, and indicate how the CSFs might be prioritized. In turn, the awareness of CSFs might also provide guidance for evaluating potential limitations of sub-supplier management success. Consistent with the findings of study 2, the involvement of the respective direct suppliers especially turned out to be one of the key CSFs, positively influencing assessment and collaboration practices with sub-suppliers. Responsible managers should be aware that not only CSFs have an impact on sub-supplier management practices; the latter also impact a set of CSFs in a feedback loop.[39] Furthermore, the 14 CSFs could already be considered in the selection processes of direct suppliers within critical supply chain paths (i.e. supply chains where social or environmental issues are expected) in order to improve the initial position of any anticipated sub-supplier initiative in later phases.

5.3 Limitations and future research

Although the chosen research design is widely acknowledged for the exploration of immature and partially new fields (Eisenhardt, 1989a; Stuart et al., 2002; Yin, 2003), various limitations are evident. All four exploratory studies were based on a case/field study approach. To ensure the validity and reliability of the present research, various recommended quality measures were implemented (Yin, 2003). However, the respective samples were restricted to a limited number of studied cases and industries. Thus, an investigation of more firms and industries with other characteristics could reveal additional insights and ground the findings in a stronger basis for generalization. Furthermore, the data collection mainly relied on the subjective and perceptive data of the case study respondents and field study companies. Future research might test the findings by using a confirmatory, quantitative research approach. However, measuring outcome variables such as CSS compliance in multi-tier supply chain settings—as required for the present research setting—might not be

[39] For a specific discussion of these CSFs and the observed effects, see section 4.5.2 and Appendix D.

an easily achievable objective for future research (Egels-Zandén, 2007, 2013; Jiang, 2009a; Toffel et al., 2012). Furthermore, the explored concepts of organizational capabilities and CSFs mainly correspond to latent variables that are not immediately observable and easily measurable. Measuring instruments do not yet exist for all concepts (Grimm, Stölzle, et al., 2013); thus, future quantitative large-scale research would initially require the development of appropriate measuring instruments.

Even though the present research concerned sustainability challenges in multi-tier supply chain settings, studies 1 and 2 relied to a large extent on data provided by the focal firms. Future research should collect more data from affected suppliers and sub-suppliers (Lee, 2008; Millington, 2008; Vermeulen and Ras, 2006), as partially achieved in studies 3 and 4.

As the present research sharply focused on exploring the management of sub-suppliers for CSS compliance, comparing the present research findings with sub-supplier management approaches in other fields (e.g. quality or inventory) could reveal further facets and might constitute the next step toward a holistic concept of sub-supplier management (cf. Choi and Linton, 2011; Mena et al., 2013).

The present research applied various organizational theory lenses (i.e. institutional entrepreneurship, the resource-based view, and critical success factor theory) to explain the studied "behaviors, designs, or structures" (Sarkis et al., 2011, p. 2). However, most organizational theories mainly provide explanations for dyadic inter-relationships; thus, theoretical lenses for multi-tier supply chain management need stronger considerations. A dedicated theory of multi-tier supply chain management has yet to be developed (Mena et al., 2013).[40]

[40] For further details on the limitations and derived future research directions of the four research studies, see their respective sections in the Appendix.

Appendix

Appendix A. Capabilities for corporate sustainability standards institutionalization along the supply chain (study 1)

Published in a former version:

Grimm, J. H., Hofstetter, J. S., Mueggler, M., & Peters, N. J. (2011). Institutionalizing Proactive Sustainability Standards in Supply Chains: Which Institutional Entrepreneurship Capabilities Matter? In A. Marcus, P. Shrivastava, S. Sharma, & S. Pogutz (Eds.), Cross-Sector Leadership for the Green Economy. Integrating Research and Practice on Sustainable Enterprise (pp. 177–193). New York: Palgrave Macmillan.

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Logistikmanagement 2011, Bamberg, September 03-07, 2011.

31st Annual meeting of the Strategic Management Society, Miami, November 6-9, 2011.

72nd Annual meeting of the Academy of Management, Boston, August 03-07, 2012.

Appendix B. Exploring sustainability compliance of sub-suppliers (study 2)

Presented in a sequence of advanced versions at following conferences:

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Appendix C. Identifying critical success factors to sub-supplier management for sustainability compliance (study 3)

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Appendix D. Evaluating critical success factors to sub-supplier management for sustainability compliance (study 4)

Presented at the Logistikmanagement 2013, Bremen, September 10-13, 2013.

Submitted to the special issue of the Transportation Research Part E: Logistics and Transportation Review on "Green Supply Chain Collaboration and Incentives" (status: *under review*).

A. Capabilities for corporate sustainability standards institutionalization along the supply chain

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We develop a framework outlining key capabilities for an institutional entrepreneur that seeks successful implementation (institutionalization) of a new institution across its supply chain. We focus on the institution of corporate sustainability standards. To achieve this objective, we complete an exploratory research study based on six comparative case studies within the retail, paper, medical textile, and information technology industry. The research integrates institutional entrepreneurship and the resource-based view theories to help explain the phenomenon exhibited by the case studies. While the first theory explains how organizations can drive institutional change, the latter outlines criteria for organizational capabilities enabling the focal firm, i.e. the institutional entrepreneur, to achieve the targeted institutional change. Our analysis suggests five key capabilities enabling the focal firm to effectively implement the CSS in its supply chain that is reflected by both suppliers' and also sub-suppliers' compliance with the previously defined CSS: (1) inter-firm dialogue, (2) risk management, (3) external stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement. The organizational key capabilities identified help to extend the theory of institutional entrepreneurship with concepts that facilitate the institutional change in supply chains with respect to corporate sustainability. This exploratory work opens up significant avenues of additional research in general and supply chain theory development.

Key words: Sustainable supply chain management, corporate sustainability standards, institutional entrepreneurship, resource-based view, case studies.

A.1 Introduction

The complexity of today's supply chains is widely acknowledged. Firms procure a major share of the value added from suppliers, who – primarily independently – procure a major share of their value added goods and services from sub-suppliers. Many firms report around 10 supplier levels into their supply chain.

A significant body of literature seeks to address the challenge of how to control and govern such complex supply chains from the perspective of the original equipment manufacturer (OEM) as the focal firm, reducing heterogeneity by implementing standards (Briscoe et al., 2004; Sroufe and Curkovic, 2008). This literature discusses how to align a supply chain with a defined set of performance objectives (e.g. cost efficiency, responsiveness, etc.) set by the OEM. Explaining how various focal companies within the supply chain can manage these complex issues and managing standards can be aided by utilization of emergent theory.

Emergent elements of institutional theory can prove to be valuable in helping further understand supply chain management practices. Using an institutional theory perspective of the institution and applying it to supply chain management can help gain insights into standardizing business practices within a chain as intended by the focal firm.

There is some discussion in the literature about how single organizations have managed to change traditional practices in organizational fields (e.g. regions or industries – but not yet in supply chains) to new norms, beliefs and values, also known as institutions. These organizations have been named institutional entrepreneurs and the transition from old to new institutions as institutional change. Institutional change might incorporate three steps emergence, establishment, and institutionalization as final implementation of new rules and norms (Hargrave and Van De Ven, 2006; Peters, 2010). The literature has extensively investigated the first two stages. Within these stages, the activities and roles of institutional entrepreneurs have been described and are more mature. Yet, the final implementation (i.e. the institutionalization phase) is a less investigated and important area of study (Battilana and Leca, 2009; Wijen and Ansari, 2007).

One of the critical questions in this field is why do some institutional entrepreneurs succeed and why do others fail? Investigating institutional change implementation may

provide for some insights into the success or failure of institutional entrepreneurs in implementing these changes. The resource based view (RBV) suggests that organizational capabilities may help explain the differences in this success rate. While the capabilities needed in the first two stages of the institutional entrepreneurship (IE) theoretical framework have been previously described and investigated to some extent, the third step, the final implementation, still lacks investigation (Battilana and Leca, 2009; Peters et al., 2011).

A currently prominent institutional change is the issue of corporate sustainability standards (CSS) which firms seek to implement in their supply chains as well. CSS are comparable with voluntary sustainability standards (e.g. labels or certifications), with the difference that these CSS are defined individually by a firm for its own business practices. They typically focus on individual organization strategy and operations. CSS typically incorporate voluntary industry sustainability standards and regulation, adding further standards. Voluntary sustainability standards integration across supply chains has been rarely investigated from either theoretical or practical perspective, CSS are not yet studied (Basu and Palazzo, 2008; Delmas and Montiel, 2009; Foerstl et al., 2010; Lee, 2008; Millington, 2008; Reuter et al., 2010). External stakeholders usually do not differentiate between the behavior of the focal firm or its suppliers, and hold the focal firm responsible for all practices involved product manufacture (Koplin et al., 2007; Rao, 2002). Thus, any party in the supply chain not complying with the focal firm's CSS can potentially damage corporate reputation or harm customer confidence (Barnett and King, 2008; Wagner et al., 2009).

By analyzing six case studies, we develop a framework outlining capabilities of the institutional entrepreneur that increase the institutionalization of a new institution in a supply chain, on the example of CSS. Given this objective the contributions of this research are:

1. Advancing IE theory and understanding by focusing on institutionalization, the final implementation phase.
2. Further grounding of RBV (capabilities) theory within IE.
3. Application of IE to further understanding and development of sustainable supply chains.

A.1.1 Institutional theory and entrepreneurship

Institutions refer to schemes, norms, regulations, or formal sets of rules that constrain behavior (Greenwood et al., 2008; Hargrave and Van De Ven, 2006). Transferred to supply chain management, institutions consist of contracts, practices, benchmarks and other agreements between different supply chain actors. Institutions may also consist of implicit behavioral patterns.

Institutional theory posits that organizations will face certain exogenous isomorphic pressures, i.e. mimetic, normative, and coercive, that require organizations to maintain organizational legitimacy (DiMaggio and Powell, 1991; Sarkis et al., 2011).

Institutional theory has typically been applied to an individual organization. Institutional theory has also focused on external or exogenous (to the organization) influences affecting organizational change. Two advances in institutional theory have been used to expand its explanatory lens. The first advance is the organizational fields concept expanding the level of analysis to interorganizational situations (Warren, 1967; Wooten and Hoffman, 2008). The second advance is the concept of IE, expanding the concept that institutional change can occur, and that this change can be managed internally within the organizational field (Battilana et al., 2009). That is, institutional change does not require or necessitate external influences only (Dacin et al., 2002). Institutional change is the alteration or evolution of institutional form, quality or state over a period of time (Hargrave and Van De Ven, 2006).

IE has been defined as actions by an agent who mobilizes resources to transform or create institutions that favor their interests (DiMaggio, 1988; Eisenstadt, 1980; Pacheco et al., 2010). IE stresses the role of actors and agency as key factors for institutional change (DiMaggio, 1988; Powell, 1988). Both organizations, as well as individuals, could be acting as institutional entrepreneurs (Lawrence, 1999). An institutional entrepreneur is an initiator of institutional change and actively participates in the change process (Battilana et al., 2009).

Extending these concepts to the supply chain, institutional entrepreneurs are supply chain members that seek to change the supply chain institution facing their supply chain to most effectively favor their interests.

The process of institutional change requires an initial new institutional design followed by an overall collective action plan, and finally the institutionalization by the diffusion

of this plan across the organizational field (see Figure A - 1). The institutional entrepreneur starts with breaking from current institutional practices (Battilana, 2006) and engages in framing/strategizing a new institution in order to make it "understandable" for other actors in the institutional field. The institutional entrepreneur then undertakes activities to gain support for and acceptance of new institutions (Battilana et al., 2009). The final institutionalization takes place as soon as the inherent norms, cognitive schemes, and rules are accepted by the institutional field (Matten and Moon, 2008), which is reflected by the compliant behavior of directly affected actors (Peters, 2010). A focal firm within a supply chain may act as an institutional entrepreneur (Peters, 2010; Peters et al., 2011).

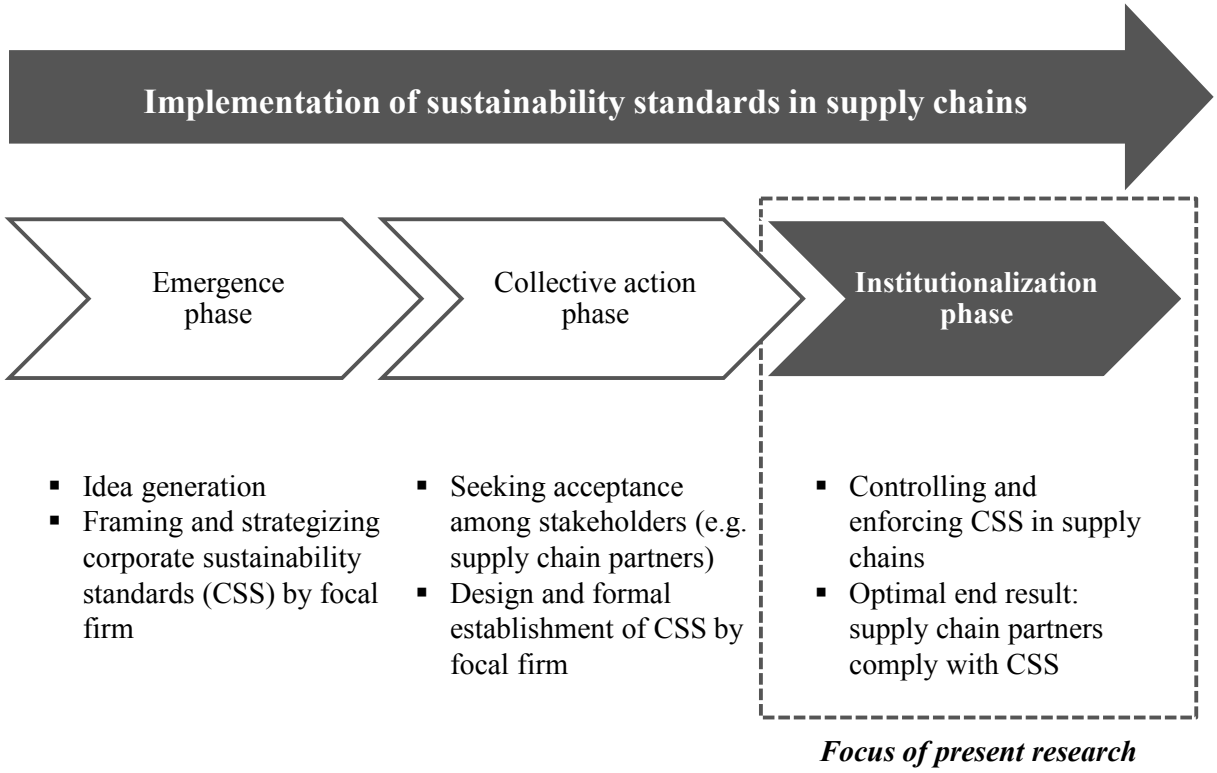

Figure A - 1. Institutional entrepreneurship phases (cf. Hargrave and van de Ven, 2006)

A.1.2 Institutional entrepreneurship within the supply chain

The supply chain may be considered an organizational field. Supply chain actors include producing, storage, transport, and trading organizations.

One important characteristic of supply chain institutions is that they should be more than simple dyadic contracts or relationships across two individual organizations. A second characteristic is not only internal supply chain practices but relationship management across supply chain partners will be influenced by institutions. Practical

examples of institutions within the supply chain organizational field exist. Some of these include:

- Diffusion of quality standards and requirements such as ISO 9000 certification and its processes across supply chains (Sroufe and Curkovic, 2008).
- Efficient consumer response (ECR) requiring retailers and suppliers establish new collaborative processes, data standards, organizational structures that enable collaboration (Corsten et al., 2005; Hofstetter, 2006).
- Sustainability standards where firms try to eliminate specific materials or certain practices across their supply such as following Restriction on Hazardous Wastes regulation; or maintaining International Labor Organization standards (Ciliberti et al., 2009; Wolf, 2011).
- Food safety and traceability standards by the European Union (EU) requiring every ingredient to be traceable.
- The Wal*Mart "buy American" initiative which sets supplier preference choice to one nation only.
- Information sharing requirements across a supply chain to minimize the bull-whip effect (Disney, 2003).

Institutional entrepreneurs within a supply chain can be almost any agent within the supply chain where circumstances would require them to change the supply chain's institutions. For example, larger focal companies with substantial power may be the supply chain entrepreneur, e.g. Walmart, due to competitive reasons. Alternatively, an organization with a rare resource may be the institutional entrepreneur. Organizations that are most directly influenced by a regional regulatory policy can be an institutional entrepreneur. These are example triggers and characteristics for institutional entrepreneurs, additional originating triggers have been discussed in the literature (Battilana et al., 2009; Pacheco et al., 2010).

The success of an institutional entrepreneur to successfully implement the aimed institution in its supply chain depends on its actions and activities within the final implementation phase (i.e. institutionalization).

The effective implementation and maintenance of an institutional order are essential for long-term institutional survival. Even though, the maintenance of organizational fields has received significantly less attention than their creation (Wijen and Ansari,

2007). Literature further outlines the importance of enforcement, auditing and monitoring mechanisms to control the change and to ensure other actors' compliance with the new institutions (Guler et al., 2002; Lawrence and Suddaby, 2006). However, explanations on why change does occur in some cases but not in others have yet to be fully supported (Battilana et al., 2009). In this context, institutional entrepreneur's resources and capabilities are considered to be of key importance for change adoption (Battilana and Leca, 2009; Dacin et al., 2002; Lawrence, 1999; Peters et al., 2011).

The importance of an institutional entrepreneur's actions and activities to change their institutional environment is acknowledged (Aldrich and Fiol, 1994; DiMaggio, 1988; Oliver, 1991; Phillips et al., 2004; Powell, 1988; Suchman, 1995; Zimmerman and Zeitz, 2002), however, the systematical examination of resources and capabilities that an institutional entrepreneur requires for his successful endeavor tends to be unspecified or described on a generic level (Battilana and Leca, 2009). There has been a call for research to investigate how and what resources and capabilities enable an institutional entrepreneur to change the existing or create a new institution successfully (Battilana and Leca, 2009; Battilana et al., 2009; Lawrence and Suddaby, 2006).

Given these issues and concerns, the RBV provides a framework to systematically identify necessary institutional entrepreneur capabilities for the successful implementation of new institutions. In general, the RBV emphasizes specific resources (e.g. capabilities) that explain the unique advantage of a firm (Barney, 1991; Peteraf, 1993). In IE, the value of a capability specifies the effectiveness of a capability to achieve the intended institutional change (Peters, 2010; Peters et al., 2011). Simultaneously, capabilities have to be rare, hard to duplicate and difficult to substitute in order to preclude others from achieving comparative positions (Barney, 1991), that is preventing other institutional entrepreneurs from driving institutional change in unwanted directions (Peters, 2010; Peters et al., 2011).

The targeted institutionalization of new institutions typically involves "collective actions" (Hargrave and Van De Ven, 2006). Thus, in addition to internal capabilities, key capabilities for institutional entrepreneurs could span firm boundaries (Dyer and Singh, 1998; Lavie, 2006). According to (Dyer & Singh 1998, p. 660) such key capabilities can be categorized into relation-specific assets, knowledge-sharing routines, complementary capabilities, and effective governance.

Simultaneously applying the perspective of IE and RBV enables the identification of those capabilities relevant to the institutional entrepreneur, which already proved their importance for the successful implementation of strategies in other contexts. By this, the RBV is a fertile theoretical lens that may suggest capabilities helping to explain the differences in success rates of institutional entrepreneurs and requires additional investigation.

A.1.3 Corporate sustainability standards as institutions in supply chains

The present research considers IE in supply chain settings, where the focal firm is the institutional entrepreneur. The focal firm as institutional entrepreneur may pursue the adoption of CSS through, at least, its upstream supply chain partners which would include direct suppliers and indirect sub-suppliers. A firm's CSS requires supply chain partners to comply with specific environmental or social criteria. CSS may contain statements and practices for a firm to comply with legal requirements and further individually defined aspects that voluntarily go beyond the law (Barnett and King, 2008). Some of these aspects may have been defined by industry self-regulating institutions or other voluntary sustainability initiatives (Peters et al., 2011).

Whether the focal firm was successful in achieving the targeted institutional change is reflected by suppliers' and particularly sub-suppliers' compliance with the requested CSS.

Efforts to implement the CSS and to achieve supply chain partner's compliance may lead firms to set up sustainability compliance management systems (SCMS) in supply chains. Past research suggests that SCMS consists of two dimensions: assessment of and collaborations with supply chain partners (Klassen and Vachon, 2003). Specifically, firms process a set of SCMS practices to improve supply chain partners' sustainability performance aligned with requested CSS (Brammer et al., 2011; Gimenez and Tachizawa, 2012; Jiang, 2009a), examples may include:

1. Requesting certifications (e.g. ISO14000) from suppliers as signaling mean,
2. Supplier evaluation and selection processes in accordance with CSS,
3. Supplier monitoring and audits, and
4. Supplier development programs to close previously identified performance gaps.

Supplier third-party certifications indicate that the supplier fulfills certain minimum requirements which were externally verified (Delmas and Montiel, 2009). It allows for efficient screening and pre-selection of suppliers. Further evaluations of suppliers according to defined sustainability criteria during supplier selection processes enables more "capable" suppliers be selected upfront and reduces the risk that any non-compliance might be revealed in later phases of a business relationship (Foerstl et al., 2010; Reuter et al., 2010).

Audits may be further used to measure suppliers' actual sustainability performance against requested CSS in order to identify any potential non-compliance (Boyd et al., 2007; Teuscher et al., 2006). Various actors such as the focal firm itself, NGOs or independent auditing companies could be integrated in the audit process, depending on the required knowledge or the credibility sought (Darnall et al., 2009; Locke, Qin, et al., 2007). Supplier monitoring refers to the more informal type of auditing with the purpose of continuously observing suppliers' performance (Brammer et al., 2011). In case of any identified deficiencies, supplier development programs (including training, workshops, transfer of employees, investments etc.) are foreseen as mean for corrective actions to support the respective supplier in developing its capacity (Bai and Sarkis, 2010b).

Firm’s efforts to fully implement the CSS ultimately achieving supply chain partners' compliance with the new institution is not typically fully achieved. A focal firm's limited capacity, the immense numbers of suppliers, and especially sub-suppliers, and lack of direct reach to most sub-suppliers hinder the focal firm to apply the described SCMS practices to all actors in the supply chains. In addition to these SCMS practices alone, a focal firm requires complementary organizational capabilities to ensure compliance with the issued CSS in its supply chains (cf. Bowen et al., 2001; Das and Narasimhan, 2000; Lintukangas et al., 2010; Locke, Qin, et al., 2007; Makadok, 2001). Therefore, our research seeks to identify those capabilities, which act as enablers for the aforementioned SCMS and contribute to achieve the aimed institutional change reflected by high levels of compliance.

A.2 Methodology

Since research about firm's CSS implementation is still at early stages of investigation (Basu and Palazzo, 2008; Delmas and Montiel, 2009; Lee, 2008; Millington, 2008), we have chosen an exploratory case study research approach in order to increase our understanding about the research phenomena. The case studies seek for the identification of organizational key capabilities that positively contribute to achieve the institutional change in firm's supply chain.

A.2.1 Case selection

To increase external validity and to provide a stronger base for theory building compared to single-case studies, a setting of comparative case studies in different contexts is chosen (Gibbert et al., 2008; Yin, 2003). Construct validity is ensured by selecting cases that were suited for exemplifying the phenomenon of how firm's successfully drive and ensure suppliers' and particularly sub-suppliers' compliance with CSS (Eisenhardt and Graebner, 2007), and by gathering and combining data from different parties (e.g. the firm and its suppliers) (Yin, 2003).

We focused on examples of CSS that were already formally implemented and achieved the intended institutional change in the respective supply chain. However, our research also looked for cases, in which the firm went through problems during the final implementation.

We applied pre-defined selection criteria covering factors such as external stakeholder pressures, power relations, supply chain structures, or industry complexity (Roberts, 2003). Consequently, we selected six cases within the food/retail industry, the paper industry (two cases each), the medical textile industry and the electronic industry (one case each), which faced issues of implementing CSS beyond the tier-1 supplier level. An overview of selected cases is presented in Table A - 1.

A.2.2 Data collection

In order to ascertain construct validity, we applied a three-step data collection process throughout all cases (Gibbert et al., 2008). Firstly, we started desktop research and collected secondary data about the respective firm and its (sub-)suppliers to gain first insights. Secondly, we conducted interviews with responsible key personnel such as

senior sustainability or purchasing managers. Further key informants were identified by following a snowball principle (Sharma and Vredenburg, 1998).[41] Interviews were transcribed, verified by interviewees, and subsequently analyzed to enable an early identification of emerging results (Yin, 2003). Thirdly, narrative accounts were explicitly analyzed with respect to discrepancy, and if any identified, further data were consulted in order to obtain the "true story" (Pentland, 1999). An overview of respective primary and secondary sources is provided in Table A - 2.

A.2.3 Data analysis

Emerging concepts were categorized and constantly compared during the three data collection steps (Eisenhardt, 1989a). We consolidated key quotes in data analysis sheets and craft structured mind maps. Aiming for internal validity, we studied theories which could explain emerging concepts. Therefore, we combined our empirical data with the review of existent concepts within the RBV and IE literature (Gibbert et al., 2008). Data abstraction took place in three steps (Sharma and Vredenburg, 1998): first-order schemes comprised quotes retrieved from data collection, second-order schemes summarized respective quotes, and final schemes represented the linkage to the existent literature body (see Table A - 3).

[41] Remark: for the two cases BetaRetail and DeltaPaper, primary data from previous research projects were accessed and analyzed.

Table A - 1. Overview of selected cases

	AlphaIT	**BetaRetail**	**GammaRetail**	**DeltaPaper**	**PsiPaper**	**OmegaTex**
Industry	Information technology	Retail	Retail and wholesale	Paper (print media)	Paper (packaging)	Medical textiles
Sales (in 2010)	–	ca. EUR 20 bn	EUR 4.5 bn	ca. EUR 3.0 bn	> EUR 5.0 bn	ca. EUR 125 mio
Employees (in 2010)	–	< 100,000	> 50,000	> 10,000	< 40,000	> 2,000
Direct suppliers	> 1,000	> 4,000	n/a	n/a	n/a	< 1000
Products	IT Hardware	Consumer goods	Consumer goods	Print media, online media, applications	Packaging Intermediates, Base Materials Graphic & Printing	Bandages, carrier fabrics
Customers	Enterprises, Government Agencies, Consumers	Consumers	Consumers	Consumer	Pharmaceutical, chemical, consumer goods, logistics, engineering industry	Medical industry
Corporate sustainability standards	AlphaIT's modified Electronic Industry Code of Conduct	The Business Social Compliance Initiative (BSCI) Code of Conduct (in general) 'International Roundtable on Sustainable Palm Oil' requirements (supply chain specific)	The GammaRetail Ethical Trading Policy (and further sustainability standards embedded in product specifications)	Principles of a voluntary sustainability initiative	The PsiPaper Code of Business Practice	The OmegaTex Purchasing Standards

Table A - 2. Data sources

	Primary data / informants	Secondary data
AlphaIT	Program Manager and Supplier Sustainability Lead Auditor Various presentations of Supplier Sustainability Lead Auditor	Project report Supplier management systems Tools of voluntary sustainability initiative Annual Reports Sustainability Reports Websites Codes of conduct
BetaRetail	Director Strategic Procurement and Supply Chain Support Head of Social Compliance and Standards Head of Issue Management and Sustainability Various presentations of Head of Issue Management and Sustainability and Head of Social Compliance and Standards	Supplier management systems Annual reports Sustainability reports Websites Codes of conduct Project description of BetaRetail' co-foundation of the Roundtable on Sustainable Palm Oil (RSPO), including interactions and challenges with sub-suppliers (Hamprecht, 2006; Peters, 2010; Peters et al., 2011)
GammaRetail	Group Environmental Executive Quality Manager	Annual reports Sustainability reports Websites Codes of conduct
DeltaPaper	Corporate Sustainability Officer Sustainability Consultant Sustainability Manager of a strategic supplier of DeltaPaper Director of Forestry and Recycling of a strategic project partner of DeltaPaper	Project report Annual reports Sustainability reports Websites Codes of conduct Case narratives of the respective voluntary sustainability initiative (Peters and Schaupp, 2009; Peters, 2011)
PsiPaper	Group Sustainability Executive Assistant Secretary General Paper Purchasing Manager Environmental Manager Europe	Supplier management systems Supplier questionnaire Annual reports Sustainability reports Websites Codes of conduct
OmegaTex	Head of Purchasing	Purchasing standards Websites Codes of conduct

A.3 Implementing corporate sustainability standards in supply chains

This section provides an overview and context of six cases of organizations seeking to introduce CSS in their supply chains. Included in the evaluation is the identification of key organizational capabilities. We propose that these capabilities fundamentally contributed to the final implementation (i.e. institutionalization) of the CSS in a firm's supply chains, ultimately achieving (sub-)suppliers' compliance with CSS by enabling the sound execution of SCMS (including the various practices such as supplier auditing or development).

A.3.1 Overview of cases

BetaRetail, a major Swiss retailer, established together with the World Wildlife Foundation (WWF) and other organizations the 'International Roundtable on Sustainable Palm Oil' (RSPO) aiming for the settlement of sustainable production standards within the 'palm oil industry sector'. From an internal perspective, BetaRetail was motivated to improve its own purchasing practices concerning sustainability factors, whereas from an external perspective, supply chain members were expected to improve their business practices according to the CSS by the RSPO too.

> *"Ten years from now, a sustainable production of palm oil should be business as usual. We want to achieve a worldwide change of the palm oil production" (Head of Environmental and Ethical Projects, BetaRetail, cited in Hamprecht* (2006, p. 80)*).*

GammaRetail, a major Irish retailer, was the first Irish firm that signed up to the principles of the UN Global Compact. GammaRetail emphasized their commitment to sustainable business practices in their supply chains.

> *"GammaRetail is committed to ensuring that all of our supply chain stakeholders, regardless of where they live or work, are treated with respect and dignity and are able to live in an environment undamaged as a result of production" (GammaRetail Ethical Trading Policy, GammaRetail* (2006, p. 8)*).*

In order to promise to this commitment, GammaRetail established the 'GammaRetail Ethical Trading Policy' which is also binding requirement for their suppliers.

> *"[We] are committed to ensuring that our products, particularly our own-brand products are sourced only from suppliers who share our commitment to sustainability" (GammaRetail Ethical Trading Policy).*

DeltaPaper, a major German publisher, realized the risks resulting from non-sustainable paper productions. Associated risks were assessed as manifold for the environment and society – potentially also leading to reputational losses for DeltaPaper, since non-sustainable business processes could be directly linked to DeltaPaper as a customer of the paper industry. Together with one of their main paper suppliers, DeltaPaper set-up guidelines and standards for sustainable business practices in the supply chain.

> *"It is in the interest of the entire supply chain to stimulate the development of a sustainable and long-term forest industry in Russia. This is important to secure continuous reliable supply of wood through mitigating risks and to ensure that products do not lose their credibility to customers in one of the most demanding markets" (Project interim report, DeltaPaper, cited in Peters & Schaupp* (2009, p. 14)*).*

PsiPaper, one of the biggest paper-based packaging producers in Europe and Latin America as well as a operator of several paper mills, issued policies codifying their commitment to sustainability. Thereby, PsiPaper sought to avoid any purchases of wood from controversial sources. The firm established sustainability standards rooted in their 'Sustainable Forestry Policy Statement' which became applicable to their direct and also indirect suppliers.

> *"We are more or less the first ones to introduce all these requests at the same time" (Environmental Manager Europe, PsiPaper).*

OmegaTex is one of the largest producers of special elastic textiles for medical use with production facilities in Germany, India and China. OmegaTex requests from his suppliers and sub-suppliers the fulfillment of sustainability standards in accordance with internationally widely accepted environmental (e.g. ISO 14001) and social (e.g. SA8000) standards.

> *"Although OmegaTex is a major producer within its industry segment, OmegaTex is not in a very powerful position towards suppliers, thus, it requires high efforts to drive sustainability in the upstream supply chain" (Head of Procurement, OmegaTex).*

AlphaIT is a major information technology (IT) company, operating worldwide. AlphaIT has adapted an industry-wide supplier code of conduct, the Electronic Industry Code of Conduct (EICC). In order to ensure supply chain partner's compliance with the developed EICC, AlphaIT initiated various projects, which

especially targeted the improvement of sustainability performance beyond the tier-1 suppler level.

A.3.2 Capabilities for the implementation of sustainability standards in supply chains

In all cases in this study, firms implemented a sound SCMS for its supply chains consisting of activities and practices such as supplier monitoring or development to pursue supply chain partners' compliance with the previously introduced *CSS* (see section A.1.3). The interviewees frequently described capabilities which were considered as particularly important in this context. In line with IE theory, we identified a set of capabilities from which firms used to perform the previously described SCMS practices effectively, ultimately contributing to suppliers' compliance with the *CSS* (Dacin et al., 2002; Lawrence, 1999). The findings are also supported by RBV theory arguing that these intra- and inter-organizational capabilities effectively enabled a firm’s strategy to implement the CSS (Barney, 1991; Dyer and Singh, 1998).

Table A - 3 summarizes the identified capabilities which resulted from the analysis of the collected data. In the remainder of this section, we present each of the five identified key capabilities, reflect them with relevant literature, and discuss capabilities' characteristics with respective criteria of the RBV.

Table A - 3. Scheme analysis of intra- and inter-organizational capabilities (Grimm et al., 2011)

First-order schemes	Second-order schemes	Final schemes
• Ability to clearly formulate sustainability values and visions • Ability to explain sustainability standards and policies towards supply chain partners • Ability to outline expectations towards suppliers • Ability to identify gaps between own and suppliers' understanding concerning sustainability factors • Ability of making suppliers understand the purpose of PSCSS and sustainability standard itself • Ability to understand suppliers' behavior and practices • Ability of demonstrating relevance and persuading suppliers to comply with sustainability standards • Ability to sensitizes suppliers to sustainability factors • Ability to convince suppliers to follow sustainable practices • Ability to communicate findings from auditing activities towards suppliers, leading into specific actions concerning the development of supplier capabilities • Ability of sharing information about sustainable practices with suppliers • Ability of taking cultural context and local specificities into considerations during interactions	• Ability to communicate with supply chain partners about corporate sustainability • Ability to gain mutual understanding • Ability of reasoning relevance of corporate sustainability and persuading suppliers • Ability to provide and receive feedback • Ability to adopt communication to cultural and local specificities	Inter-firm dialogue (Black & Härtel, 2004, adapted from 'dialogue')
• Ability to recognize sustainability issues at direct suppliers • Ability to anticipate sustainability issues within upstream supply chain processes • Ability to map entire supply chain • Ability to identify root causes of sustainability issues within supply chain • Ability to asses supply base concerning business risk and impact resulting from sustainability issues in the supply chain • Ability to assess sustainability threads within upstream supply chain processes • Ability of pre-assessing critical suppliers or components which may hide non-compliant business practices • Ability to prioritize impact of identified sustainability issues • Ability to transfer sustainability requirements into supplier selection criteria • Ability to streamline supply chain (reduce supply base and focusing on most capable suppliers) • Ability to anticipate potential sustainability issues within supply chain • Ability of developing proactive solutions for foreseen/upcoming sustainability issues	• Ability to identify sustainability risks • Ability to assess impact of sustainability issues • Ability to prioritize sustainability risks • Ability to mitigate sustainability risks through the application of appropriate mechanisms and resources	Risk management (Foerstl, Reuter, Hartmann, & Blome, 2010, adapted from 'Supplier Sustainability Risk Management')
• Ability to select best-fitting stakeholders / partners • Ability to select and build up relationships with strategic stakeholders • Ability to maintain frequent dialogue with stakeholders • Ability to continuously exchange experiences and share knowledge with stakeholders (e.g. suppliers, NGO, etc) • Ability of analyzing chain-of-custody by including supply chain partners to increase insights • Ability to solve sustainability issues collaboratively with stakeholders • Stakeholders' trust in focal firm's competence to approach sustainability factors • Stakeholders' trust in focal firm's "sustainability vision" • Ability of fair supplier treatment	• Ability to build relationships with strategic stakeholders • Ability to share tacit-knowledge with strategic stakeholders • Ability to integrate stakeholders for solving sustainability issues • Trust of strategic stakeholders	External stakeholder collaboration (Sharma & Vredenburg, 1998, adapted from 'stakeholder integration')
• Ability to form project teams working on sustainability factors with representatives from various affected corporate functions • Ability to exchange experiences on sustainability factors from different functional perspectives • Ability to perform the evaluation of sustainability factors jointly with affected corporate functions • Ability to integrate affected corporate functions for	• Ability to coordinate affected corporate functions for the implementation of sustainability standards in the supply chain • Ability to bundle	Cross-functional integration (Verona, 1999)

First-order schemes	Second-order schemes	Final schemes
solving sustainability issues in supply chains (i.e. integration of sourcing experts into environmental teams) • Ability to integrate the competencies of affected corporate functions for the implementation of sustainability standards in the supply chain (i.e. supplier trainings)	competencies of affected corporate functions to approach sustainability issues	
• Ability to exploit feedback from stakeholders concerning sustainability practices • Ability to identify best practices and improve sustainability policies accordingly • Ability to incorporate experiences from previous 'sustainability projects' • Ability to modify supply chain processes according to findings in supply chains concerning sustainability issues • Ability to adopt purchasing practices by incorporating sustainability factors • Ability to consider sustainability factors in the new product development • Ability to improve compliance management activities (i.e. supplier audits) to increase the likelihood to reveal potential non-compliances with sustainability standards	• Ability to exploit feedback and lessons learnt • Ability to assess current supply chain processes with respect to their social and environmental performance • Ability to adopt policies and standards to identified sustainability issues • Ability to improve supply chain processes with respect to social and environmental performance	Continuous improvement (Hart, 1995; Benner & Tushman, 2003)

Inter-firm dialogue. In all cases, the interviewees emphasized the importance of open dialogue between their firm and the respective supply chain partners. The focal firms clearly communicated *CSS* related objectives, and by intensive dialogue with suppliers, they made sure that requirements were understood – both by the supplier and themselves. For example, GammaRetail checked via interaction and discussions suppliers' potential gaps between their own and suppliers' understanding of the different sustainability factors, instead of just informing the suppliers about requirements.

> *"[We] help the supplier to deliver as close to what we want as possible. From our point of view there is no point in just issuing it as an instruction to suppliers. What we try to do is to guide them in the direction that we want them to go" (Group Environmental Executive, GammaRetail).*

Interviewed managers not only stressed the discussion of the sustainability standards themselves but also of both sides' underlying philosophy, values and norms to derive effective communication and eventually a common understanding. Particularly, the importance of open dialogues was highlighted.

> *"(...) this thinking was totally new to the Russian company. So, in a way, [they] needed to open their own operations and show how they are working to the Western customers - so we needed to give them reasons why this is important (...) t and what kind of benefits they would get from participating" (Sustainability Manager of a strategic supplier of DeltaPaper, cited in Peters & Schaupp* (2009, p. 10)*).*

Similar to DeltaPaper, AlphaIT stresses the importance of close dialogue with supplier's and the dialogue between suppliers and sub-suppliers to distribute AlphaIT's views. Constant dialogues between AlphaIT and their suppliers – for example during auditing processes or respective follow-ups – remind the suppliers of AlphaIT's expectations and facilitate "guidance on how to correct deficiencies". In turn, AlphaIT is able to recognize opportunities for their own improvements with respect to their sustainability compliance management activities resulting from intense discussions during interactions in training or audits with suppliers. This practice is difficult when supplier audits were performed by third-party auditors, since information might be filtered and potentially not reach AlphaIT.

The BetaRetail case also highlighted that a trustful dialogue allows information sharing and is the basis for any improvement in sustainability practices. Therefore, proper 'inter-firm dialogue' was not only considered key for presenting, explaining and demonstrating the importance of sustainability standards when introducing the *CSS*, but also in later phases when auditing supply chain practices at suppliers: in all cases, discussions about identified gaps and poor conditions lead to improved practices, if reported appropriately adopted to the specific supplier needs.

OmegaTex noted that informal inter-firm dialogue with direct suppliers – beside the formal auditing activities at a supplier's site – might provide the opportunity to gain deeper knowledge about tier-2 suppliers that is not always shared by direct suppliers from the start.

As we have observed in our cases, 'inter-firm dialogue' has a positive impact on the various compliance management activities. It creates a common understanding of sustainability standards and factors, motivates suppliers to follow sustainable practices, enables the development of supplier's societal and environmental capabilities, and increases the probability that suppliers adopt their business practices according to defined requirements.

The rareness and inimitability of 'inter-firm dialogue' in this context can be illustrated by the generally limited availability of personnel who had profound experiences on sustainability factors and practices to perform these dialogues effectively. Inter-firm dialogue is embedded in socially complex interactions and grounded on previously obtained experiences.

Concluding from our observations, we define inter-firm dialogue as a 'two-way' process that breaks down existing assumptions, uncovers shared meanings and facilitates collectively learning in the field of corporate sustainability by exchanging arguments and experiences (Burchell and Cook, 2006; McNamee and Gergen, 1999). In differing context settings, it has also been argued that firms' capability to perform dialogue with stakeholders contributes to run their sustainability strategies successfully (Black and Härtel, 2004).

The identified pattern finds also support in the IE literature where institutional entrepreneur's discursive (Maguire and Hardy, 2006; Munir and Phillips, 2005) and communication skills (Bansal and Clelland, 2004; Suchman, 1995) are acknowledged. However, complementing the existing IE literature, our case findings emphasize the characteristics of a 'two-way' dialogue within inter-organizational processes of the firm and their supply chain partners.

Proposition 1: The capability of 'inter-firm dialogue' is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

Risk management. Nearly all interviewed managers mentioned the challenge of efficiently controlling supply chain partner compliance with their sustainability standards. Most firms' focus lies on their tier-1 suppliers – and particularly on those, which deliver critical materials in terms of hidden sustainability risks. Aiming for a sustainability compliance guarantee throughout the entire supply chain ideally requires that all supply chain partners are audited and monitored regularly, and if any non-compliance is identified, then firms must initiate corrective actions. However, in none of the cases did firms have enough financial and human resources to audit all direct suppliers.

> *"We cannot audit all the suppliers (..) every year, this is impossible" (Purchasing Manager, PsiPaper).*
>
> *"(...) the resources to do something like that would be enormous" (Group Environmental Executive, GammaRetail).*

Only when they decided to differentiate among their suppliers and apply compliance management activities of different scale did economic feasibility become possible.

PsiPaper initially relied on undifferentiated compliance management activities to ensure sustainability compliance. They altered this homogeneous approach when they realized that their supplier base includes suppliers with varying importance and performance on sustainability factors.

The other case study organizations also illustrated how firms followed approaches which structure their supply chains and prioritized suppliers in terms of auditing and monitoring frequency. Thus, firms had to increase their knowledge about practices within the supply chain, and to increase the awareness of potential sustainability issues in order to pre-assess critical suppliers and their delivered components, which may hide non-compliant business practices.

GammaRetail identified critical paths by mapping their supply chains. GammaRetail categorized their suppliers in accordance with the risk associated with a sourced product and the potential business impact, if non-compliant behavior was revealed regarding the production of that product or material. This categorization ranges from 'very high risk' to 'low risk'. Whereas high-risk suppliers are audited on a regular basis with optional supplier development programs, low risk suppliers are only requested to fill in self-assessment questionnaires as a monitoring means. GammaRetail's approach enabled a more efficient usage of their limited resources to maximize control over suppliers' sustainability compliance.

AlphaIT also differentiated its supplier base and considered factors in their risk assessment such as supplier’s location, production and process characteristics, existing supplier relationship and additional available company information about the supplier. Based on the risk assessment, ‘high risk’ suppliers were prioritized by AlphaIT for further actions.

DeltaPaper selectively started to approach sub-suppliers, if sustainability issues were presumed in a critical path, identified by mapping the supply chain.

BetaRetail and AlphaIT early on included sustainability aspects into their supplier selection criteria. Transferring sustainability standards into supplier selection criteria helped to select suppliers with strong sustainability capabilities right from the start and limited later monitoring efforts (Tang, 2006).

The RBV and IE literature rarely refers to the concept of 'risk management' (Battilana et al., 2009; Foerstl et al., 2010; Peters, 2010). In our cases we observe that the

capability of 'risk management' allowed a rigorous prioritization of sustainability risks in the supply chain, which made it possible to implement auditing and supplier development programs of different scales in accordance with the prioritized risks. Risk prioritization enables an efficient usage of limited resources by processing the respective compliance management activities that ensure a supply chain partner's compliance with the *CSS* (Delmas and Terlaak, 2001; Neilson and Pritchard, 2007). The rareness and path-dependence of 'risk management' in the context of sustainable supply chain practices is reflected through the limited availability of profound experiences on which the focal firms could draw on (Foerstl et al., 2010; Reuter et al., 2010). The inimitability can be illustrated by the respective supply chain specificities that must be considered.

Therefore, we define 'risk management' as the identification, assessment and prioritization of sustainability related risks followed by the aligned and efficient application of resources to examine and minimize the probability and/or impact of unwanted non-compliance with sustainability standards (Hubbard, 2009). As we have seen from the cases, all firms followed similar stages in performing 'risk management': identification, analysis, and response (Borge, 2001; Kutsch and Hall, 2009; Raftery, 1994).

Proposition 2: The capability of 'risk management' is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

External stakeholder collaboration. From the case studies we found firms repeatedly highlighted their collaboration with various strategic stakeholders who contributed to the successful CSS implementation in their supply chains. Stakeholders included NGOs, auditors, and major strategic suppliers.

BetaRetail' ability to identify and build up strong relationships with credible and competent NGOs, enabled them to acquire further knowledge in sustainability practices. This ability was key for the joint development of environmental management and certification systems, and the subsequent transfer into suppliers' supply chain practices. This situation also included the ability to integrate external auditing bodies, since in an early phase, the necessary competence to audit in accordance with the *CSS* was not available in-house.

> *"We knew already in the beginning of the project that we would not have the specific knowledge to do the monitoring of the sustainable palm oil production ourselves" (Head of Standards & Social Compliance, BetaRetail).*

DeltaPaper built up strong partnerships with strategic key suppliers which were considered pre-requisite for successfully implementing their *CSS*. The collaborative approach between DeltaPaper and selected key suppliers enabled both sides to combine different aspects of the supply chain and to explore counterpart's competencies during joint activities. Together, they approached tier-2 suppliers (i.e. DeltaPaper's sub-suppliers) in the upstream supply chain with 'one voice', leading to an increased persuasiveness with respect to sustainability practices.

> *"Instead of receiving pressure from downstream your company in the supply chain and putting pressure above you in the upstream, we could now say: Well guys, we all want the same thing, so instead of getting one to put pressure on each other, let's work together and agree on the objectives and try to have a partnership, so the achievements can happen for everyone"(Director of Forestry and Recycling of a strategic project partner of DeltaPaper, cited in Peters & Schaupp* (2009, p. 20)*).*

Furthermore, AlphaIT's project results showed that the intense collaboration with external stakeholders – who possess wide-ranging expertise in the fields of social and environmental sustainability issues, and cultural and legal aspects – improved AlphaIT's sustainability performance as well as participating supplier's compliance with the CSS.

In all cases, we have observed that the integration of competent and sustainability concerned stakeholders allowed firms to fill in missing internal knowledge about sustainability issues during interactions or to bundle their capabilities for joint efforts. However, building the relationships usually followed a long and intensive process. The rareness of these capabilities is reflected by the limited availability of stakeholders (e.g. NGOs) which both are willing to build such relationships and provide targeted sustainability competencies.

> *"[We] learned how to gain and how to 'flirt' with an NGO and to gain them to participate. And it took many months" (Corporate Sustainability Officer, DeltaPaper, cited in Peters & Schaupp* (2009, p. 11)*).*

Further, trust with external stakeholders is path-dependent and "can not be easily imitated by competitors" (Sharma and Vredenburg, 1998, p. 740).

Concluding from our observations, we define 'external stakeholder collaboration' in the context of sustainable supply chain management as the cooperation of strategic stakeholders in which sustainability concerned solutions are jointly developed and implemented in supply chains by making use of each other's knowledge, resources or competencies (cf. Olden, 2003; Peters et al., 2011; Sharma and Vredenburg, 1998).

The capability of 'external stakeholder collaboration' enables the identification of relevant stakeholders and the effective cooperation with them (Mitchell et al., 1997; Sharma and Henriques, 2005). Further, it facilitates the establishment of trusted relationships (Oliver and Holzinger, 2008) as basis for the later exploration of external stakeholders' tacit knowledge and competencies (Lavie and Rosenkopf, 2006; Rothaermel and Deeds, 2004).

Proposition 3: The capability of 'external stakeholder collaboration' is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

Cross-functional integration. Interview partners considered implementation of *CSS* partially operated by cross-functional teams, integrating the different perspectives of corporate functions, as crucial for success. Stepwise, studied firms had included experts with different backgrounds such as purchasing, legal, communications, quality etc. in 'sustainability task forces'. The bundling of the various knowledge enabled firms to perform their compliance management activities attuned to the various sustainability issues in the supply chain.

PsiPaper highlighted that their sustainability group firstly struggled with challenges of existing supply chain configurations, since they lacked related knowledge. After the integration of dedicated purchasing personnel, they were more effective in solving sustainability issues that have their origin in the upstream supply chain (Bowen et al., 2001).

> *"[We] chose people from different parts of the organization to form an effective working group to drive the whole process of sustainability forward (...) Up until recently, we had nobody in the sustainability working group from sourcing. And we recognized that that was a problem"(Group Sustainability Executive, PsiPaper).*

BetaRetail outlined that they were only able to solve certain issues by the systematic approach of their cross-functional sustainability team *"depending on specific people*

and their personal network inside and outside [of the firm]" (Head of Standards & Social Compliance, BetaRetail).

OmegaTex highlighted that only through close collaboration between the purchasing, engineering and quality assurance department, was OmegaTex able to improve product specifications in such a way that a product's environmental impact was continuously reduced. Moreover, improved product specifications had also an impact on sourced goods and implicitly required suppliers to improve their sustainability performance in line with OmegaTex's requested CSS.

The studied cases support the tendency of cross-functional teams becoming standard management practice. Nevertheless, the capability of 'cross-functional integration' was illustrated as being causally ambiguous and socially complex since various corporate functions with different personnel, objectives and tasks must be thoroughly coordinated (Peters et al., 2011).

Concluding from our observations, we define the capability of 'cross-functional integration' as "adhesive by absorbing critical knowledge from external sources and by blending the different technical competencies developed in various company departments" (Verona, 1999).

RBV literature predominantly discusses 'cross-functional integration' with linkage to new product development processes. In our research we observed that the 'cross-functional integration' capability comprises the ability to include and to coordinate representatives from various sustainability concerned corporate functions, facilitating the bundling of different expertise (Brown and Eisenhardt, 1995; Eisenhardt and Martin, 2000), which effectively supports the execution of various compliance management activities.

Proposition 4: The capability of 'cross-functional integration' is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

Continuous improvement. In a majority of the cases, the studied firms continuously improved their structures and processes, including compliance management activities, which subsequently positively contributed to their supply chain partners' compliance with the respective *CSS*.

DeltaPaper and BetaRetail reported their ambitions for continuous improvements concerning tools and methods used for supply chain assessment and supplier auditing purposes. DeltaPaper tried to accelerate their learning curve and incorporated past experiences into better methods for risk assessments. Similarly, BetaRetail permanently sought for innovations in their auditing mechanisms to reveal suppliers' non-compliant business practices.

> *"We are continuously developing new methods for auditing the supply chain. For example we can go to the plantations and measure them with a GPS device and then feed all the coordinates into Google earth. Then we can use satellite pictures to see if they have expanded their plantations into the rain forest" (Head of Standards & Social Compliance, BetaRetail).*

GammaRetail emphasized that they make use of input and feedback received from their trading managers and various external stakeholders, thus GammaRetail's sustainability team was able to incorporate recognized best practices into their sustainability policy. At DeltaPaper, we also observed how policies and principles were improved by incorporating experiences from former projects. Frequently, interviewees mentioned that DeltaPaper learned from project collaborations with suppliers and vice versa during supplier development programs - e.g. identified and subsequently analyzed sustainability issues were incorporated into improved management systems, thus gaps were closed.

BetaRetail analyzed findings they gained in one supply chain concerning the beneficial application in other supply chains. OmegaTex highlighted their continuous efforts to control potential non-compliance of suppliers via improvements within specifications for products they source from suppliers. OmegaTex was able to indirectly influence certain sustainability factors within the production processes at their suppliers' site and beyond the tier-1 supplier level due to these improvements.

The rareness of approaches to improve sustainability performance was in most cases reflected by the limited availability of experienced experts and partners with deep experiences in sustainability practices who could contribute to improvements. Furthermore interviewed managers highlighted the importance of continuously improving their indirect supplier management practices (e.g. managing tier-2 suppliers), since their previous experiences with those were still limited.

Observed adaptive learning routines leading to improvements outline the inimitability of the identified capability. The capability of 'continuous improvements' enabled through intra- and inter-organizational routines that valuable tacit knowledge was made explicit (Brown and Duguid, 1991), resulting in improved compliance management activities, which consequently improved sustainability performance in the supply chain (Repenning, 1999).

Consequently, we define 'continuous improvement' in our context as the ongoing effort to improve processes, policies and products in terms of social and environmental performance by the evaluation of current practices, and the incorporation of feedback and lessons learnt (Benner and Tushman, 2003; Hart, 1995). The relevance of the continuous improvement capability is also discussed in other literature on sustainability that considers the success of focal firm's sustainability strategies (Christmann, 2000; Hart, 1995; Sharma et al., 2007).

Proposition 5: The capability of 'continuous improvement' is positively related to the successful implementation [i.e. institutionalization] of the corporate sustainability standards.

A.4 Summary of results

Literature discussed how organizations acting as institutional entrepreneurs have managed to change traditional practices in organizational fields to new norms, beliefs and values. While this institutional change generally incorporates three steps: development, establishment, and final implementation of new rules and norms, the final implementation step is less investigated (Battilana and Leca, 2009; Wijen and Ansari, 2007). Although the importance of the institutional entrepreneur's (the focal firm's) capabilities to drive institutional change is widely acknowledged, researchers explicitly called for a more systematic approach to examine such capabilities (Battilana and Leca, 2009; Battilana et al., 2009; Lawrence and Suddaby, 2006). Efforts to understand IE within a supply chain have also been limited.

Our research sought to examine how capabilities enable the focal firm to successfully implement previously defined CSS throughout its supply chain. We did this by using six comparative case studies. We were able to identify five key capabilities which contribute to the institutional change: (1) inter-firm dialogue, (2) risk management, (3)

external stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement.

The capabilities allow the institutional entrepreneur to build up a common understanding about the new standards among affected parties; to identify, prioritize and approach standard non-compliances; to collaboratively solve of issues occurring during the standard implementation (either supported by external stakeholders or cross-functional units internally); and to continuously advance processes and methods with respect to the standard implementation. These capabilities specifically enable the effective execution of a sound sustainability compliance management throughout the supply, consisting of activities such as monitoring value chain partner's behavior (i.e. supplier auditing) or performing corrective actions (i.e. supplier development). Consequently, they account for higher level of supply chain partners' compliance with the CSS, reflecting the institutionalization of the CSS (see Figure A - 2).

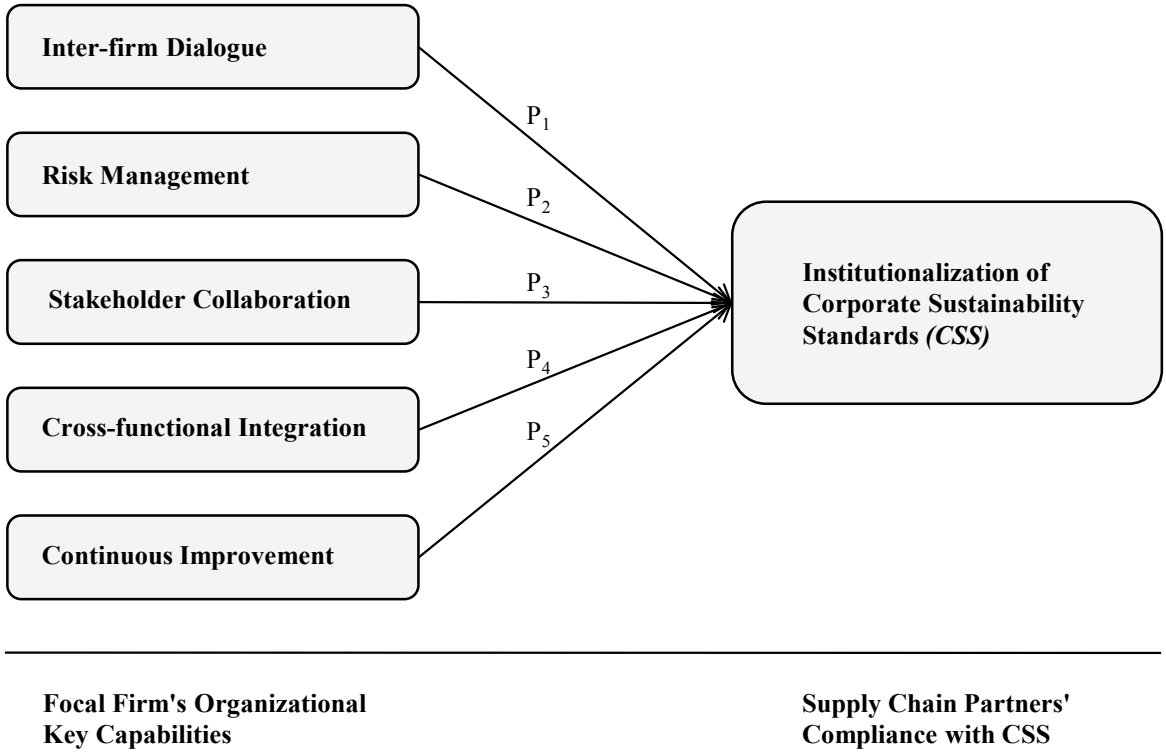

Figure A - 2. Summary of research findings

These are all direct relationships as seen by Figure A - 2. Yet, within a broader theoretical framework these relationships may provide greater insight into how the resource-based view, using capabilities, is a necessary theoretical underpinning for implementation of sustainability standards which may be driven by various

institutional forces. The understanding of and evidence of how these capabilities can be utilized by a supply chain entrepreneur for institutional change in the supply chain are important and critical if sustainability is to diffuse throughout the supply chain. Additional nuanced relationships may also exist beyond the direct relationships. For example the mediation or moderation of these factors to each other and other external characteristics that might exist before the implementation phase of IE are also considerations.

A.5 Conclusion and discussion

Our research examined the institutionalization of CSS in supply chains driven by a focal firm acting as an institutional entrepreneur. The research contributes to IE literature by putting a stronger focus on the factors facilitating the implementation institutional change (Battilana and Leca, 2009; Wijen and Ansari, 2007), while identifying key capabilities that specifically support the firm's efforts during the institutionalization phase. It also contributed to the literature by further incorporating IE concepts to the supply chain, especially with respect to sustainability.

Firms having formally established CSS as new institutions for their upstream supply chain, face the uncertainty of whether their supply chain partners comply with the issued CSS. The identified capabilities contribute to reduce these uncertainties (and other barriers) and suggest higher success rates for institutional entrepreneurs possessing these capabilities.

Our findings provide further grounds that together RBV and IE are both valuable explanatory theoretical paradigms for supply chain management research and theory building. During the research process, we continuously compared emerging IE processes with capabilities that were previously reported in the RBV literature. This consideration enabled us to identify the following capabilities of (1) inter-firm dialogue, (2) risk management, (3) external stakeholder collaboration, (4) cross-functional integration, and (5) continuous improvement, which collectively made the focal firms (i.e. institutional entrepreneurs) more, or less, successful with respect to their implementation efforts with the existence or lack of these capabilities. Accordingly, we discussed whether these capabilities fulfill the criteria for key capabilities outlined by the RBV and reviewed them against the background of

relevant literature. This argumentation suggests that firms – having built up the necessary capabilities – can gain advantageous positioning against competing supply chains.

These theoretical linkages also aid researchers in further understanding of how sustainability practices may diffuse throughout the supply chain, not only the dyadic nature of traditional supply chain studies. That is, sub-supplier adoption of sustainability standards may be greatly enhanced by further understanding of how certain capabilities are developed and managed by focal firms or other partners within the supply chain. Given that institutional theory as applied to the full supply chain is still in its infancy, this work represents novel and initial efforts to build both general supply chain theory, but also sustainable supply chain theory (Sarkis et al., 2011).

In general, the results further support the application of a contingency based institutional theoretic based perspective to diffusion of non-business oriented standards across the supply chain. Thus, there are general theoretical insights and specific sustainability and supply chain management insights garnered from this study.

The practical implications of the research should not go unnoticed. Organizations are dealing with real and significant forces in managing their image, reputation, and long terms economic sustainability. The use of sustainability standards (corporate or otherwise) is critical to the long-term viability of many organizations. Without the effective implementation of CSS firms may lose market share or complete business in certain markets and locations. Getting buy-in across and throughout the supply chain by supply chain partners into these CSS is serious. Knowing what capabilities to build is a first step in the successful implementation (i.e. institutionalization) of what could be critical CSS.

A.6 Limitations and future research

This paper focused on six focal firms and their supply chains and respective industries: the food/retail industry, the paper industry (two cases each), the medical textile industry and the electronic industry (one case each). The investigation of other firms and industries could reveal further insights. To draw generalized conclusions, future research should testing our research propositions against a large set of data including other industries As we relied mainly on data provided by informants from focal firms

and their direct suppliers, future research may put stronger focus on including indirect upstream suppliers beyond tier-1 suppliers (Lee, 2008; Millington, 2008; Vermeulen and Ras, 2006).

Also, even though we have provided a general set of relationships and identified critical capabilities for diffusion of CSS throughout the supply chain, the level and prioritization for each capability is still not completely understood. The direct relationships of these key capabilities do exist, but indirect relationships with each other and with other contextual variables requires more investigation. We have attempted to keep this a parsimonious model due to the exploratory nature of our study. Further investigations to tease out nuances with these and other capability factors are needed. The relationship to success in previous IE stages such as emergence and planning are also important. These issues will not only focus on the design of the process for diffusion of new institutions, but also on the institutions themselves. We have focused on corporate sustainability standards in our study, whether business, economic, and political norms can be diffused through a supply chain utilizing the same or different capabilities are also fertile areas for investigation.

There are many interesting questions to answer as supply chain competition continues to increase. Supply chain development and theory can only benefit as further understanding of applicable theory is understood, developed and applied. We believe we have contributed to this further understanding.

Acknowledgments

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A.7 Appendix

Interview guideline

1. Company's sustainability approach

- Background: impulse, motivation, drivers
- Internal sustainability strategy: objectives, policies, practices

2. Supply chain strategy

- Supply chain strategy: normative, strategic and operational level
- Configuration of the supply chain
- Relationship to suppliers
- Main supplier performance requirements and selection criteria

3. Sustainability standards for the supply chain

- Embeddedness in overall supply chain strategy and relationship to other supplier performance requirements
- Contents and characteristics of standard, actors involved in setting the standard

4. Standard introduction

- Roadmap, processes, mechanisms and practices for implementing the standard in the supply chain
- Scope of standard implementation
- Internal and external actors involved in introducing the standard in the supply chain

5. Driving/ensuring compliance

- Processes, mechanisms and practices for driving/ensuring compliance
- Scope of initiatives
- Internal and external actors involved in driving/ensuring compliance

6. Monitoring compliance

- Processes, mechanisms and practices for monitoring compliance
- Scope of monitoring activities
- Internal and external actors involved in monitoring compliance

B. Exploring sustainability compliance of sub-suppliers

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Firms face the challenge for ensuring compliance of their corporate sustainability standards (CSS) by their suppliers and sub-suppliers. Supplier management strategies are key to increasing suppliers' sustainability performance. While firms' sustainable supplier management practices towards their first-tier suppliers have been studied relatively extensively, little is known on how firms influence suppliers beyond the first-tier level, i.e. their sub-suppliers. Firms' challenges include the identification of sub-suppliers, few opportunities, and enforcement of changes. This study investigates the sub-supplier management practices of two focal firms in the electronics and retail/food industries using case study research. Our findings propose that firms can improve sub-suppliers' compliance with their CSS by actively managing sub-suppliers through assessment and collaboration. In addition, it was found that (1) public attention, (2) perceived risks, and (3) channel power are antecedents to sub-supplier management. A moderating role of strategic business partner involvement amplified the positive effect of sub-supplier management on sub-suppliers' compliance with their CSS. This moderator plays a differentiating role when compared to traditional supplier management practice. This paper is one of the first studies addressing the management of sub-suppliers from a sustainability perspective. It proposes a framework for understanding sub-supplier management to achieve sustainability compliance, which can also be used for further research and theory development.

Key words: Sustainable supply chain management, multi-tier supply chain management, sub-supplier management, corporate sustainability standards, exploratory case study research.

B.1 Introduction

Since the emergence of the public debate on environmental sustainability in the early 1970s, researchers and practitioners realized the importance of the industrial sector to achieve sustainable development. Corporate sustainability consists of the three dimensions: the natural environment, society, and economic performance. At this intersection of social, environmental, and economic performance, organizations can engage in activities that positively affect the natural environment and society, while maintaining long-term economic benefits and competitive advantage for the firm (Carter and Rogers, 2008). We build and contribute to this understanding by focusing on a focal firm's objective to improve social and environmental sustainability in its upstream supply chain beyond their first-tier supplier level.

External stakeholders (e.g. consumers, investors, NGOs) introduce significant pressures to which companies have to respond. Often times they do not differentiate between the behavior of the focal firm or its suppliers and sub-suppliers (Choi and Linton, 2011; Koplin et al., 2007; Rao, 2002). An increasing number of firms voluntarily make corporate sustainability claims. They specify their sustainability commitment in corporate sustainability standards (CSS), which commonly comprise statements to comply with legal requirements and add aspects that voluntarily go beyond the regulatory requirements (Bansal and Hunter, 2003; Barnett and King, 2008). Any party in the supply chain not complying with the focal firm's corporate sustainability standards can potentially damage the focal firm's corporate reputation or harm customer confidence (Barnett and King, 2008; Wagner et al., 2009).

Focal firms face significant uncertainty on whether their suppliers and higher tiers of upstream sub-suppliers comply with their CSS (Matten and Moon, 2008; Roth et al., 2008). The recent environmental misbehavior by Nestlé's sub-supplier Sinar Mas underpins how a brand can suffer from such misbehaviors. An effective Greenpeace-campaign accused Nestlé of sourcing palm oil, which was responsible for rainforest destruction, from a sub-supplier and forced Nestlé to change its sourcing decisions (The Economist, 2010). Other brands such as Nike and Mattel have similarly brought their sub-suppliers into focus after scandals at sub-supplier sites were revealed.

Supplier management strategies are key to increasing suppliers' sustainability performance (Brammer et al., 2011; Reuter et al., 2010; Wolf, 2011). While focal

firms' sustainable supplier management practices towards their first-tier suppliers have been studied relatively extensively (Brammer et al., 2011), little is known on how firms may approach suppliers beyond the first-tier level in multi-tier supply chains, i.e. their sub-suppliers (Lee, 2008; Millington, 2008; Seuring and Mueller, 2008a). Although literature indicates a long tradition on multi-tier (multi-echelon) supply chains issues, those considerations are mainly limited to simulation or modeling approaches with a focus on production, inventory and distribution dynamics (e.g. Clark and Scarf, 1960; Lee and Whang, 1999; Sterman, 1989). Yet, multi-tier supply chain challenges ranging from the mere identification of sub-suppliers to few opportunities to enforce sub-suppliers' practices have not been covered. Only recently, empirical (qualitative) research also considered multi-tier supply chain settings and observed how power balance, interdependence, and relationship stability depend on the structural arrangements of the multi-tiered supply chain consisting of a focal firm, a supplier and a sub-supplier (Mena, Humphries, & Choi, 2013). Evidence how sub-suppliers' practices, behavior or performance can be actually influenced by focal firm's managerial practices are limited.

Shifting our focus to sustainability challenges, the research on sub-supplier management in sustainable supply chains has been virtually non-existent, although it plays a critical role given the systemic characteristics of this field. Whereas sustainable supply chain management research has predominantly focused on dyadic relationships between firms and immediate supply chain partners, we seek to extend these organizational boundaries within our research (Sarkis, 2012a). Using the literature on sustainable supply chain management and insights from two case studies within the electronic and retailing/food industry, our research aims to increase understanding about "sub-supplier management" in the context of sustainability guided by the following research question:

> *Under which circumstances and to what extent do firms manage their sub-suppliers in order to ensure that these sub-suppliers comply with the firms' corporate sustainability standards (CSS)?*

In this paper we set the stage with a background and literature review of issues and theories surrounding sub-supplier management and CSS in sustainable supply chains. We then provide additional investigation using detailed case studies of two firms, Hewlett-Packard and Migros furthering our insight into the phenomenon of CSS

diffusion in the supply chain. The case study information provides foundation for a series of propositions around a testable framework to advance theory and knowledge in this field. Implications and future research directions form the concluding section of this paper.

B.2 Background

Firms have increasingly focused on their core competencies to maintain competitive advantages. Organizations tend to outsource non-core activities and capabilities to suppliers (Barney, 1991). These suppliers may be more innovative, less costly, provide higher quality, and offer more capacity than the firm can achieve by itself. In turn, firms' success becomes more dependent on the capabilities of their suppliers. However, not all suppliers may sufficiently contribute the necessary capabilities to achieve or maintain firm's targeted competitive advantage (Krause et al., 1998). Therefore, aspects such as quality, cost optimization, delivery, product development, or sustainability may play a key role within supplier management strategies to control suppliers' performance (Bai and Sarkis, 2010b; Wagner, 2010).

Shifting our focus to supply chain sustainability, firms make predominant use of (1) requesting certifications (e.g. ISO14000) from suppliers, (2) supplier evaluation and selection processes in accordance with selected sustainability criteria, (3) supplier monitoring and audits, and (4) supplier development programs to improve suppliers' sustainability (Brammer et al., 2011).

Third party supplier certifications require that suppliers fulfill certain minimum requirements, and are externally verified (Delmas and Montiel, 2009). It allows for an efficient screening and pre-selection of suppliers for a 'short-list'. Further evaluations of suppliers according to defined sustainability criteria during supplier selection processes enable selection of more "capable" suppliers and reduce the risk that any non-compliance might be revealed in later periods (Foerstl et al., 2010; Reuter et al., 2010). Social and environmental audits may also be used to evaluate suppliers' actual sustainability performance against requested corporate sustainability standards in order to identify any potential non-compliance (Boyd et al., 2007; Darnall et al., 2009; Teuscher et al., 2006). Various organizations such as the focal firm itself, NGOs or independent auditing companies could be integrated into the audit process (Locke,

Qin, et al., 2007). Depending on the organization processing the audit, an audit can be first party audits (i.e. self-assessments processed by the supplier itself), second party audits (i.e. by the buying firm, which may include the buyer's buyer), and third party audits (i.e. by an independent, accredited auditing company) (Darnall and Carmin, 2005). Supplier monitoring refers to the more informal type of auditing with the purpose of continuously observing suppliers' performance (Brammer et al., 2011). In case of any identified deficiencies, supplier development programs (including training, workshops, transfer of employees etc.) are foreseen as means for corrective actions to support the respective supplier in developing its capabilities (Bai and Sarkis, 2010a).

These supplier management practices can be summarized along the two dimensions: assessment (i.e. requesting certifications, supplier evaluation and selection, supplier monitoring and audits) and collaboration (i.e. supplier development including activities such as trainings, workshops, or employee transfers) (Klassen and Vachon, 2006). Whereas assessment practices have a more unidirectional focus characterized by gathering information and evaluating suppliers' sustainability performance, collaboration practices are comprised of interactions with suppliers to enable the integration of tacit knowledge and the joint development of sustainability solutions (Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008).

Past sustainable supply chain research predominantly focused on the investigation of these practices on immediate suppliers. Little research has considered sub-suppliers (beyond tier-1 suppliers) on sustainable or even more general topics (Mena et al., 2013; Millington, 2008). Firms have recognized the relevance of considering their overall supplier network and have more recently started to manage beyond the first-tier supplier level (Choi and Linton, 2011; Choi and Wu, 2009). Few firms actively manage their sub-suppliers, and those sub-suppliers are usually part of extraordinary supply paths (Ciliberti et al., 2009). Even less knowledge exists on how sub-suppliers can be managed from a sustainability perspective.

B.3 Literature review

The literature provides initial evidence on how firms approach sub-suppliers and how interactions, direct and indirect, occur. The consideration of sub-suppliers in a sustainable supply chain is especially pivotal. A number of real-world cases exist (e.g.

Nike, Nestle, Mattel), where sub-supplier actions greatly influence a focal firm's reputation, when the sub-supplier's environmental or social misbehavior become public. However, such misbehavior is usually not immediately observable at the supplied product. This lack of clarity of influence shows the difficulty for the focal firm to ensure sub-supplier's compliance with its CSS.

Recent surveys reveal that only about 10-15% of corporations require the proof that sub-suppliers comply with certain sustainability standards (Schaltegger and Harms, 2010). Much of this 'proof' is restricted to the formal proof by signed codes of conduct or certifications such ISO14001[42] or SA8000[43]. Other practices and initiatives are not well reported. The focus on certifications is not necessarily misguided as one study in the Spanish automotive industry has found that organizations who adopt certifications for their environmental management systems (e.g. ISO 14001 or EMAS[44]) tend to pass on sustainability requirements to their suppliers (Gonzalez et al., 2008).

In multi-tier supply chains, SA8000 certifications can smooth the progress of coordinating first-tier suppliers by reducing information asymmetry and transaction costs (especially searching, negotiation, monitoring, bonding, enforcement costs). SA8000 certified companies have to evaluate and select suppliers on the basis of the fulfillment of SA8000 principles. Effectively, it encourages suppliers to adopt socially responsible behavior. This dissemination effects multiple tiers in the supply chain (Ciliberti et al., 2009).

Given the novelty and complexity of issues surrounding social and environmental sustainability, managers find it difficult deal with much more than the first-tier of suppliers due to resource limitations (Welford and Frost, 2006).

Although direct pressures on sub-suppliers are not as common, motivating first-tier suppliers to consider environmental factors in their own supply chain management may help firms manage their sub-suppliers indirectly (Lee and Klassen, 2008). Other studies report that sustainability concerned firms increasingly contract suppliers that tend to pass firm's sustainability requirements to sub-suppliers (Schneider and

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[42] ISO14001 specifics requirements for an auditable environmental management system (ISO, 2012).

[43] SA8000 is an auditable social sustainability standard based on conventions of the International Labour Organization, United Nations and national laws (SAI, 2012).

[44] EMAS (EU Eco-Management and Audit Scheme) is a management tool for organizations to assess and report their environmental performance (European Commission, 2012).

Schwerk, 2010). Thus, suppliers which have supplier management programs in place to control their own suppliers (i.e. the focal firm's sub-suppliers) largely contribute to a focal firm's efforts to extend their reach beyond the first-tier level (Spence and Bourlakis, 2009). In cases where first-tier suppliers do not take their responsibility of passing sustainability requirements to sub-suppliers, focal firms might establish direct relationships with lower tier-suppliers or request their first-tier suppliers to select sub-suppliers from approved "vendor lists" (Linton & Choi, 2011).

Successfully managing the entire supply chain by engaging with stakeholders of all stages in joint voluntary sustainability initiatives can be achieved (Teuscher et al., 2006). Strong partnerships along the supply chain (including sub-suppliers) may enable joint planning in various key areas and provides a focal firm further opportunities to evaluate its supply chain partners' sustainability performance (Grimm et al., 2011; Peters et al., 2011).

Most of the currently available studies on managing sub-supplier sustainability put the onus of managing sub-suppliers on the first-tier suppliers. There are studies that have investigated more direct relationships between the focal firm and its sub-suppliers. One study involves mapping of a firm's supply chain to increase transparency and identify potential sustainability misbehavior (Boyd et al., 2007). In another study a case is described in which a firm managed requested information about focused sustainability factors (e.g. carbon emission) from its first-tier supplier and sub-suppliers. Even in this multi-tier supply chain management study, the extent of involvement between the focal firm and the sub-suppliers was limited (Wolf, 2011).

Overall, we have found a modest amount of research investigating the sustainability relationships between focal firms and their sub-suppliers. The few studies that have described focal firms' practices referring to the sub-suppliers described practices of the relationships (e.g. supply chain mapping or very specified information gathering (Boyd et al., 2007; Wolf, 2011)) rather than detailed or critical analysis and theoretical development. Many firms simply rely on their first-tier suppliers to manage sub-suppliers in the upstream supply chain (Gonzalez et al., 2008; Lee and Klassen, 2008; Spence and Bourlakis, 2009).

Practically, focal firms' management of their sub-suppliers is a new task for which little knowledge exists from and for both practitioners and academics (Wognum et al.,

2002). Therefore, our study aims to increase our understanding of "sub-supplier management" through exploratory case study research.

B.4 Methodology

The research surrounding firms' management of their sub-suppliers, especially from a sustainability perspective, is still relatively immature. Given the immaturity and complexity of this field we have chosen an exploratory case study research approach in order to identify a framework for further research and investigation (Stuart et al., 2002). Aiming for high rigor throughout our research phases, we took the following four quality measures into account (Yin, 2003): (1) construct validity, (2) internal validity, (3) external validity, and (4) reliability as summarized in Table B - 1 and discussed in the following sections.

Table B - 1. Research quality measures (adapted from Yin, 2003, p. 33)

	Objective	**Actions taken**
Construct validity	Establishing correct operational measures for the constructs under study	Development of interview guide line based on reviewed literature
		Multiple data/information sources
		Multiple interviewers
		Interviewees reviewed transcripts
Internal validity	Establishing causal relationships and distinguish them from spurious relationships	Inclusion of multiple data/information sources and triangulation of primary and secondary data
		Control for social desirability
		Open coding and pattern matching
		Inter-rater agreement by discussion of authors
External validity	Establishing a domain in which the findings can be (partially) generalized	Theoretical sampling approach
		Comparative case study design by including more than one case study firm and industry (limitations that result from limited number: two case study firms)
Reliability	Demonstrating that the study can be repeated with the same results	Development and application of case study protocol and database
		Most senior author not being involved during the data collection phase

B.4.1 Case selection

Initially a long list of potential cases was developed. We included firms with complex supply chains, a global reach, and procuring goods with a major share of value added beyond the first-tier supplier level. This case sample list was shortened using the following selection criteria: (1) firm's sensitivity and maturity towards sustainability in their multi-tier supply chains (Buysse and Verbeke, 2003), (2) pressure by external stakeholders to conduct sustainable supply chain management (Eesley and Lenox, 2006), and (3) running supply chains containing sub-suppliers with high relevance to the focal firm (Lee and Klassen, 2008).

Consequently, two leading firms within the field of sustainability and sustainable supply chain management and actively addressing sustainability issues beyond the tier-1 supplier level were selected: Hewlett-Packard and Migros. These case study firms conduct "sub-supplier sustainability management" to a greater extent compared to their industry peers, thus enabling us to observe the focused research phenomenon within two industry settings. However, Hewlett-Packard and Migros also faced challenges while approaching their sub-suppliers, also permitting the identification of "barriers" within the management of sub-suppliers – beside identified "success factors". Focusing on these two cases allows us to conduct a robust in-depth analysis of their complex supply chains while still allowing for a comparative analysis. The described theoretical sampling approach helps to increase external validity of our research findings (Gibbert et al., 2008; Yin, 2003). Table B - 2 provides an overview of the two case study firms.

Table B - 2. Overview of cases

	Hewlett-Packard (HP)	**Migros**
Industry	Information and communication technology	Retailing/food
Sales	USD 126 bn (in 2010)	CHF 25 bn (in 2010)*
Employees	325,000 (in 2010)	83,500 (in 2010)*
First-tier suppliers	1,000 50,000 non-production suppliers	4,000 n/a
Second-tier suppliers	n/a	4,000 registered sub-suppliers
Customers	Enterprises, Government Agencies, Consumers	Consumers
Requested sustainability standards	HP's Electronic Industry Code of Conduct (HP-EICC)	Business Social Compliance Initiative (BSCI) Code of Conduct

* incl. business units that are not in Migros' core business: financial services, travel, and shared services.

B.4.2 Data collection

Starting with our case study research, we developed a case study protocol in which all relevant information to our research procedure was continuously documented (e.g. research purpose and question, case study schedule, methodological reminders, etc.) (Yin, 2003).

In order to ascertain construct validity, a three-step data collection process was followed (Gibbert et al., 2008). First, secondary data was collected from the respective focal firm to gain initial insights. Second, semi-structured interviews with key personnel (senior management) responsible for sustainability factors in the firm's supply chain were conducted. Interviews allow the interaction with the respective informant and enable the immediate clarification of differing definitions/understandings concerning sustainability, or sub-supplier related context factors. To minimize social desirability bias within the interviews, discussions about critical aspects were linked to more objective secondary data (e.g. audit statistics or public reports). The underlying interview guideline was developed in line with reviewed literature and appears in the Appendix (see section B.8). Interviews lasted between 1.5 and 2 hours and were conducted by two authors. The most senior author did not take part in the data collection, enabling a more independent view during the subsequent analysis and increasing reliability of our research.

Interviews were transcribed and verified by interviewees. Subsequently these transcriptions were analyzed for early identification of emerging results that were subject to follow-up interviews (Yin, 2003). Third, narrative accounts were explicitly analyzed with respect to discrepancy. For any identified discrepancies, further data was consulted in order to obtain a accurate "story" (Pentland, 1999). The primary and secondary data used for triangulation are summarized in Table B - 3. In order to further increase reliability we maintained a case study data base throughout our case study research, in which all observations, notes and collected data were retrievable (Yin, 2003).

Table B - 3. Data sources

	Hewlett-Packard	**Migros**
Primary data	Program Manager and SC SER Lead Auditor *(2 interviews)*	Director Strategic Procurement and Supply Chain Support *(1 interview)* Head of Social Compliance and Standards *(2 interviews)*
	Presentation of SER Lead Auditor at "BME Green Procurement Day" (09/12/2009 in Frankfurt, Germany) *(and follow-up interview)* Presentation of SER Lead Auditor at "Stakeholder Day" (08/11/2012 in Bonn, Germany) *(and follow-up interview)*	Presentation of Head of Issue Management and Sustainability at "St.Galler Forum zu Nachhaltigkeit im Handel" (23/03/2011 in St.Gallen, Switzerland) *(and follow-up interview)* Presentation of Head of Social Compliance and Standards at "3rd BSCI Food Conference" (13/06/2012 in Brussels, Belgium) *(and follow-up interview)*
Secondary data	Project report (including verbatim quotes of direct suppliers and sub-suppliers) by the Danish Commerce and Companies Agency (DCCA, 2008)	Project description of Migros' co-foundation of the Roundtable on Sustainable Palm Oil (RSPO), including interactions and challenges with sub-suppliers (Grimm et al., 2011; Hamprecht, 2006; Peters, 2010; Peters et al., 2011)
	Annual Reports Sustainability Reports Audit statistics Websites Codes of conduct Supplier Management Systems	Annual Reports Sustainability Reports Audit statistics Websites Codes of conduct Supplier Management Systems
	Documents and presentations by the Electronic Industry Citizenship Coalition	Documents and presentations by the Business Social Compliance Initiative

B.4.3 Data analysis

Transcripts and collected secondary data were independently coded by two authors using open coding schemes to identify key factors. Therefore, codes were assigned to specific terms and statements of collected primary and secondary data and subsequently structured into categories, which enabled us to reduce data complexity. Following an incremental process, we stepwise crafted concept maps to visualize key factors and relationships between them, and tabularized case data according to observed key factors (Jackson and Trochim, 2002). To avoid investigator bias and to ensure inter-rater reliability, we compared and discussed individual authors' results after each process step. Initially an analysis of each case was completed separately to increase understanding for a within case contextual environment.

Following the within-case analyses, a cross-case analysis to identify differences and common patterns was performed. Emerging concepts were categorized and compared (e.g. categorization of management practices or triggers for managing sub-suppliers), and tabularized in spreadsheets (Eisenhardt and Graebner, 2007; Yin, 2003).

B.5 Case studies

This section provides an overview of the two cases and their context along with a description of identified approaches for managing these firms' sub-suppliers.

B.5.1 Hewlett-Packard

Hewlett-Packard (HP) is one of the largest global information technology (IT) companies. HP is an early industry leader of supply chain sustainability initiatives. In 2002, HP introduced a supply chain code of conduct, and in 2004, HP co-founded the Electronic Industry Citizenship Coalition, including the development of an industry-wide code of conduct, the Electronic Industry Code of Conduct (EICC).

> *"EICC promotes an industry code of conduct for global electronics supply chains to improve working and environmental conditions."* (EICC, 2009a)

HP's sustainability requirements towards suppliers and sub-suppliers

The EICC comprises labor, health and safety, environment, and ethics dimensions. Generally accepted standards such as the International Labour Organization core

convention, United Labour Global Compact, ISO14001, SA8000, and Ethical Trading Initiative have been integrated into this code.[45] EICC signatory firms are obliged to comply with the laws, rules and regulations of the countries they operate in. They are encouraged to adopt even stricter environmental and social regulations that go beyond compliance. Signatories are also obliged to transfer the regulations of the code at least one stage to their first-tier suppliers. (EICC, 2009a, 2009b; HP, 2007). HP established even stricter requirements beyond EICC, supplementing the standard with additional requirements on freedom of association, resulting in the so called "HP-EICC" (HP, 2011a).

Motivation for managing sub-suppliers (sustainability issues beyond tier-1 supplier level)

Due to its leading industry position, HP has increasingly faced stakeholder pressure to improve business practices along their entire supply chains including sub-suppliers beyond the first-tier supplier level.

> *"Heightened media, government, and customer attention, as well as the involvement of new governmental and non-governmental organizations (NGOs), has increased the public profile of many issues we are working to resolve."*(HP, 2011a)

HP's supply base possesses around 1,000 direct material suppliers (manufacturers of goods and materials, out of an overall supply base of 50,000 suppliers). The largest sourcing volumes are from the Asia Pacific region with approximately 75 percent, followed by South- and North America (20%) and Europe, Middle East and Africa (DCCA, 2008). Thus, HP sources a large proportion from regions where legislation and the cultural context may allow business practices that may violate HP's sustainability requirements (Awaysheh and Klassen, 2010).

HP introduced the HP-EICC to a majority (about 90%) of its approximately 1,000 suppliers (HP, 2011b). However, HP has recognized that their indirect sub-suppliers can greatly influence their business (DCCA, 2008).

> *"It is possible that any sub-supplier could damage our reputation to the same extent as a first-tier supplier could." (HP, SER Lead Auditor)*

[45] For full list see: EICC, 2009b: 19.

In order to ensure supply chain partners' compliance with the developed HP-EICC, HP initiated various projects targeting sustainability improvements beyond the tier-1 supplier level.

Approaches for managing sub-suppliers

HP's sub-suppliers are approached due to one or more of three different "triggers". First, HP has implemented a supplier management system that targets its direct suppliers and incorporates HP's supply chain social and environmental responsibility program (SER) (HP, 2011b). This SER expects HP's first-tier suppliers to be responsible for passing on HP's requirements (i.e. HP-EICC) to their sub-suppliers — HP may become involved on request of the first-tier supplier. Secondly, HP set up dedicated sub-supplier initiatives in which HP directly interacts with its sub-suppliers. Thirdly, HP's sub-suppliers' are approached by the Electronic Industry Citizenship Coalition, which regularly conducts training programs for (sub-)suppliers in emerging and developing countries.

The management of sub-suppliers within HP's social and environmental responsibility program (SER)

HP's supplier management system, including the SER, consists of four phases (1) introduction, (2), assessment, (3) validation and improvement, (4) capability building. During the introduction phase HP assesses potential suppliers integrating HP-EICC requirements into supplier contracts. In the assessment phase HP requires a supplier self-assessment making sure the supplier comprehends HP's expectations. These assessments are reviewed and feedback is provided to the supplier. In the validation and improvement on-site audits occur. If necessary, HP requests a corrective action plan that addresses non-compliance issues. In the capability building phase HP further identifies suppliers' areas for long-term improvement by supporting implementation of HP-EICC standards within the supplier's processes.

In this process, HP seeks to increase suppliers' commitment towards the improvement of social and environmental factors and stresses the importance of passing these efforts on towards suppliers' own suppliers. HP understands and communicates to suppliers and suppliers' own suppliers, the importance of their familiarization with sustainability issues and resulting impacts, which HP-EICC endeavors to remediate.

"HP's top tier of direct suppliers [were developed] with regard to how to manage second-tier suppliers and encourage the cascade of social and environmental good practice down the supply chain. (...)." (SustAinability et al., 2008, p. 13)

HP follows a risk management approach to identify, assess and prioritize sustainability risks in its supply chains. HP considers risk factors such as supplier's location, production and process characteristics, existing supplier relationship and additional available company information about the supplier. 'High risk' suppliers are prioritized for further action in accordance with the four SER phases. HP expects its direct suppliers to ensure that their suppliers (i.e. HP's sub-suppliers) comply with HP-EICC. HP's suppliers take the lead for managing HP's sub-suppliers and HP may only have a guiding function providing advice and frameworks in accordance to HP-EICC requirements. If HP identified any major sustainability risk beyond the tier-1 supplier level, HP initiates further actions and seeks to directly approach the sub-supplier together with the respective direct supplier. HP's actions remain in line with the above described four-phases, thus, approaching sub-suppliers reflects a 'special case' of its SER supplier management program.

The management of sub-suppliers within HP's dedicated initiatives for sub-suppliers

In addition to efforts to work through suppliers, HP has seen benefits from working directly with sub-suppliers as well. These circumstances have led HP to set-up dedicated sub-supplier initiatives. These initiatives cover regions such as East Europe, Thailand, India and Mexico (SustAinability et al., 2008, p. 13).

While HP's SER program focuses on the direct suppliers – which are mostly large multinational corporations – the sub-supplier initiatives enable HP to develop closer interactions with their indirect sub-suppliers. Within these initiatives, three types of activities are observable: (1) on-site assessments, (2) training workshops, and (3) workshops for exchanging experiences (DCCA, 2008: 15-17). To broaden audit capacities and to extend collaborations within the supply chain, HP trains its first-tier suppliers in independently auditing their own suppliers (i.e. HP's second-tier suppliers).

On-site assessments mainly consist of document reviews and a factory tour. During on-site assessments, the sub-supplier is assessed against the HP-EICC, and sub-suppliers' implemented management systems. The assessment results in a sub-supplier

HP-EICC sustainability compliance report, with requests for corrective actions (DCCA, 2008; HP, 2007). HP and HP's first-tier supplier aim to provide the sub-supplier with input for improvement opportunities.

HP initiates training and awareness raising workshops for its sub-suppliers. This training utilizes previous general findings of sub-supplier assessments and focuses on the internalization of management systems. The training workshops further illustrate the underlying business case for "going green" (DCCA, 2008: 53-54).

The third major HP sub-supplier activity is exchange-of-experience workshops. This type of workshop – typically following a training workshop – is meant to be a platform for interactive and open dialogs amongst sub-suppliers, their direct customers (i.e. HP's first-tier suppliers), and HP. The workshop focuses on implementing and diffusing the HP-EICC throughout the entire supply chain and its business case outcomes. Emphasis is put on how to integrate HP-EICC practices into strategy and business operations. The workshops are conducted at the first-tier suppliers' site to lessen second-tier supplier's reluctance and to motivate them for greater collaborative efforts. HP and first-tier suppliers share their own experiences to sub-suppliers regarding best practices.

The management of sub-suppliers within the Electronic Industry Citizenship Coalition

A third "trigger" for HP's sub-suppliers sustainability engagement is through the Electronic Industry Citizenship Coalition. The inter-linkage between the coalitions' Electronic Industry Code of Conduct (EICC) and the HP-EICC enables HP to gain synergies within risk assessment activities. For example, the coalition shares audit results among members via a joint supplier data base. As all members build on the same fundamental EICC, the access to audit results conducted by other coalition members enables the avoidance of any "double auditing" activities. Also the (sub-)suppliers benefit from the joint EICC by being approached with harmonized sustainability requirements and by not undergoing multiple audits from different customers. Furthermore, the Electronic Industry Citizenship Coalition is in the lead to organize various workshops for (sub-)suppliers, independently from specific coalition members. The workshops seek to provide a deepened understanding of EICC's objectives as well as to provide first guidance how to achieve those. However, as HP

may not be involved in these workshops, sometimes direct personal interaction between HP and its sub-suppliers is missing (DCCA, 2008: 55-56).

B.5.2 Migros

Migros is a major Swiss retailer that has sought proactive sustainability initiatives for its supply chains. Migros established the 'International Roundtable on Sustainable Palm Oil' (RSPO) in cooperation with the World Wildlife Fund (WWF) and other organizations, aiming for the settlement of sustainable production standards within the 'palm oil industry sector'. Highlighting these efforts, Migros received the 'World Business Award' in 2002 for its successful work toward sustainable palm-oil production. Migros' sense of responsibility as well as its intention to protect itself against the loss of reputation can be cited as the reasons for Migros' commitment in this field.

Sustainability requirements towards suppliers and sub-suppliers

Migros was an early member of the "Business Social Compliance Initiative" (BSCI) foundation in Switzerland. The BSCI is a division of the Foreign Trade Association (FTA) and "open to all retail, brand and importing companies committed to improving working conditions in the global supply chain" (BSCI, 2011b). The BSCI's code of conduct comprises factors concerning forced labor, child labor, fairness of working contracts, anti-discrimination, working conditions, solidarity, appropriate wages, humane working hours and is in line with commonly accepted standards and principles, i.e. the International Labour Organization (ILO) Conventions and the Declarations of the United Nations, the OECD guidelines for multinational enterprises and the UN Global Compact (BSCI, 2011a).

Migros, as a BSCI member, requests compliance with the BSCI Code of Conduct from all suppliers. Similar to EICC principles, BSCI principles require Migros' suppliers to pass the BSCI Code of Conduct on to their own suppliers (i.e. Migros' sub-suppliers). However, this diffusion does not always happen in practice:

> *"All our first-tier suppliers must sign the BSCI Code of Conduct, committing themselves to disclose all their own suppliers, namely our sub-suppliers, and to implement the BSCI Code of Conduct at the sub-suppliers' site. Unfortunately,*

reality sometimes looks somewhat different." (Migros, Head of Social Compliance and Standards)

Motivation for managing sub-suppliers (sustainability issues beyond tier-1 supplier level)

With a supply base of approximately 4,000 consumer goods manufacturers, ingredient suppliers, and traders, Migros managers stated that they face risks of hidden environmental or social misbehaviors at any stage within their global and complex supply chains, including sub-supplier sites.

"Scandals are commonly associated with the brand-owner and less with the distributor. Therefore, we particularly take more care of sub-suppliers in the supply chains for our Migros-labeled own-brand products." (Migros, Director Strategic Procurement and Supply Chain Support)

In fact, Migros sources a large proportion from traders, whereas the production of the sourced goods takes place at traders' suppliers and beyond (i.e. Migros' sub-suppliers). Since smaller traders often do not have the resources to control Migros' sub-suppliers with respect to social or environmental sustainability factors, Migros take over the responsibility to ensure that these sub-suppliers comply with the requested BSCI code of conduct.

In this context, Migros' major sustainability issues and challenges are well reflected by "sustainability labels" that Migros partially uses for its own-brand products. Some of the labels are "Migros Bio Cotton" (cotton cultivation without harmful pesticides), "Bio" (organic farming), "Fairtrade Max Havelaar" (products from developing countries manufactured under fair working conditions), "MSC" (sustainable fishing), "TerraSuisse" (environmentally friendly cultivation of crops and appropriate animal husbandry), and "FSC" (sustainable use of forests).

Approaches for managing sub-suppliers

Although Migros managers stated that they seek total sustainable supply chain control, the number of involved actors is just too high. Consequently, Migros focuses on a select, smaller number of sub-suppliers, based on an initial risk assessment with respect to sustainability issues. Migros has identified approximately 4,000 sub-

suppliers. From this larger set, Migros has been in contact with approx. 2,000 sub-suppliers in total.

Various factors are taken into consideration when assessing supply chain sustainability risks. Internal discussions at Migros have frequently dealt with the question of whether the major risks were related to a particular product, production process, or country. The major factor found was location (country). Social and environmental risks at certain locations are higher than at others, even if the exact same product is manufactured. For a risk assessment Migros further draws on certifications, such as SA8000, as a signaling instrument. Thus, suppliers can obtain a lower ranking within the risk matrix by having SA8000 certification.

Following an initial risk assessment, Migros' sub-suppliers are managed by two approaches. Migros may engage its sub-suppliers resulting from Migros' BSCI membership. However, the BSCI focuses more on "high risk" countries. Thus, sub-suppliers not within the scope of the BSCI are approached independently from the BSCI engagement. Migros takes a more active role for non-BSCI engaged sub-suppliers, whereas its role is mainly a coordinating function for BSCI engaged sub-suppliers.

The management of sub-suppliers within BSCI engagement

BSCI members are obligated to audit two thirds of their first-tier suppliers in high risk countries within three years of joining BSCI, followed by sustainability improvement processes, if necessary. BSCI members actively seek increases in the number of suppliers and sub-suppliers that are assessed with respect to BSCI Code of Conduct (i.e. CSS) compliance.

Since a significant share of the first-tier suppliers are traders or brokers, the majority of suppliers that have to be audited are in the second-tier. Migros itself conducts selective pre-assessments at both the first-tier and second-tier suppliers in order to get an overview of the sustainability situation. Pre-assessments mostly encompass BSCI self-assessments which might be supervised by external consulting companies.

Migros had audited approximately 190 (sub-)suppliers through use of external audit companies in 2010 (Migros, 2011).[46] Migros maintains the role of initiating, organizing and planning audits as well as monitoring corrective measures according to BSCI requirements.

> *"Generally, Migros does not conduct any audits itself – rather we contract specialized audit companies. However, our own conducted pre-assessments and factory visits are important to gain our own impression and enable us to preserve an effective coordinating function." (Migros, Director Strategic Procurement and Supply Chain Support)*

If deviations from the BSCI criteria are detected in the audit process, a corrective plan is developed. The supplier is required to implement those corrective measures within 12 months. The actual implementation is then validated by a mandatory re-audit (BSCI, 2013b). Migros supports the "corrective actions" systematically and visits the (sub-)supplier on-site. As a signal of Migros' strong commitment towards sustainability in supply chains, Migros has introduced an "audit costs cap" for their suppliers. Any cost exceeding it is paid by Migros.

Apart from specific audits and corrective actions, the BSCI recommends measures for supplier development by organizing training events. Training topics may include "awareness-raising" or "advanced training" for Asian producers, who mainly comprise Migros' second-tier suppliers. Sustainability sensitivity is a central point that still has to develop among a majority of Asian suppliers.

Individual management of sub-suppliers outside BSCI engagement

Initiated by Migros themselves, suppliers and sub-suppliers from certain global regions, e.g. southern Spain or southern Italy, are closely evaluated. In those countries, Migros introduced corrective measures in order to be able to encounter constantly recurring criticism with respect to current environmental and social practices. Corrective measures comprise audits with critical first- and second-tier suppliers and collaborations with (sub-)suppliers, depending on the audit results.

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[46] The audit process is conducted by SAAS-certified third party auditors, which also offer particular SA8000 trainings. SAAS (Social Accountability Accreditation Services) is an accreditation agency for certifiers of compliance with social standards, including the SA8000 (SAAS, 2012).

Migros also organizes awareness-raising workshops and training for brokers, who comprise most of Migros' first-tier suppliers. Through these efforts Migros seeks to improve the performance of second-tier suppliers indirectly. Within the workshops, the necessity of a transparent supply chain is highlighted and critical sustainability requirements are explained in depth.

B.6 Cross case analysis and research propositions

A cross-case analysis will help in identification of some commonalities and differences. The analysis sets the stage for six research propositions.

HP and Migros continuously seek to increase transparency in their supply chains. A complete picture of supply chain partners is a key prerequisite to identify any social or environmental misbehavior in supply chains. Both companies will approach sub-suppliers, especially if they feel the need for actions to improve sub-suppliers' compliance with their respective CSS (i.e. HP-EICC and BSCI code of conduct). The collection of publicly available data, site visits, and formal audits help both firms to identify any gaps between sub-suppliers actual performance and firms' requested compliance with CSS. Ideally, these activities enable a realistic assessment about the level of (non-)compliance and allow the involved parties to set-up a corresponding corrective action plan to improve CSS compliance. HP shows a higher direct involvement in sub-suppliers' execution of the corrective action plan compared to Migros. The latter draws more on external support (e.g. from business partners such as audit companies) due to resource constraints.

Consequently, when the studied firms approached their sub-suppliers in both cases we observed managerial practices, which were similar to traditional supplier management practices, either performed by the focal firms themselves or supported by strategic business partners. These practices were either or both "assessment" (e.g. supplier questionnaires, site visits, audits, etc.) and "collaboration" (e.g. training, workshops, etc.), see Table B - 4, and as supported by the literature (Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008).

Table B - 4. Overview of sub-supplier management practices and contextual factors

	Hewlett-Packard (HP)	**Migros**
Approaches towards sub-suppliers	Indirect approaches: (1) Suppliers are expected to pass the HP-EICC on to sub-suppliers (2) The Electronic Industry Citizenship Coalition and other affiliates approach sub-suppliers via audits and awareness workshops; audit results are shared among coalition affiliates Direct approaches: (3) Direct interaction in dedicated sub-supplier initiatives including on-site assessments, training workshops, and exchange-of-experience workshops	Indirect approaches: (1) By mandatorily signing the BSCI Code of Conduct Migros' first-tier suppliers commit themselves to enforce the BSCI standards at their own suppliers (i.e. sub-suppliers) (2) Within the BSCI engagement suppliers and critical sub-suppliers are audited and corrective action plans set up, if necessary. Migros mainly maintains a coordinating function Direct approaches: (3) Selective sub-suppliers are directly approached by Migros, beside the BSCI engagement via site-visits, audits and collaborations for corrective actions
Criteria for approaching sub-suppliers	If location, procurement category, company information, or NGO reports indicate any high social/environmental risks at sub-suppliers	Sub-suppliers operating in "high risk" countries are in the main focus
Parties involved while approaching sub-suppliers	First-tier suppliers External consultants Electronic Industry Citizenship Coalition	First-tier suppliers (traders) External consulting companies Specialized BSCI-audit companies Certification accreditation agencies
Approached sub-suppliers	Over 100 sub-suppliers until 2010 (HP, 2010)	Approx. 2,000sub-suppliers until 2012
Assessment practices	– Site visits – On-site assessments / audits conducted by HP (partially by 3rd parties) – Shared EICC audit reports – Sub-suppliers' self-assessments	– Site visits – Audits conducted by BSCI auditors (Migros in coordinating function) – Shared BSCI audit reports – Sub-suppliers' self-assessments
	➔ Increased transparency about sub-suppliers' practices ➔ Identification of deficiencies between HP's and Migros' CSS requirements and sub-supplier's actual practices	
Collaboration practices	– Training workshops – Exchange-of-experience workshops – Awareness workshops by EICC	– Corrective action plans – Awareness-raising workshops
	➔Building up sub-supplier's general sustainability capabilities ➔Improving sub-suppliers' practices in line with HP's and Migros' CSS	

The outcome of observed sub-supplier management practices was documented by formal audit reports in both cases (also partially publicly available, e.g. DCCA (2008) and HP (2011c)). Hereby, the comparison of (1) self-assessments, initial site visits or audits, and (2) subsequent re-audits commonly demonstrate an increase of sub-suppliers' compliance with focal firm's CSS.

> *"The final audit results are the best indicators to compare sub-suppliers' actual practices with our sustainability requirements. […] The audit report communicates a 'performance score'. We also define minimum scores. Typically the re-audit score is higher. This enables us to observe a positive development." (HP, SER Lead Auditor)*
>
> *P1: The management of sub-suppliers for CSS compliance consists of two dimensions: assessment and collaboration.*
>
> *P2: The greater the sustainability assessment and collaboration of a focal firm with its sub-suppliers, the greater the increase of the sub-suppliers' compliance with CSS.*

Both case study firms realized the importance of involving strategic business partners (i.e. first-tier suppliers, auditors or consulting firms) in assessment and collaboration activities with sub-suppliers. The integration of competent business partners allowed both HP and Migros to explore missing internal knowledge about sustainability issues and to bundle forces with these strategic business partners for joint efforts. The inclusion of these intermediaries is more critical for sub-supplier management than the typical direct customer-supplier relationship.

HP integrated their first-tier suppliers in its sub-suppliers initiatives. These suppliers initially approached the second-tier suppliers and asked for their willingness to participate in the initiatives. In fact, some sub-suppliers were initially reluctant to participate. As the initiatives matured, HP's first-tier suppliers became more permanently involved, enabling increased commitment – both on the side of first- and second-tier suppliers. The HP case highlighted that sub-suppliers highly benefit from "setting up the activities in collaboration with [further] external organizations with expertise within social and environmental issues, how these issues intersect with business, and relevant legal and cultural aspects, which the MNCs [such as HP]

usually do not have in-house" (DCCA, 2008: 5), resulting in higher performance outcomes of sub-suppliers. HP's SER Lead Auditor summarized the importance of business partners as follows:

> *"The first-tier supplier commonly enables access to the respective sub-supplier und sets the arena for a trustful interaction with the sub-supplier. External consultants bring in specific know-how as well as knowledge of the cultural context and language skills. Third party auditors provide neutrality, an independent opinion, and enable a cross-check of our approach. The EICC fosters a broader reach, levels the playing field, enables efficiency gains, and bundles power of various players in the market. SAI brings in neutrality and credibility as well as tools and trainings."*

Compared to HP, Migros made more use of third party auditors (i.e. independent auditing companies) instead of second party audits (i.e. conducted by Migros itself). However, both firms underlined that the audit results did commonly not differ for standard routines regardless of the audit type (i.e. second vs. third party).

> *"We have initiated 'shadow audits' to test us and our external third party auditors and in order to get a neutral view from outside on our program. The results are usually almost identical." (HP, SER Lead Auditor)*

In our research context the involvement of strategic business partners enables the successful processing of assessment and collaboration activities with sub-suppliers, ultimately aiming for sub-suppliers' compliance with CSS. Similar observations have been reported in the literature on either direct relationships or industry groups, but not on indirect relationships with sub-suppliers (Hart, 1995; Pagell and Wu, 2009; Sharma and Vredenburg, 1998). Relational view theory explains how the focal firm can benefit from competent business partners' complementary resources (Dyer and Singh, 1998). The relationship and collaboration with strategic business partners enables the firm to explore/exploit these partners' knowledge and resources (Carmin et al., 2003; Roloff, 2008; Roome and Wijen, 2005). In our novel research context, the focal firms were able to transfer this positive effect to indirect business relationships with sub-suppliers, resulting in higher level of sub-supplier's compliance with CSS.

P3a: The involvement of additional strategic business partners in the management of sub-suppliers amplifies (moderates) the effect of assessment and collaboration on sub-suppliers' CSS compliance.

P3b: Second and third party audits have similar effects on sub-suppliers' compliance with CSS.

The recent environmental misbehavior by Nestlé's sub-supplier Sinar Mas, which was responsible for destruction of rainforests in Malaysia, underpins how a brand can suffer from such misbehaviors. Greenpeace ran a media-effective campaign against Nestlé with the consequence of reputational losses (The Economist, 2010). Referring to such cases, both firms HP and Migros state that the risk of losing reputation is a key motivational factor to engage in managing their sub-suppliers in the context of sustainability.

Migros especially stresses the protection of its highly visible own brand products, which are directly connected to Migros as a brand. In turn, Migros is less concerned about the assorted big manufacturer brands, since any revealed social or environmental misbehavior in those big brands' supply chains will typically be associated with manufacturer.

"Past scandals made the big brands increase their efforts to guarantee social and environmental minimum requirements in their entire supply chains including sub-supplier sites." (Migros, Head of Social Compliance and Standards)

Because of its size and profile, HP attracts attention from „watch dog organizations". For example, if a NGO such as Greenpeace seeks to denounce supply chain practices within the industry, the accusation of one of the industry leaders, such as HP, would achieve the highest public attention.

"Once a NGO or a research organization assumes that any social or environmental misbehavior is hidden at sub-supplier sites, which [indirectly] deliver to us or to one of our competitors, we become immediately active. Firstly, we assess whether these allegations hold true for the sub-supplier. If yes, we trigger an independent third party audit – hereby, neutrality and credibility are key." (HP, SER Lead Auditor)

Conversely, Migros as well as HP stated that most of their suppliers, who are less publicly exposed, put less effort in managing their supply base concerning sustainability factors (Hall, 2000), forcing the case study firms to put more efforts into managing sub-suppliers.

These observations find support from institutional theory. A firm's efforts to improve supply chain sustainability respond to institutional pressures (normative, coercive, mimetic) typically formed from external stakeholders such as NGOs or media, requesting compliance with corporate sustainability standards throughout the entire supply chain including sub-suppliers (Murillo-Luna et al., 2008; Sarkis et al., 2011). The firm's response to these pressures ensures firm's legitimacy and ultimately its long-time survival (Bansal and Roth, 2000; Godfrey et al., 2009; Zhu and Sarkis, 2007).

P4: The greater the public attention on a firm, the more the firm seeks additional collaboration with and assessment of its sub-suppliers.

HP and Migros are aware that their organizational resources are not sufficient to exert complete control over their entire supply chains, like all big organizations. Both firms continuously perform risk analysis concerning sustainability factors in their supply base. For their analysis, the two firms especially consider the region (i.e. origin of goods/materials) and product-related production processes as risk indicators. Depending on their risk analysis results, the firms prioritize and decide on further actions in order to increase the level of compliance with their CSS (i.e. HP-EICC and BSCI code of conduct) in their supply base. If sustainability risks are expected beyond the first-tier supplier level, both firms will decide about actions to address their concerns with the respective sub-suppliers. Both cases underline that any engagement beyond the first-tier supply level results from initial risk management activities (Wolf, 2011).

"If we get the feeling that our first-tier suppliers do not pass on the BSCI requirements and anticipate critical misbehaviors by sub-suppliers, we decide about actions directed towards sub-suppliers." (Migros, Director Strategic Procurement and Supply Chain Support)

As previously stated, the focal firm is dependent on consistently implemented supply chain sustainability – from the raw material to the final product. In this context

information theory acknowledges that firm's contractual and regional distance to its sub-suppliers hinders transparency and builds up information asymmetry between the firm, its first-tier supplier and sub-suppliers (Sarkis et al., 2011; Simpson et al., 2007). If suppliers and sub-suppliers seem to have different risk preferences and attitudes towards sustainability, the focal firm consequently seeks to align the differing interests by intensified interactions with its suppliers and also sub-suppliers (Simpson, 2010). To strongly reduce the perceived risk, the focal firm might directly connect with its sub-suppliers (Mena et al., 2013).

P5: The higher a focal firm's perceived risk of social or environmental misbehaviors in its supply chains, the greater its engagement in assessment and collaboration with sub-suppliers, in addition to its engagement with first-tier suppliers.

Usually, focal firms do not have direct contractual relationships with sub-suppliers (exceptions do exist such as in the automotive and aerospace industries). The focal firm is dependent on its first-tier supplier's disclosure of their supplier information and has no to little "direct" power over sub-suppliers. Both case companies showed that the focal firm was only able to gain information about the sub-supplier when the focal firm had enough power over the respective direct supplier.

"Some of our suppliers just refuse to disclose their own suppliers. However, we have no means to force them. Our suppliers fear that we could bypass them – those sub-suppliers reflect their key assets." (Migros, Director Strategic Procurement and Supply Chain Support)

It was observed in the HP case that sub-suppliers who participated in HP's sustainability initiatives either were aware of the relevance of complying with the HP-EICC or felt a certain pressure to participate. The latter situation could be explained by the sub-suppliers' perceived dependence on their customers (i.e. HP's direct suppliers) (Cox, 2001; Delmas and Montiel, 2009; Yang and Sheu, 2007). Similarly, increased power levels caused by direct supplier involvement during the interaction with sub-suppliers were a success factor for assessing and collaborating with sub-suppliers.

A Migros senior manager further gave the example that less dependent suppliers and sub-suppliers may switch their selling volume to those customers who do not explicitly request compliance with any corporate sustainability standards.

"We deal with Chinese suppliers, who are gaining more domestic demand. These Chinese suppliers partially prefer selling to local customers with less sustainability consciousness." (Migros, Head of Social Compliance and Standards)

Both case firms bundle efforts by engaging in industry initiatives: EICC and BSCI, respectively. Both initiatives induce a certain degree of pressure towards the entirety of suppliers and sub-suppliers, enabling the initiative members to approach their sub-suppliers concerning sustainability requirements. With numerous buying firms, representing a substantial purchasing volume, collectively requesting compliance with specific industry codes-of-conduct, suppliers and sub-suppliers find it hard to refuse participation in those inter-organizational assessment or collaboration activities (Grimm et al., 2011; Peters et al., 2011).

Institutional theory provides support for our observations as a firm's ability to impose coercive pressure on its upstream supply chain (mediated by their suppliers to the sub-suppliers) is a key factor for acquiring access to sub-suppliers and sub-suppliers consequent response to any requests (Sarkis et al., 2011).

Our observations are further in line with resource dependence theory (RDT), which argues that a dependent actor is likely to respond to any requirements of a more powerful counterpart. Thereby, the counterpart's powerful position may arise from controlling critical scarce resources or relationship-specific assets (Gonzalez et al., 2008; Pfeffer, 1992). However, RDT commonly considers dyadic relationships. Our context extends this perspective to multiple dyads (and possibly even triads): one consisting of the focal firm and its supplier, and one consisting of the supplier and the focal firm's sub-supplier (Cox, 2004; Cox et al., 2001). Accordingly, we define a focal firm's "channel power" as the power that result from the individual dyadic power relationships in multi-tier supply chains and that consequently describe the ability to directly or indirectly influence firm's supply chain partners (Mena et al., 2013; Yang and Sheu, 2007).

P6: The higher a focal firm's channel power, the greater the assessment and collaboration practices with sub-suppliers.

B.7 Discussion and conclusions

Although a large body of literature underlines the importance of sub-suppliers (tier-2 to tier-n suppliers) in various fields such as sustainability, quality, or inventory management, little research directly addresses how sub-suppliers might be managed by a focal firm successfully (Choi and Wu, 2009; Fawcett and Magnan, 2002; Lee, 2008; Millington, 2008). Our research is a first step into this new important field that is already a major concern to business practice. With our exploratory research we shed light into this field of investigation.

B.7.1 Framework for sub-supplier management and differences from traditional supplier management

We contribute to the general literature on supply chain management by providing evidence that focal firms can and do influence sub-supplier's processes and performance outcomes through various managerial practices. In our research context, both case study firms, Hewlett-Packard and Migros, specifically approached their sub-suppliers to drive sub-suppliers' compliance with their corporate sustainability standards (CSS). Following our case study investigations, we propose a framework for the understanding of sustainability compliance in sub-supplier management as summarized in Figure B - 1.

The essential difference between managing suppliers versus sub-suppliers lies in the greater challenge of identifying critical sub-suppliers and getting their involvement in efforts. Dynamic sourcing markets make identification even more difficult. Focal firm's suppliers might switch their own suppliers (i.e. sub-suppliers) making previous sub-supplier management activities obsolete. According to Linton and Choi (2011), focal firms could issue approved "sub-supplier lists" to their first-tier suppliers or directly source from critical sub-suppliers, if risks or dependencies are perceived too high.

> *"We are dependent on sub-supplier's good-will, since we don't have any direct contractual relationship with them – and thus we are not able to enforce any practices. […] Commonly, it's a long process until we 'arrive' at the sub-supplier – and when arrived, the sub-supplier may not be a source of supply anymore. The more organizational distance, i.e. tiers of suppliers, between us and the sub-*

supplier, the faster moving is the market." (Migros, Head of Social Compliance and Standards)

The actual practices for sub-supplier management turned out to be similar to the general sustainable supply chain management practices of "assessment" (e.g. audits, site-visits, supplier questionnaires) and "collaboration" (e.g. trainings, workshops, corrective action plans) to manage direct suppliers as previously identified by Klassen and Vachon. However, we found out that by involving additional strategic business partners in these management practices, focal firms report to achieve better results, ultimately reflected by higher level of sub-suppliers' CSS compliance. This may be an important difference between regular supplier and sub-supplier management, e.g. for quality, delivery, and other traditional business performance measures, and those that focus on sustainability. Since processes beyond the first-tier supplier level are less familiar to the focal firm, the involvement of business partners, who have a better understanding about these processes and context factors, might be necessary to a greater extent than in traditional supplier management settings. By sharing knowledge, making others aware of process and material requirements or providing resources, the focal firm – together with the business partners – was able to achieve better results with sub-suppliers.

"The business partners' support is more critical in the case of managing sub-suppliers [compared to first-tier suppliers]. For example partners such as consultants can bring in better and more specialized resources [then HP has], which are specifically required to successfully manage a targeted sub-supplier." (HP, SER Lead Auditor)

In both cases, especially the involvement of the first-tier supplier was considered vital. Whereas traditional supplier management might take place without the involvement of any further business partner, managing sub-suppliers should not be organized without the respective first-tier supplier (i.e. sub-supplier's direct customer). The first-tier supplier involvement (1) accelerates building mutual trust between the focal firm and the sub-supplier, (2) avoids the impression of being ignored and the fear of being by-passed, or (3) ensures that the first-tier supplier remains aware of its responsibility.

"When managing sub-suppliers, it's important that the respective direct supplier is not passed over. The direct supplier must not get the impression that he is ignored, and

furthermore, that he can evade responsibility for his own supplier. Thus, managing sub-suppliers becomes an element of our [traditional] supplier management." (HP, SER Lead Auditor)

The often discussed effect of collective pressures on participants to realize their promises may play a further role.

In addition, our research identified three antecedents that effect the management of sub-suppliers: (1) public attention, (2) perceived risks, and (3) channel power. These three elements enabled the focal firm to engage in the management of sub-suppliers. Firstly, public attention on the focal firm and its brands and products highly motivated this firm to approach supply chain actors beyond the tier-1 supplier level (i.e. its sub-suppliers). Secondly, the identification of critical supply chain paths (i.e. sub-suppliers potentially hiding social and environmental misbehaviors and the associated perceived risk) triggers the firm to manage questionable sub-suppliers. Thirdly, channel power towards the upstream supply chain allowed the focal firm to identify sub-suppliers and to get in contact with them by using punitive or incentive mechanisms for their participation. In situations, where firms' had little channel power, suppliers disclosed own suppliers (i.e. firm's sub-suppliers) upon their free will, making the focal firm dependent on suppliers to engage in managing sub-suppliers.

These antecedents are expected to be less pronounced for firms not engaging in sub-supplier management:

- *Public attention.* As we saw in the Migros case, product supply chains commonly have lower priority, if respective products are less associated with the focal firm's brand. Furthermore, watch-dogs (e.g. NGOs) seldom accuse firms that are unknown to the public for misbehaviors in their supply chains, since public reactions and "insurgency" would remain lower for these firms. Consequently, the firms attach less importance to managing their upstream supply chain (including sub-suppliers).
- *Perceived risks.* Supply chain sustainability investigations start with the first-tier supplier. Firms do not possess the resources to control their entire supply base and the upstream levels beyond the first-tier supplier. If firms do not anticipate any social or environmental misbehavior in the further upstream supply chain tiers,

firms invest their scarce resources for higher prioritized issues elsewhere and do not approach sub-suppliers.

– *Channel power.* Both cases include situations where the focal firm struggled to exert sufficient power over a direct supplier to make it disclose its sub-suppliers, ultimately inhibiting access to sub-suppliers. In other situations, direct suppliers were willing to disclose sub-suppliers, but later refused to join a firm's sub-supplier initiatives. As it turned out, these sub-suppliers were not dependent on the business relationship. Both examples highlight the necessity of channel power towards sub-suppliers in order to get access to them and to conduct any assessments or collaborations.

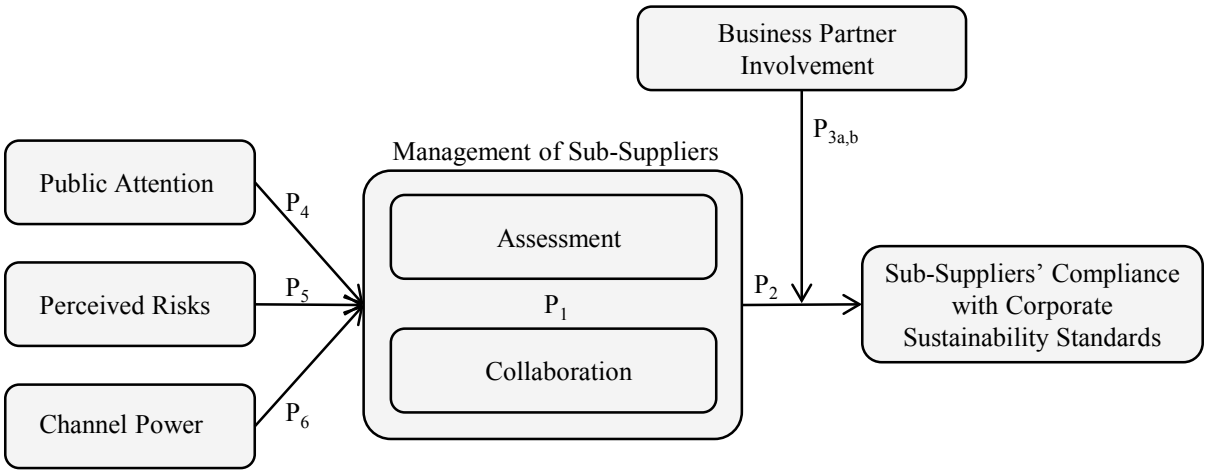

Figure B - 1. A framework for understanding sustainability compliance in sub-supplier management

B.7.2 Managerial implications

Since society (including consumers, investors, NGOs etc.) introduces significant pressures concerning CSS, focal firms must ensure that their suppliers and sub-suppliers comply with their CSS. Particularly, firms attracting public attention should actively address social or environmental misbehavior hidden in supply chains to protect credibility of their brands. The key challenge lies in identifying and getting sub-suppliers involved as commonly firms have little direct power over their sub-suppliers. As is the case for traditional supplier management, firms should assess sub-suppliers' compliance with CSS and collaborate with them, if any deficiencies were revealed. Involving additional business partners such as suppliers, or consultants

enables firms to achieve their objectives more efficiently. Especially the involvement of the direct first-tier supplier is considered key, since it positively contributes to the relationship dimensions within the triad consisting of the firm, the supplier itself, and the respective sub-supplier as discussed above.

Since a firm's capacity is commonly not sufficient to approach the entirety of their suppliers and sub-suppliers, firms are forced to build up a sound risk management, enabling an efficient usage of limited organizational resources by identifying, prioritizing and controlling sustainability risks throughout the entire upstream supply chain (incl. sub-suppliers). Furthermore, a certain degree of power over suppliers – and indirectly over sub-suppliers – is considered essential, if sub-suppliers do not see the necessity to comply with a requested CSS. Particularly, firms not possessing enough channel power towards their upstream supply chain might consider the participation in joint industry initiatives or roundtables to benefit from the collectively represented "sourcing volume" requesting specific sustainability standards.

B.7.1 Limitations and future research

Exploring new fields in research offers tremendous opportunities which a single exploratory study can only begin to investigate. We focused on two focal firms (HP and Migros) and their supply chains in two industries (electronic and retail/food). Investigating other firms or industries may reveal further insights. Testing our propositions against a large cross-sectional data set would allow drawing more generalized conclusions. However, measuring sub-supplier's compliance with focal firm's CSS is a challenging task for a subsequent quantitative study.

As we mainly took the perspective of the focal firm, future research may include the perspective of (sub-)suppliers. Also considering and comparing the management of sub-suppliers in other fields (e.g. quality or inventory) might discover additional aspects and further ground the concept of sub-supplier management.

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B.8 Appendix

Interview guideline

Introduction

- Introducing researcher, study and its research objectives
- Assuring confidentiality, informing about recording and transcription

Supply Chain Structure

- How much value added comes from your first-tier, second-tier suppliers and beyond? How many first-tier suppliers do you have? How many second-tier sub-suppliers are known?
- With which (sub-)suppliers are you directly in contact?
- For what reasons and in which cases do you actively approach (sub-)suppliers within the context of sustainability? What are the criteria to select these (sub-)suppliers?

Sustainability Issues

- What are the major social and environmental sustainability issues your firm is facing within your supply chains?
- What are the main problems at (sub-)supplier sites?
- How would you describe your (sub-)suppliers' social and environmental awareness?
- What kind of (sub-)suppliers could particularly harm your business, if any social or environmental non-compliance might be revealed?

Sustainability Requirements

- What are your social and environmental requirements (i.e. corporate sustainability standards) towards your first-/ second-tier suppliers and beyond?
- How do you communicate your requirements to your first-/second-tier supplier etc.? Who is in charge?
- How do you ensure that these requirements are correctly interpreted by your (sub-) suppliers?
- Are these requirements measurable and verifiable?

(Sub-)Supplier Management Approaches

- How do you control (sub-)suppliers for compliance with your corporate sustainability standards (e.g. audit, site visits)? What are your various

approaches driving compliance (e.g. self-assessments, certifications, audits, trainings, etc.)?

- In which (sub-)supplier-relationships are these approaches appropriate (i.e. effective in terms of achieving compliance with corporate sustainability standards)?
- For which (sub-)supplier do you use what approaches to control compliance with your corporate sustainability standards?
- Do you foresee specific milestones for achieving compliance with corporate sustainability standards?
- Do you involve additional business partners (e.g. auditing firms) to drive your (sub-) suppliers' compliance? What is the rationale for your decision? In case of involvement, what is their role?
- Are you working together with other firms to ensure compliance with corporate sustainability standards (e.g. bilaterally with an industry fellow or industry initiative)?
- What capability building activities do you initiate for your (sub-)suppliers in terms of social and environmental responsibility (e.g. based on the findings of an on-site assessment)?
- Do you train your first-tier suppliers to cascade requirements/standards down to their own suppliers (i.e. your sub-suppliers)? Is it enough to simply demand your first-tier suppliers to do so?
- Are there any other initiatives going on in terms of sub-supplier management?
- What makes a successful sub-supplier management possible (i.e. success factors)? What are the barriers? What are your main challenges in terms of sub-supplier management?
- What are the main drivers for your sub-suppliers to comply with your issued requirements (e.g. governmental regulations; customer demand; business case)?
- How do you see the role of actively managing your sub-suppliers in the future?
- What are the difference between managing direct suppliers and indirect sub-suppliers? (e.g. behaviors, interactions, involvement of additional partners)
- What are the unique challenges of managing sub-suppliers? And what effective "success factors" do you therefore suggest?

C. Identifying critical success factors to sub-supplier management for sustainability compliance

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Effective supply chain management requires careful consideration of multiple tiers of partners, especially with respect to sustainability issues. Firms increasingly approach their sub-suppliers to drive compliance with firms' defined corporate sustainability standards (CSS). A number of complexities and unique challenges make sub-supplier management more difficult than direct supplier management, e.g. a lack of contractual relationships to sub-suppliers, few opportunities to put direct pressure on sub-suppliers, or non-transparency concerning the involvement sub-suppliers in a focal firm's supply chains. The literature has not investigated from either a sustainability or any other perspective the critical success factors (CSFs) for firms' sub-supplier management. Therefore, the present research seeks to explore and increase our understanding of critical factors that contribute to overcome aforementioned complexities and unique challenges of managing sub-suppliers for CSS compliance. Using data and information from a one year field study in two food supply chains, our research identified 14 CSFs that potentially influence the success of the sub-supplier management outcome of sub-suppliers' compliance with CSS. The identified CSFs can be classified into (1) focal firm-related, (2) relationship-related, (3) supply chain partner-related, and (4) context-related CSFs. The present research expands on the theory of critical success factors by introducing the theory to the sustainability and sub-supplier management context. For each CSF, a foundational definition and analysis with respect to existent literature is provided. CSFs' unique importance to sub-supplier management success was highlighted and exemplified by field study insights from practitioners. Respective research avenues are outlined.

Keywords: Sub-supplier management, sustainable supply chain management, corporate sustainability standards, theory of critical success factors, field study.

C.1 Introduction

Firms increasingly face pressure from external stakeholders (e.g. NGOs, customers, regulators) to maintain sustainable supply chains. Focal firms, buyers, are required to take responsibility of their suppliers ensuring the actions of their supply chain in a sustainable manner. Oftentimes, external stakeholders do not differentiate the behavior of the focal firm from its suppliers and hold the focal firm responsible for all activities within product manufacture (Koplin et al., 2007; Rao, 2002). Any party in the supply chain not complying with the focal firm's corporate sustainability standards (CSS) can potentially damage corporate reputation and/or harm customer confidence. Mattel (Barbie), Nike (Football) and Nestlé (Kit-Kat) are prominent examples that demonstrated how firms' brands can suffer from non-compliant sub-suppliers (Barnett and King, 2008; Choi and Linton, 2011; Wagner et al., 2009).

Sustainable supply chain management (SSCM) comprises the "management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals of all three dimensions of sustainable development, i.e. economic, environmental and social, into account which are derived from customer and stakeholder requirements" (Seuring and Mueller, 2008a, p. 1700). Past SSCM research has extensively discussed the management of direct suppliers' sustainability performance, but little research has shed light beyond the tier-1 supplier level, neglecting sub-suppliers' relationships, roles, and activities.

This research takes a multifaceted perspective of evaluating how to ensure CSS adoption and diffusion through the supply chain. CSS expresses an organization's social and environmental sustainability commitment, which commonly exceeds regulatory requirements (Bansal and Hunter, 2003; Barnett and King, 2008). Although our research emphasizes efforts in the food supply chain, the issues set the stage for investigation into general sub-supplier supply chain management.

The sub-supplier management literature highlights how focal firms may apply managerial practices to sub-suppliers to increase a sub-supplier's level of CSS compliance. These sub-supplier management practices can be classified into the two dimensions: assessment (e.g. informal site visits, audits) and collaboration (e.g. training, workshops, corrective action plans), having similar characteristics to those applied to direct suppliers (Klassen and Vachon, 2003; Vachon and Klassen, 2006,

2008). However, a lack of contractual relationships with sub-suppliers, inability to put direct pressure on sub-suppliers, incomplete knowledge about the existence and level of involved sub-suppliers in a focal firms' supply chain reflect some challenges that make managing sub-suppliers unique (Choi and Linton, 2011). Given that the food industry and its supply chains have significant sustainability implications (Roth et al., 2008; Yakovleva et al., 2012) we view their concerns to be an especially sensitive, timely and important focus.

Research has not comprehensively addressed what enables or hinders the management of sub-suppliers, in any industry, much less the food industry (Fawcett and Magnan, 2002; Lee, 2008; Millington, 2008; Seuring and Mueller, 2008a). Focal firms require assistance on identifying and ultimately influencing factors, which lead them to successfully implement CSS at sub-suppliers. Consequently, our guiding research questions are:

1) *What are the critical success factors (CSFs) for the management of sub-suppliers to ensure their compliance with corporate sustainability standards in food supply chains?*
2) *What are the perspectives of various players in food supply chains related to these CSFs?*
3) *What research needs to be completed to more fully address and build on this important research concern?*

To address these research questions, the remainder of this paper is organized as follows: Firstly, we provide a literature review on managing sub-suppliers for sustainable supply chains and critical factors. Secondly, theoretically positioning this work within the critical success factors theoretic lens, the present research aims for the identification of CSFs, seeking to extend the theory of critical success factors to supply chain management in general and SSCM for food supply chains in particular. Thirdly, the exploratory field study methodology is presented. Fourthly, the results section describes the identified CSFs for the management of sub-suppliers with linkages to field study empirical evidence that results from two multi-tier supply chains in the food industry. Avenues for further research are proposed throughout. Our paper ends with a discussion of our research findings, and a provision of managerial implications

guiding managers who seek to approach issues beyond the tier-1 supplier level, especially from a sustainability perspective in the food supply chain.

C.2 Literature review

In this section we look to the sustainable supply chain management (SSCM) literature to provide some foundation for understanding interactions with sub-suppliers. We then extend our review to critical factors that either reflect barriers or enabled engagement in SSCM, potentially pinpointing on CSFs for sub-supplier management. Due to the immaturity of the field with respect to managing sub-suppliers and respective CSFs, the review is not limited to food supply chains and initially considers the entire body of SSCM. Consequently, sustainable food supply chain idiosyncrasies are highlighted.

C.2.1 Sub-Suppliers in sustainable supply chain management

SSCM literature has extensively investigated managerial practices and relationships between focal firms and their direct suppliers (Bai and Sarkis, 2010a; Brammer et al., 2011). These relationship practices have been classified into two dimensions: assessment and collaboration (Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008).

Assessment practices enable the firm to evaluate suppliers' sustainability performance and give an indication about the level of compliance with a firm's CSS. During an initial contracting/tendering phase, firms may apply defined sustainability criteria in order to select "capable" suppliers upfront and to reduce the risk that these suppliers do not comply with the firms' CSS (Foerstl et al., 2010; Reuter et al., 2010). Firms increasingly request certifications by suppliers in these early stages, proving that suppliers fulfill social or environmental requirements (Delmas and Montiel, 2009). Conducting audits allows an in-depth assessment of supplier sites and processes and consequently the identification of non-compliances with CSS (Boyd et al., 2007; Darnall et al., 2009; Teuscher et al., 2006). Supplier monitoring and re-auditing serves as a continuous assessment approach to observe suppliers' sustainability performance (Brammer et al., 2011).

Collaboration practices are typically more supportive activities that seek to improve the relationships or practices between the buying firm and the respective supplier.

Therefore, firms may implement supplier development programs in which collaborative activities such as training, workshops, or employee transfers are applied in order to develop suppliers' CSS identified capabilities (Bai and Sarkis, 2010a, 2010b).

Despite the large body of literature on "traditional" supplier management, relatively minimal research has addressed the challenge of managing suppliers beyond the tier-1 level, which we refer to as sub-suppliers (Lee, 2008; Millington, 2008; Seuring and Mueller, 2008a). Past research has typically mentioned sub-suppliers as an aside. The existent literature does indicate that focal firms can generally manage and approach sub-suppliers with similar practices of traditional supplier management. Practically, Hewlett-Packard (HP) operates dedicated sub-supplier initiatives in which comprehensive assessment (e.g. sub-suppler site visits and audits) and collaboration practices (e.g. trainings and workshops) with HP's sub-suppliers take place (Andersen and Skovgaard, 2008). Examples also include focal firms gathering information from suppliers and sub-suppliers to map their supply chain partners for the identification of hidden sustainability risks (Boyd et al., 2007) or to assess carbon emissions for their multi-tier supply chain (Wolf, 2011).

In food supply chain research Hamprecht et al. (2005) report on how a global food manufacturer made use of control points of the food safety systems to trace back material flows to agricultural production. The increased transparency gave the food manufacturer the opportunity to evaluate risky suppliers concerning their sustainability performance. Tool development for such as benchmarking tools for multiple stages of sustainable food supply chains has been addressed (Yakovleva et al., 2012), with partners in the supply chain including growers, processors, distributors, and retailers. The focus on multiple dimensions of sustainability, organizational types, and industries make for difficult benchmarking and management effort. Risk management plays a significant role in the food supply chain and its sub-suppliers, especially social sustainability issues such as health and human risks (e.g. Diabat et al., 2011). The focus of this research has been on descriptive and planning issues, with very little focus on direct issues of sub-supplier management (Mena et al., 2013).

Directly approaching sub-suppliers bears several unique challenges that are not existent within traditional supplier management. There is a lack of direct control and dependence between the focal firm and the sub-supplier. The focal firm is dependent

on its direct suppliers' willingness to disclose sub-suppliers and to manage the dependent relationship. The focal firm might not be able to put direct pressure, normative or coercive, on the sub-supplier. Commonly, there is no direct contractual relationship that exists between the firm and its sub-suppliers. Issuing approved "sub-suppliers lists", which dictate firm's direct suppliers from which supplier (i.e. sub-supplier) they must source, could clear a hurdle (Choi and Linton, 2011), but specific control or collaboration at these lower tier levels is very difficult to manage. The relational complexity of managing sub-suppliers just leads many firms to rely on their direct suppliers to manage their sub-suppliers (Gonzalez et al., 2008; Lee and Klassen, 2008; Spence and Bourlakis, 2009).

Although some literature describes managerial practices with respect to sub-suppliers, there is little knowledge about what aids focal firm success in managing these sub-suppliers. To identify potential insights into this issue, the literature review is consequently extended to examine critical factors for SSCM in general.

C.2.2 Critical factors to sustainable supply chain management

Starting with a broad focus on sustainable supply chains, the reviewed literature refers to food supply chains as well as to supply chains in other industries. However, the idiosyncrasies of food supply chains are subsequently highlighted. Commonly, critical SSCM factors may be classified into internal or external enablers and barriers (Walker et al., 2008). Table C - 1 summarizes critical factors that were identified in the literature.

Internal critical factors

Many firms struggle to engage in sustainable supply chain management due to *high costs and a lack of financial resources*. SSCM practices such as conducting audits or running supplier development programs are costly and time consuming. Typically a small proportion of the entire supply base might be covered by SSCM practices (Ciliberti et al., 2008; Kolk and Tulder, 2002). Cost efficiency pressures might lead to cost cutting in SSCM before other operations are affected. Despite difficulties of defining scope and evaluating the return-on-investment, or the *reluctance to invest in SSCM*, firms might seek to explicitly outline the business case of SSCM (Ageron et al., 2012; Peters et al., 2011; Walker et al., 2008).

Beside costs and financial factors, personnel related factors such as *competences, skills* (Bowen et al., 2001), and *commitment* (Cooper et al., 2000; Walker et al., 2008) play a major role in the failure or success of a firm's SSCM initiative. Thus, firms need to assure that their personnel receive required *training* and build up the necessary competences and skills to address sustainability factors and to understand how these factors are embedded within supply chains (Bowen et al., 2001; Carter and Dresner, 2001). *Top management support* further ensures commitment and resources for effective implementation of organizational SSCM initiatives (Carter and Dresner, 2001; Zhu et al., 2008).

Table C - 1. Literature review of critical factors to SSCM

Critical factors to SSCM	Sources
Internal critical factors	
Costs, lack of financial resources	(Ageron et al., 2012; Hervani et al., 2005; Min and Galle, 1997, 2001; Walker et al., 2008; Wycherley, 1999)
Investment reluctance (defining scope and evaluating return-on-investment)	(Ageron et al., 2012; Peters et al., 2011; Walker et al., 2008)
(Lack of) competences, and skills	(Bowen et al., 2001)
(Lack of) personnel commitment	(Cooper et al., 2000; Walker et al., 2008)
Trainings	(Bowen et al., 2001; Carter and Dresner, 2001; Cooper et al., 2000)
Top management support	(Carter and Dresner, 2001; Zhu et al., 2008)
External critical factors	
(Lack of) power	(Ciliberti et al., 2008)
Stakeholder partnerships (e.g. with NGOs, suppliers or industry fellows)	(Granek and Hassanali, 2006; Grimm et al., 2011; Pesonen, 2001; Walker and Preuss, 2008)
Stakeholder pressures (e.g. regulatory incentives, NGO pressures, or customer demands)	(Argenti, 2004; Peters et al., 2011; Seuring and Mueller, 2008b)
(Lack of) commitment and trust between supply chain partners	(Jenkins, 2006; Walker et al., 2008; Wycherley, 1999)
(Lack of) supplier competences	(Ageron et al., 2012)
(Lack of) information and transparency	(Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
Cultural and language differences	(Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
Geographical distance	(Awaysheh and Klassen, 2010)

External critical factors

A *lack of power* over their "independent" suppliers could hinder enforcing suppliers' compliance with a firm's CSS. Thus, the focal firm might be unable to positively influence a supplier's social and environmental behavior and to implement their

auditing and supplier development programs at supplier sites (Ciliberti et al., 2008). However, involving further stakeholders into a firm's SSCM approach and making use of *stakeholder pressures* (e.g. regulatory incentives, NGO pressures, or customer demands) can positively contribute to influence supply chain partners' behavior (Argenti, 2004; Peters et al., 2011; Seuring and Mueller, 2008b). Especially within the food industry, NGOs and media frequently make aware of health, safety and environmental issues, which consequently pressure retailers, manufacturers and suppliers to change practices (Peters et al., 2011). For examples, extensive campaigns were recently started against Nestlé to make aware of its "unsustainable" sources of palm oil, which is used in its "Kit-Kat" brand (Wolf, 2013). Commonly, these campaigns are directed towards the owner of the respective brand to achieve higher public attention and indirectly impact suppliers and sub-suppliers due to changing sourcing decisions of the brand owner.

A *lack of commitment and trust between the supply chain partners* (i.e. the focal firm and its suppliers) may further hinder close collaboration on sustainability factors or the participation of suppliers in a firm's SSCM activities (Jenkins, 2006; Walker et al., 2008; Wycherley, 1999).

Even if suppliers show a willingness to follow a firm's SSCM strategies, *suppliers' low competence level* may force the focal firm to put higher investments into the supplier relationship in order to develop respective competences at supplier sites (Ageron et al., 2012).

Lacking *information and transparency* about supply chain partners, their processes or policies are major barriers for identifying and assess sustainability risks in supply chains (Awaysheh and Klassen, 2010; Ciliberti et al., 2008). In food supply chains, regulatory requirements concerning food safety systems ideally enable tracing back flows of products and ingredients all the way up to the agricultural (or chemical) production. However, powerful intermediaries or the characteristics of bulk goods might prevent the traceability (Hamprecht et al., 2005; Smith, 2008). Further positive means might be reflected in certification and labeling schemes such as "Fair Trade" that require a consistent adherence to underlying sustainability requirements and traceability up to the raw material production (Raynolds, 2009).

Furthermore, *cultural and language differences* make SSCM collaboration more difficult and requires additional effort to gain a common understanding (Awaysheh and Klassen, 2010; Ciliberti et al., 2008). These differences may also be related to *geographical distance*, which may further hamper the implementation of auditing programs or the set-up of necessary collaboration (Awaysheh and Klassen, 2010; Koplin et al., 2007; Sarkis, 2012a).

Several of these hindering critical factors could be countervailed by strategic *stakeholder partnerships*, for example with NGOs, key suppliers or industrial associations. Such partnerships help to demonstrate the relevance of a firm's SSCM and bundles necessary resources to improve sustainability conditions in its supply chains (Granek and Hassanali, 2006; Grimm et al., 2011; Pesonen, 2001; Walker and Preuss, 2008). Fair Trade, the Round Table on Sustainable Palm Oil (RSPO) and the Marine Stewardship Council (MSC) are prominent examples within the food industry that changed practices in multi-tier supply chains including sub-suppliers (Peters et al., 2011).

These findings concerning internal and external critical factors equally refer to small and medium sized enterprises (SMEs) engaging in SSCM. However, SMEs might face more difficulties to overcome barriers due to their more limited resources and lower bargaining power compared to larger firms such as retailers and multinational consumer goods manufacturers (Ciliberti et al., 2008, 2010).

Most of the cited critical factors primarily refer to general SSCM settings and do not describe critical factors targeting management settings of suppliers (exceptions may be critical factors such as missing personnel competences and skills, and supply chain partner commitment and trust, language and cultural differences). The typical SSCM context refers to direct relationships between the focal firm and its direct suppliers. Although stakeholder partnerships as critical factor provided examples how sub-suppliers might be indirectly influenced through initiatives such as the RSPO or MSC, specific sub-supplier critical factors for SSCM practices success have not been addressed in the literature. This is the purpose and contribution of our investigation.

C.3 Theoretical positioning of the study

Our study is well positioned within the theory of critical success factors (CSFs). The theory of CSFs has its foundation within strategy research (Daniel, 1961; Dinter, 2013; Rockart, 1979) and is defined as "the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization" (Rockart, 1979, p. 85). The theory of CSFs argues that poorly aligned CSFs will lead to less desirable results. Consequently, CSFs pinpoint on "the areas in which good performance is necessary to ensure attainment of those goals" (Rockart, 1979, p. 85).

CSFs and related activities should be consistently monitored for proper management decisions. Key performance indicators measuring the CSFs and their integration into performance management systems are means for effective management decisions. Besides focusing on CSFs themselves, the necessary actions on how to get there, i.e. process, should be considered as well. Ideally, a clear causal relationship between actions and target outcomes can be drawn (Kaplan and Norton, 1992, 1996).

In addition to the theory of CSFs applicability to a firm's overall strategic competitive advantage, the theory of CSFs has been linked to diverse fields such as project management and information systems management (Belassi and Tukel, 1996; Poon and Wagner, 2001; Shenhar et al., 2002; Zwikael and Globerson, 2006). Past research in these fields has shown that the presence of specific CSFs resulted in project implementation success, eventually increasing overall organizational success (Dinter, 2013).

Field of study idiosyncrasies require the identification of varying CSFs separately. There are difficulties in identifying and determining a CSF's relative importance to achieve targets (Leidecker and Bruno, 1984). "Success" is not always easy to define and it depends on the taken perspective (Chan et al., 2002), the theory of critical success factors can thus be linked to strategic and organizational contingencies.

Considering focal firms' objectives in our research context, success is achieved when a sub-supplier's performance is compliant with focal firm's CSS. In order to achieve this ultimate goal, it is necessary to identify and to get access to the sub-supplier, thus being able to conduct necessary assessment and collaboration practices if deficiencies are revealed. Consequently, identifying relevant critical factors can be important contributions to successful sub-supplier management.

Our literature review highlighted several enablers and barriers. The specific consideration of critical factors for SSCM such as implementing sustainable supply chain strategies to ensure sub-suppliers' compliance with a firm's CSS is not covered in the literature. Firms who face the unique challenges of managing sub-suppliers would highly benefit from such guidance. Thus, within the framework and understanding of the theory of CSFs, the present research seeks to identify factors that contribute to successful sub-supplier SSCM implementation.

Subsequently, the methodology to identify CSFs for successful sub-supplier management within focal firm SSCM initiatives will be presented.

C.4 Methodology

Due to the immaturity of sub-supplier management research and the complexity of multi-tier supply chain partners and their interactions in food supply chains, an exploratory, qualitative, field study research approach was chosen. Aiming for an investigation of critical factors for successful sub-supplier management for CSS compliance, a collaboration with two multi-level food supply chains was achieved. Insights were gained through group settings (e.g. workshops) and by semi-structured interviews with individual representatives of each supply chain. A number of site visits to the focal companies and some of their suppliers were completed.

C.4.1 Sample

The sample represented two multi-tier food supply chains, each consisting of the focal firm, a direct supplier, and a sub-supplier directly supplying the supplier. Chocolate/sugar and fruit/juice product supply chains were selected. These supply chains were selected because the two focal firms sought to ensure compliance with their CSS throughout their entire food supply chains. One key aspect was the management of sub-suppliers with respect to CSS compliance. The CSS comprised social and environmental sustainability criteria with linkages to existing cross-industry sustainability standards such as the Business Social Compliance Initiative Code of Conduct (BSCI, 2011a, 2011b).

The study participants represented a significant portion of the entire product-specific supply chain, including close linkages to the raw material extraction portion of the

food supply chain. Study participants also represented a major portion of the added value of the end product. In both cases, the supply chain complexity was manageable, while the aforementioned challenges of managing sub-suppliers remained evident, especially the relevance of urging sub-suppliers for compliance with the focal firms' CSS.

The respective (dyadic) business relationships of the field study companies build on relatively long established partnerships/collaborations (more than 2–5 years), thus the field study research was embedded in an open and trusting environment.

In the following a brief overview of the focus group participants is provided (also see Table C - 2).

The chocolate/sugar supply chain

The focal firm *«Maestrani»* is a Swiss producer of chocolate and confectionery specialties. The company is a relatively small player in the chocolate market. Their major supply products are cocoa butter and cocoa paste which - besides sugar, milk powder and flavoring - account for the main ingredients.

«ZMR», one of the strategic Swiss-based direct suppliers of Maestrani, operates a sugar mill in Switzerland and specializes in the production and trading of sugar products. They offer white refined sugar, cane sugar, and bio-sugar. Their suppliers are from Switzerland, European neighboring countries, and overseas.

«ZAF», a direct supplier of ZMR and an indirect sub-supplier of Maestrani, operates two major sugar mills in Switzerland. ZAF is the only processor of sugar beets and has a leading position in the Swiss sugar market.

The fruit/juice supply chain

The second focal firm *«Obermeilen»* is specialized in the processing of fruits and the creation of flavours and extracts. In 2010, Obermeilen acquired the jam business of a major Swiss consumer goods manufacturer. It purchases about 1000 different product types from 200 national and international suppliers per year, among them sugar and fruits. Depending on demand fruits arrive in multiple forms: entirely, puréed, frozen, diced, as concentrate or mousse.

«Allfood», the direct supplier, is a Swiss trading company and imports and exports food and raw materials. Among their products are fruit juices and fruit juice

concentrates or purees, beverage bases, and fruit and vegetable for industrial purposes. Most of their products are sourced from South America (Brazil, Ecuador, Argentina, Peru, etc.), but also from India, the Philippines and South Africa.

«Capricorn», a direct supplier of Allfood and an indirect sub-supplier of Obermeilen, is an India-based food-processing company specialized in manufacturing pulp, purees and concentrates. Capricorn processes fresh tropical fruits (e.g. mango, pineapple, guava, papaya, banana, etc.) and vegetables (e.g. gherkins, peppers, beans, potatoes and green peas etc.) in frozen form.

Table C - 2. Project participants of the two focus group supply chains

Role	**The chocolate/sugar supply chain**	**The fruit/juice supply chain**
Focal firm	Maestrani Maestrani Schweizer Schokoladen AG www.maestrani.ch turn-over: ca. CHF 45-50 mio. employees: ca. 150 Project members/informants: Chief Operations Officer Head of Procurement (*)	Obermeilen Obermeilen Schweizer Getränke AG www.obermeilen.ch turn-over: ca. CHF 50 mio. employees: ca. 100 Project members/informants: Chief Executive Officer Head of Procurement & Logistics (*)
Direct supplier	ZMR Zuckermühle Rupperswil AG www.zuckermuehle.ch turn-over: n/a employees: ca. 55 Project members/informants: Chief Executive Officer Senior Sourcing Manager (*) Quality Manager	Allfood Allfood AG www.allfood.ch turn-over: n/a employees: <10 Project members/informants: General Manager Deputy General Manager (*)
Indirect sub-supplier	ZAF Zuckerfabriken Aarberg + Frauenfeld AG www.zucker.ch turn-over: ca. CHF 210 mio. employees: ca. 270 Project members/informants: Head of Quality & Sustainability (*)	Capricorn Capricorn Food Products India Ltd. www.capricorngroup.com turn-over: n/a employees: n/a Project members/informants: Assistant Manager Exports (*)

(*) Interviewees for structured interviews for CSF identification

C.4.2 Data collection

Initial CSFs evidence on sub-supplier management in the field study supply chains was observed and gathered by interactively working with these organizations in a project setting, where specific managerial issues were addressed. In addition to these collaborative, field-based interactions, two rounds of semi-structured interviews with members of the two supply chains to support the systematic identification of CSFs were also completed (Eisenhardt, 1989a). The semi-structured interview details are provided below and in the Appendix C.8.

The supply chain participants sought to implement their CSS within their entire supply chains, including sub-suppliers beyond the tier-1 level. Study participants included "C-level" managers, purchasing managers, or additional employees with sourcing, quality, and/or sustainability functions. Research team members were also embedded within the supply chain decision and project management process (especially with the focal organizations) for approximately a year. Observational information was gathered and field notes taken throughout the year, transcribed, and maintained in a field study data base (Yin, 2003).

In order to enable a more systematic and structured identification of targeted CSFs, the research team conducted additional semi-structured interviews with the most experienced project members of each field study company. To enable broader, holistic identification of factors, three different interview guideline protocols were developed in line with the previous literature review and initial experiences that were gained within the year-long field study settings. Each protocol was adapted to the perspective of the interviewed supply chain partner, namely (1) the focal firm, (2) the direct supplier, and (3) the sub-supplier (see Appendix C.8). The "supply-chain-tier-specific" adaptations addressed the individual roles, objectives, challenges, and outcomes that the supply chain partners might have within the sub-supplier management initiative. Consequently, field study participants' explanations should enable the identification of perspective-specific critical (success) factors.

Not all members of the supply chain were physically interviewed. The interview with the Indian-based sub-supplier Capricorn was conducted via telephone, all other interviews took place at company sites, where observations could also be made. The

targeted interviews on CSFs lasted between 60 and 90 minutes and were recorded, transcribed, and subsequently verified by interviewees.

C.4.3 Data analysis

Coding was initiated only after data collection was completed. The coding process followed multiple steps as recommended by Miles and Huberman (1994). The coding process was combined with template analysis techniques for capturing, ordering and interpreting the taken field notes, archival data, and qualitative interview data (King, 2004; Waring & Wainwright, 2008).

In the initial stage, two researchers individually started to derive an analytical template for each field study company. A set of pre-defined codes, which were based on identified critical factors from the literature review, the interview guideline, and on individual company experiences were initially used (King, 2004). Coding was further extended to common terminology used among the field study participants, since the objective was to identify CSFs that are important or unique to the management of sub-suppliers in the sustainable food supply chain context, which might have not been reported in the literature yet. As a key feature of template analysis techniques and similar to affinity diagrams, a hierarchical organization of codes, with groups of similar codes clustered together to produce more general higher-order codes was applied (King, 2004). This enabled a structured discussion and reflection of the identified factors.[47]

To avoid investigator bias and to ensure inter-rater reliability, the individual researchers' results were discussed after each process step. Initially an analysis of each field study company was completed separately before comparing the individual field study companies and perspectives. Following this procedure, an additional academic expert was involved to initially validate the results. Table C - 3 provides a field study company analysis which led to the identification of the respective CSFs. Only those CSFs which were considered key by more than one field study company were included.

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[47] For example, the final high-order codes categorize the CSFs into (1) focal firm-related, (2) relationship-related, (3) supply chain partner-related, and (4) context-related CSFs. On a lower order, CSFs might consist of multiple dimensions (e.g. the CSFs suppliers' and sub-suppliers' perceived value is constituted by the two dimensions "benefits" and "sacrifices" that result from the sub-supplier management initiative) (Eggert and Ulaga, 2002; Walter et al., 2001).

To assure the significance and completeness of identified CSFs, feedback cycles amongst the field study companies were initiated. The field study companies provided feedback on the presented CSFs and their CSF definitions. Finally, group discussions confirmed the selection of the final set of 14 CSFs as illustrated in Table C - 3. These 14 CSFs also seem to reflect a cognitively manageable number of key factors—much research even argues to reduce the number (Fu et al., 2012). However, since the present research reflects exploratory work in an immature field, insights and CSFs are not limited at this stage.

C.5 Results: Identification of critical success factors

This field study research identified 14 critical success factors (CSF) for managing sub-suppliers (see Table C - 3). In the following sections each of the 14 CSFs are individually reviewed. In each case, a definitional foundation for the CSF and evidence for the CSF resulting from study participants input are provided. Reconciliation between participant input and literature is also completed. Potential research avenues are outlined.

Table C - 3. Identified CSFs and provided evidence within the focus group

	The chocolate/sugar supply chain			The fruit/juice supply chain		
Identified critical factors	**Maestrani Focal firm**	**ZMR Supplier**	**ZAF Sub-supplier**	**Obermeilen Focal firm**	**Allfood Supplier**	**Capricorn Sub-supplier**
CSF1 Trust between focal firm and direct supplier	X	X		X	X	
CSF2 Trust between direct supplier and sub-supplier		X			X	X
CSF3 Focal firm's buyer-power (over direct supplier)	X		X	X		
CSF4 Direct supplier's buyer-power (over sub-supplier)		X	X	X		
CSF5 Committed long-term relationship between direct supplier and sub-supplier		X	X	X	X	X
CSF6 Supply-know-how of focal firm				X	X	
CSF7 Direct supplier's willingness to disclose sub-suppliers	X	X		X	X	
CSF8 Involvement of direct supplier	X	X	X	X		X
CSF9 Perceived value for direct supplier	X	X		X	X	
CFS10 Perceived value for sub-supplier	X	X	X			X
CSF11 Low risk of supplier-by-passing	X	X		X	X	
CSF12 Sub-supplier's capability to comply with requested sustainability standards			X		X	X
CSF13 Geographical distance between supply-chain-partners	X	X		X	X	
CSF14 Cultural distance between supply-chain-partners		X		X	X	X

"Trust between focal firm and direct supplier" (CSF1)

Trust between a buying firm and its direct supplier can be described by the relationship in which the two parties perceive each other as credible and benevolent ((Doney and Cannon, 1997). Trust is critical for strategic supply chain partnerships (Handfield and Bechtel, 2002).

The study participants frequently mentioned trust as one of the key factors. Greater mutual trust between the focal firm and a supplier resulted in greater information disclosure and access with respect to the suppliers' supply base. Suppliers would also be more proactive in supporting the focal firm within sub-supplier initiatives. In less trustful relationships suppliers may fear risks associated with focal firms bypassing the supplier and directly sourcing from the respective sub-supplier, or put pressures on both the supplier and sub-supplier resulting in unfavorable economic outcomes.

These observations were supported by both the focal firms and their direct suppliers as the two following quotes highlight:

> *"When trust between us and a direct supplier exists, we don't need to force this supplier to allow us the management of his sub-supplier, he rather supports us." (Obermeilen, Head of Procurement & Logistics)*

> *"An essential prerequisite is a trustful relationship to the buying firm. Otherwise, we would not enable them to approach our suppliers [i.e. firm's sub-suppliers]." (Allfood, Deputy General Manager)*

These observations are in line with the existent SSCM literature. The trust described in this literature was needed to for general buy-in into the focal firm's SSCM approach (e.g. Walker et al., 2008). In our context the willingness to disclose sub-supplier information and partner on sub-supplier activities are the goals.

In both contexts, direct and sub-supplier relationships, trust plays a major role. The "trust threshold" for building new relationships and operations versus disclosing sub-suppliers' operations will differ. Consequently, further research on how the various facets of trust can be distinguished in these relationships, is needed.

"Trust between direct supplier and sub-supplier" (CSF2)

Similar to the focal firm-direct supplier relationships, trust between the supplier and sub-supplier is considered a critical factor. Trust in this situation is defined the same way as in CSF1.

In a trusting relationship a sub-supplier, in response to CSS requirements, must not fear retribution for CSS non-compliance. Rather the sub-supplier would expect support to overcome deficiencies, as the following quote highlights:

"We respond to sustainability requirements if we believe that they will keep us as a preferred supplier. For example at Coca Cola there is nothing explicitly written. It's just a business commitment which we have with them, which is based on trust between them and us." (Capricorn, Assistant Manager Exports)

This perspective was supported by statements at the direct supplier level:

"Sub-supplier management is successful, when our supplier [(i.e. firm's sub-supplier)] knows that we are a trustful partner, who continuously sources from them and does not terminate a contract, if things aren't immediately as expected." (ZMR, Senior Sourcing Manager)

These observations support some of the suppositions of CSF1. Although the concept of trust is well grounded in SSCM and other fields, our context includes another entity in the inter-organizational trust equation. Even when a direct supplier and sub-supplier develop mutual trust, uncertainty still remains on how the focal firm would react. Some examination on the mediating relationships between the various levels of trust is required. Since the sub-supplier does not maintain a contractual relationship with the focal firm and both entities commonly do not build up on a long-term relationship, it is yet unknown what factors may particularly contribute to facilitate trust between these more distant and independent entities.

"Focal firm's buyer-power (over direct supplier)" (CSF3)

Focal firm's buyer-power over its direct supplier is determined by a direct supplier's dependence on the focal firm for valued resources (e.g. revenue) (Cox, 2001). Transaction cost economics (Williamson, 2008) and resource dependency theory (Crook and Combs, 2007) play significant explanatory roles in understanding these power relationships.

The focal firms within our focus group members expressed their "power" as important vehicles for enabling sub-supplier management practices adoption. If the direct supplier did not see the relevance of managing sub-suppliers or was less willing to support the focal firm, putting pressure on the supplier counters their reluctance. However, managers stated that pressuring a business partner is not a desirable method.

"If we anticipated any non-compliance at sub-supplier sites, we initially stress our direct supplier to take actions. In case the direct supplier perceives us as an

unimportant customer, he may take us not seriously, but if we are a key account, the response to our requests is much better." (Obermeilen, Head of Procurement & Logistics)

In turn, representatives of the direct suppliers confirmed that they would more likely respond to a buyer's request, if they felt dependent on the buying firm due to the buying firm's demand volume.

These observations are in line with existent research that examined how suppliers responded to pressure and adjusted their own operations, for example by implementing 'voluntary' environmental measures, such as ISO14001 certification, in response to buyer requests (Delmas and Montiel, 2009; Gonzalez et al., 2008; Zhu and Sarkis, 2007). Often these requirements are anchored as contractual elements. Since in our context, a firm's request concerns sustainability issues outside of supplier's organizational boundaries, a supplier may be more pressure resistant compared to more "traditional" situations.

"Direct supplier's buyer-power (over sub-supplier)" (CSF4)

Similar to trust as a double-link factor, buyer-power can be defined in a similar context. Whereas CSF4 enables the focal firm to reveal a sub-supplier's entity (i.e. disclosure of sub-suppliers due to focal firm pressure) a direct supplier's buyer-power is an important factor that allows for greater focal firm-sub-supplier access for direct interactions. The joint approach of a focal firm's CSS requirements and a direct suppliers' assistance combined with their buyer power, will result in higher response rates by sub-suppliers, as stated by study respondents:

"Our market position and power over a supplier [i.e. Maestrani's sub-supplier] helps a lot to motivate them in favor of any sub-supplier management activities." (ZMR, Senior Sourcing Manager)

Making use of "power" to influence direct supply chain partners is well supported by the literature as diffusion of practices through normative institutional pressures is greater in power situations. Given two dyadic power relationships (CSF3 and CSF4), a question arises on how these two dyadic power relationships may influence or complement each other. Does a focal firm's power over its supplier have direct influence on the sub-supplier as well? One focal firm respondent reported attempt

direct pressure effort on their sub-supplier although no contractual relationship existed between the two.

> *"(...) or we try to directly put pressure on the sub-supplier, this works depending on how valuable the sub-supplier perceives the supply channel to us." (Obermeilen, Head of Procurement & Logistics)*

Considerations of multiple separate dyadic power relationships do exist (Cox, 2004; Cox et al., 2001). However, no "boundary-expanding" power interactions effects have been considered in the literature. A multistage supply chain "power" construct is required to effectively investigate these issues.

"Committed long-term relationship between direct supplier and sub-supplier" (CSF5)

Well-established business relationships, which partners consider so important that it requires significant effort and resources, exemplify committed long-term relationships (Ganesan, 1994; Morgan and Hunt, 1994).

Respondents frequently stated that long-term oriented relationships between the direct supplier and sub-supplier ease sub-supplier initiative implementation. These types of relationships allow for mutual trust development and openness about issues. Both suppliers and sub-suppliers stated that they are more willing to invest time and resources into requests by the focal firm, if they knew that these investments have long term implications. Comments such as these were prevalent:

> *"We pay attention to sub-supplier management requests, especially if we maintain a long-term relationship to that [sub-]supplier, since it means much to us too." (Allfood, Deputy General Manager)*

> *"We totally understand that the customer may have difficulties with agreeing to a long-term contract. But at the same time we should be given a preference as a supplier if we invested in sustainability compliance with a longer term relationship in mind."(Capricorn, Assistant Manager Exports)*

SSCM literature states a supplier is more open or puts in more effort, if they are embedded in a long-term relationship (e.g. Walker et al., 2008; Wycherley, 1999). However, in our study's context, both the sub-supplier and the direct supplier are

required to be responsive to a focal firm's requests. In this situation both sides want to make sure that they do not waste their resources for a one-time-request.

Noticing that the supplier and the sub-supplier are "coupled" by means of committed long-term relationship may enable a focal firm to pass its requirements through to the sub-supplier – even without contractual relationships. Future research might examine how the term of a relationship between the supplier and sub-supplier effects the relationship to other parties such as the focal firm (Watson, 2001). A specific research question is whether this situation puts a focal firm in a more favorable position.

"Supply-know-how of focal firm" (CSF6)

Supply-know-how of the focal firm reflects the firm's comprehensive knowledge of its supply chain – including knowledge of procured products, related processes, and characteristics of sourcing markets (e.g. cultural specificities).

Focal firm respondents in our study outlined the importance of having developed in-depth supply knowledge such as supply chain structure, inherent processes, involved people and other contextual factors. Lacking this knowledge, firms could not purposefully and effectively address sustainability issues with their supply chain partners. The firms would be more dependent on external business partners such as consultants and auditors to achieve their objectives. In addition, this involvement would further tighten available resources that are available for firm's SSCM initiatives.

> *"Managing a sub-supplier would be particularly difficult for us, if we don't understand the local market conditions, the processes, or the mentality." (Obermeilen, Head of Procurement & Logistics).*

Similarly, the literature highlights how comprehensive supply management capabilities can positively influence a firm's financial and operational outcomes (Carr and Pearson, 1999; Sánchez-Rodríguez et al., 2003). SSCM research proposed that these more generic supply management capabilities build the foundation to build up sustainability focused supply management capabilities (Foerstl et al., 2010; Reuter et al., 2010).

We can argue that the focal firm initially requires this basic supply chain knowledge before it can diffuse sustainability capabilities through its supply chain. Research may

examine what roles basic supply chain knowledge level relates to sustainability diffusion.

"Direct supplier's willingness to disclose sub-suppliers" (CSF7)

CSF7 describes the willingness of the direct supplier to reveal its sub-suppliers to the focal firm.

> *"In general, we don't just simply disclose our suppliers. We carefully evaluate to whom we do and to whom we don't." (ZMR, Senior Sourcing Manager)*

The willingness to provide sub-supplier information is an important antecedent to broader direct supplier involvement. The willingness to disclose sub-supplier information is not a prominent concept within supply research, but this item could be related to information sharing effort in general. It can also be rooted into general principal-agent-settings (Eisenhardt, 1989b; Sarkis et al., 2011). The agent (i.e. direct supplier) hides information (i.e. entity and performance of sub-suppliers) from the principal (i.e. focal firm).

Current codes of conduct of voluntary sustainability initiatives such as the Business Social Compliance Initiative (BSCI) or the Electronic Industry Citizenship Coalition (EICC) require any members' supplier to disclose their supply base (BSCI, 2011b; EICC, 2009b). Respondents in this study stated that not every supplier is willing or could be required to supply this information. Thus, supplier's disclosure willingness reflects one of the key CSFs for sub-supplier adoption of sustainability practices. Inter-relationships between supplier's willingness for disclosure and other CSFs such as power, existent trust or perceived value were observed. Antecedents to willingness to share sub-supplier information remain unclear. Further study of principal-agent theory lenses could be furtherer grounded within SSCM and sub-supplier management (Sarkis et al., 2011).

"Involvement of direct supplier" (CSF8)

"Involvement of direct supplier" reflects a direct supplier's active mediating role within the sub-supplier management activities. The coordination and processing of the sub-supplier management initiative is not left to the focal firm itself, rather support of the direct supplier is required.

Focus group members of all supply chain tiers underlined the importance of CSF8. The focal firm emphasized that the direct supplier involvement brings them "closer" to the sub-supplier. In this situation, the focal firm becomes more rapidly familiar with sub-supplier characteristics.

> *"If you would like to visit a sub-supplier site, the respective direct supplier needs to join. He knows the sub-supplier, I do not. It will only be effective, if we take action jointly." (Maestrani, Head of Procurement)*

Furthermore, the interviewed managers of the direct suppliers explained that they can mitigate some of sub-suppliers potential concerns with respect to firm's engagement.

> *"If we approach our supplier and explain to them the relevance and that one of our strategic customers wants to process certain activities such as site visits or audits, there is a good chance that our supplier accepts – without our involvement the chances of success may be almost zero." (ZMR, Senior Sourcing Manager)*

The sub-suppliers in our studies underlined the importance of having the direct supplier (i.e. their customer):

> *"(...) we insist on the involvement of our direct customer. We are the sub-supplier and haven't been in touch with the [focal] company. We have been dealing with the direct supplier. They understand our business as well as the [focal] company's business (...) the involvement is more convenient for us." (Capricorn, Assistant Manager Exports)*

Research has shown that the involvement of competent partners lead to higher success rates of sustainability initiatives (Hart, 1995; Pagell and Wu, 2009; Sharma and Vredenburg, 1998). In line with relational view theory, a firm's sub-supplier initiative can benefit from direct supplier's complementary resources (Dyer and Singh, 1998) by exploring and exploiting supplier's knowledge and resources (e.g. trustful relationship to sub-supplier or process knowledge) (Carmin et al., 2003; Roloff, 2008; Roome and Wijen, 2005).

Distinguishing from past research, we observed that the focal firm does not benefit within its own organizational boundaries from business partner involvement, but that the positive effect was transferable and took place within the indirect business relationship to the sub-supplier.

At least two research questions arise from direct supplier involvement in sub-supplier management: (1) When does a supplier take on the role of a "gatekeeper" to the sub-supplier, and (2) what supplier resources are important to ensure effective sub-supplier management from a sustainability perspective?

"Perceived value for direct supplier" (CSF9)

CSF9 focuses the direct supplier's perceived value from the execution of sub-supplier management activities or from further aspects in sub-supplier related activities with the focal firm. Value can be described as a trade-off between benefits and sacrifices and includes both monetary and non-monetary elements (Walter and Ritter, 2003; Walter et al., 2001).

Both direct suppliers participating in our study stressed the amount of effort required to be involved in sub-supplier management practices. They are only willing to support sub-supplier management if they perceive benefits from these efforts.

> *"We are open to enabling sub-supplier management for strategic customers. But if a customer [i.e. focal firm] only buys a few hundred Kilos per year, the efforts for coordination and data processing are just too high."(ZMR, Senior Sourcing Manager)*

> *"Order volumes play a major role. From an economic perspective, there must be an appropriate balance between effort and benefits. Gathering information or even taking actions at sub-supplier sites mean a lot of efforts to us. Consequently, our willingness to support sub-supplier management is connected with order volumes and a prospected long-term relationship, both with the customer [i.e. focal firm] and the supplier [i.e. sub-supplier]." (Allfood, Deputy General Manager)*

If sub-supplier management is meant to help green supply chains, a supplier would like to see returns on it (Castka and Balzarova, 2008). Whether it pays off to be "green" may be part of this debate (Ambec & Lanoie, 2008; Hart, Ahuja, & Arbor, 1996; King & Lenox, 2001). The 'it pays to be green' discussion from a supplier perspective has yet to be fully addressed. Especially not the consideration of supplier's value deriving from their engagement in sub-supplier management, thus the business case needs to be made.

"Perceived value for sub-supplier" (CSF10)

Sub-supplier's perceived value in being involved in their customer's customer's initiatives can be defined similarly to CSF9. It can be direct or indirect benefits that it perceives or accrues, but a cost/benefit evaluation is probably needed.

Sub-supplier respondents in our study explained that fulfilling compliance with the focal firm's CSS clearly identified costs and effort are required. They consequently justified these "sacrifices" with sales volumes or price premiums they could achieve by fulfilling CSS compliance.

> *"Any compliance comes with costs. If there are new requirements, we have to change systems or need to increase the amount of documentation. To justify these costs we have to explain it to the management in terms of sales being supported with those costs." (Capricorn, Assistant Manager Exports)*

> *"Additional work and expenses must be convincingly justified. If they are willing to pay premium for the additional expenses, then we are willing to participate in certain initiatives." (ZAF, Heady of Quality and Sustainability)*

Sub-supplier's perceived value does not only result from the relationship to the sub-supplier's customer, but also indirectly from the business relationship between the focal firm and the direct supplier. This situation is especially true when both the direct supplier and the sub-supplier are highly dependent on the focal firm's order volumes. In these circumstances the sub-supplier views complying with CSS standards as a "benefit" by maintaining a sales channel to the focal firm. Having a CSS may also provide greater future opportunities for the sub-supplier with other organizations who may have similar compliance requirements. Similar to CSF9, further research is required to have a comprehensive understanding about what sub-suppliers do value when approached by focal firms.

"Low risk of supplier-by-passing" (CSF11)

"Risk of supplier-by-passing" is the risk that the focal firm terminates a business relationship with the direct supplier and starts to source directly from the sub-supplier. This activity has also been defined as disintermediation in the literature (Rossetti and Choi, 2008; Spekman et al., 2002).

Direct supplier respondents in the study made it clear that they are more reluctant to support any sub-supplier management initiative if it threatened their business. This dimension is also an important contributor to level of trust. This risk may be high, if: (1) the focal firm has capabilities for direct sourcing to the sub-supplier or (2) both the focal firm and the sub-supplier have a low commitment to the business relationship with the direct supplier.

> *"If we know, that our customer does not directly source from comparable suppliers in similar regions or neither has the respective skills to do so, we are more open to disclose our suppliers and to enable access to them." (Allfood, Deputy General Manager)*

> *"It happened for commodities, which we only traded basically: customers started to directly source from our suppliers. In such cases, we would not easily disclose our supply base and enable sub-supplier management." (ZMR, Senior Sourcing Manager)*

Existent SSCM research has not explicitly evaluated the risk of supplier-by-passing and disintermediation. Although more efficient supply network design may include fewer supplier linkages, explicit evaluation based on the resources supplied by sub-suppliers has not been an issue for investigation. The fact is that disintermediation is not necessarily a barrier for SSCM itself, and may serve as a way of making the supply chain more sustainable. The major issue is this direct supplier risk hinders a direct supplier's willingness to share information about their supplier base. This issue is a barrier for managing sub-suppliers.

A recent study by Choi and Linton (2011) provided examples of how firms sought to set up direct contracts with critical sub-suppliers. Sustainability was found to be one driver; other drivers included ensuring product supply and maintaining control of prices. The relationship between this factor and trust, information sharing, and supplier risk management requires investigation.

"Sub-supplier's capability to comply with requested sustainability standards" (CSF12)

CSF12 focuses on a sub-supplier's sustainability performance and their ability to fulfill a focal firm's sustainability standards (e.g. working hours, wages or biodiversity).

From the study respondents, we observed "sub-supplier's level of compliance" as a recognizable factor influencing both suppliers and sub-suppliers' preparedness for participation in sub-supplier management initiatives.

> *"We would be a little bit reluctant to support sub-supplier management immediately if we also perceived this sub-supplier as not capable of fulfilling certain requirements. We fear the possibility of not meeting an exclusionary criterion for exclusion and eventually lose the business." (Allfood, Deputy General Manager)*

> *"We are actually prepared to comply with any sustainability program of any other company as well. So we are willing to cooperate." (Capricon, Assistant Manager Exports)*

We find the factor of "sub-supplier's compliance" to be twofold, reflecting a dilemma. On the one hand, expected low levels of compliance may lead the supplier and sub-supplier to fear consequences and be less open to sub-supplier management practices. Alternatively, low levels of compliance give the focal firm the initial reason to engage in sub-supplier management.

Although SSCM literature has called for more research examining supplier compliance with sustainability standards (Millington, 2008), few studies consider levels of suppliers' compliance (Egels-Zandén, 2007, 2013; Jiang, 2009a, 2009b). A challenge exists in finding reliable and objective compliance data (Toffel et al., 2012). Existing studies consider only the compliance of direct suppliers. Evaluating sustainability in a multi-tier supply chain is even more difficult requiring sustainability compliance data from suppliers beyond the tier-1 level.

"Geographical distance between supply-chain-partners" (CSF13)

CSF13 refers to the geographical (physical) proximity between the location of a focal firm, direct supplier and sub-supplier.

Respondents felt that significant geographical distance between suppliers and sub-suppliers made it more difficult to acquire insights into their operations and processes due to greater effort and resource requirements, especially for site visits. Supply chain partner communication is typically limited to phone and email. Face-to-face meetings

are less frequent than they are for less distant organizations. Consequently, a focal firm is less familiar with sub-supplier's sustainability performance.

Existent SSCM literature acknowledges that increasing distance negatively influences data gathering, assessment, and collaboration (Awaysheh and Klassen, 2010). Sub-supplier management practices related to issues of geographical distance between the focal firm and its (sub-)supplier do not exist.

"Cultural distance between supply-chain-partners" (CSF14)

The culture and society in which the supply chain partners are embedded play an important role in sustainability compliance dimensions (Awaysheh and Klassen, 2010; Hofstede, 1980).

The study respondents at all supply chain levels explained difficulties in interactions deriving from cultural differences amongst supply chain members. The cultural differences were rooted to norm differences and included language, habits, or values.

> *"Communication difficulties and differing mentalities can be major barriers." (Allfood, Deputy General Manager)*

In many cases, cultural and geographical distances go along with each other.

> *"I noticed, that especially German (sub-)suppliers take us seriously, although we source relatively small volumes from them. I think it has to do with the shorter distance and the very similar cultural area." (Obermeilen, Head of Procurement & Logistics)*

Our observations are in line with past research that highlighted how firms struggle to implement their sustainable supply chain strategies in foreign countries with differing cultures (Sarkis, 2012a, 2012b). Commonly, supply chain partners embedded in similar cultural structures can build up on similar rules, norms, and values (Awaysheh & Klassen, 2010). Two directions for future research can be used to examine this issue. Further knowledge is required sub-supplier management adaptation practices to differing cultural contexts. Second, future research might examine whether sources such as regulatory quality index could indicate regions in which implementation of a firm's CSS is more likely to be successful.

C.6 Discussion and analysis

Fourteen CSFs were determined from the field study investigation. The overall results mapped well to identified factors from the literature. Some of the SSCM CSFs which were identified in the initial literature review were not directly observed within the exploratory field study findings. For example: (1) top management support, (2) personnel commitment, and (3) lack of (financial) resources were not explicitly identified by the respondents. One explanation might be that interviewed managers were already committed to the subject matter and also represented senior management level themselves. Without having a minimum level of resources, any effort for managing sub-suppliers would not be feasible. In fact, due to the embeddedness of sub-supplier management in SSCM, the unobserved CSFs might already have been implicit prerequisites. In turn, our research highlighted (1) perceived value for direct supplier and (2) sub-supplier, (3) low risk of disintermediation, and (4) sub-supplier's capability to comply with requested sustainability standards as important CSFs. These CSFs have not been extensively considered in existent SSCM research due to the preponderance of research focusing on dyadic direct supplier relationships.

C.6.1 Theoretical implications

As the theory of critical success factors acknowledges, CSFs are not only key for achieving high firm performance, but also particularly important for any strategy implementation and individual project success (Dinter, 2013; Shenhar et al., 2002; Zwikael and Globerson, 2006). It has even been highlighted that CSFs are contingent on the individual settings (Chan et al., 2002). Little knowledge exists about CSFs for sustainable supply (chain) management context (Ageron et al., 2012), and much less related to sub-suppliers and the food supply chain context. Our research has sought to contribute to a better understanding of contingent CSFs in sub-supplier management and sustainable food supply chain settings.

Traditional SSCM literature reports critical factors (mainly barriers) from the perspective of the focal firm. Thus, they are commonly classified into internal and external critical factors (Walker et al., 2008). The research at hand extended the organizational boundaries for our research and took a more multifaceted perspective by individually considering perspectives of the focal firm, suppliers and sub-suppliers

to identify CSFs for sub-supplier management. Responding to this, identified CSFs can be classified into:

- Focal firm-related (i.e. internal) CSFs (e.g. focal firm's supply-know-how),
- Relationship-related CSFs (e.g. trust between focal firm and direct supplier),
- Supply chain partner-related CSFs (e.g. sub-supplier's current CSS compliance), or
- Context-related CSFs (e.g. little cultural distance).

Whereas internal CSFs can be directly influenced by the focal firm, other CSFs are not as easily observable (e.g. trust between supplier and sub-supplier) much less measurable. However, having recognized the importance of those CSFs for the effectiveness of sub-supplier management, a focal firm should be conscious of these CSFs during any interactions with suppliers and sub-suppliers. Early consideration of those CSFs during supplier selection and contracting phases might be key for later sub-supplier management outcome. In fact, incorporating sub-supplier management practices into the evaluation, monitoring, and selection of suppliers are important for organizations seeking to diffuse sustainability standards throughout their supply chains. This situation is unlike other business performance aspects such as delivery reliability, quality, and cost, where the focus can be almost entirely on the immediate supplier, who will have to worry about economic and market factors and focus on those concerns. Sustainability activities are typically more voluntary and organizations (suppliers) may not have the same motivation or expertise in diffusing these typically voluntary and very difficult to measure outcomes.

As the initial literature review discussed unique challenges of sub-supplier management compared to "traditional" supplier management, the identified CSFs and their subsequent classification further underline important differences. That is both relationship-related CSFs and supply chain partner-related CSFs contain concepts that make an explicit distinction between suppliers and sub-suppliers – a distinction that would not be necessary within a "traditional" dyadic context.

Expanding the theory of CSFs to strategic supply chain management and especially sustainable supply chain management can provide many benefits to organizations and their supply chains. Some of the critical success factors identified in this study will require significant development and effort. In our observations we also note that CSFs

are inter-related. In many cases the respondents would discuss a number of factors jointly. Thus, a relatively complex web of interactions is observed. This is not surprising since we believe that internal CSFs and external CSFs have a more complex set of interactions than a simple two category grouping. Arriving at the four dimensions above further exemplifies the additional levels of CSF complexity that can be investigated. CSF theory of the firm should seek to examine these interactions as well as the direct influence of the CSFs.

The theory of CSFs observes that CSFs do exist; further studies are needed to evaluate the relative success of these factors. Contingencies are also part of the theory of CSFs; whether the CSS diffusion context differs, and by how much from CSFs to internal sustainability, need to be evaluated. Whether CSS diffusion to sub-suppliers differs from other non-CSS (e.g. quality, cost) management of sub-suppliers is another general direction of research.

C.6.2 Managerial implications

Our findings highlight CSFs' influence on the outcome of sub-supplier management in SSCM. Firms who aim for CSS compliance throughout their supply chains including sub-suppliers need to take particular attention on the identified CSFs. For example, purchasing managers should consider these CSFs in any strategic sourcing decisions. Whereas specific sustainability criteria included in supplier selection processes give indication about a supplier's current sustainability performance, the additional consideration of the identified CSFs provide the foundation for the subsequent potential to implement CSS at sub-supplier sites. Furthermore, the CSFs can be handled as guidelines to assess the boundaries of sub-supplier management success.

Before starting any sub-supplier management initiative, managers should be aware of the characteristics of each CSF for the specific situation. This consequently helps sourcing managers to better align required resources for managing sub-suppliers, ultimately achieving higher success rates.

Potential food safety issues as well as other social and environmental misbehaviors in food supply chains pressure firms to achieve traceability throughout their supply chains upstream to the raw material (Maloni and Brown, 2006). Although food supply chains seem to be less complex compared to other industries (e.g. automotive or

aerospace), the difficulties to achieve traceability was highlighted in this study. In many cases traceability is not fully achievable even though food safety regulations (including traceability requirements) exist (Berman and Swani, 2010; Hamprecht et al., 2005; Roth et al., 2008). Traceability challenges are particularly linked to sub-suppliers. Our research findings give further guidance what factors should be considered and might be particular important to manage sub-suppliers in food supply chains to increase transparency and sustainability.

There are a number of general CSF managerial implications, each specific CSF will have its own implications as well; we have only presented a broad-brushed set of implications based on the theory of CSFs.

C.7 Conclusions

The present research focused on the identification of CSFs for managing sub-suppliers within SSCM settings.

Based on this one year field study in two food supply chains, our research identified 14 CSFs that eventually influence the success of the sub-supplier management outcome, reflected by sub-suppliers' compliance with CSS. For each CSF, we provided a foundational definition and analyzed them with respect to existent literature. CSFs' unique importance to sub-supplier management success was highlighted and exemplified by field study insights and comments from participants. Since not all CSFs were specific to the sustainability context, our research might also contribute to other fields, where sub-suppliers need particular attention such as quality, inventory, or further risk management. Also, our findings could be applicable to supply chains in other industries.

The theory of CSFs provided an effective theoretical lens that underlined our research. This strategic theory can effectively be applied to projects and supply chains as observed in our findings. Thus, we view this issue as an important step in developing a stronger theoretical foundation for multi-tier supplier management, especially for situations where sustainability strategy is important for supply chain versus supply chain competition.

To extend the organizational boundaries from dyadic considerations between firms and direct suppliers, future research needs further examination of, at least, triadic

relationships including sub-suppliers (cf. Mena et al., 2013). Furthermore, we observed several important inter-relationships between CSFs. These inter-relationships of CSFs will need further investigation, from multiple organizational perspectives. Future research can investigate how these inter-relationships could be structured and further evaluated to provide managers better guidance how to influence CSFs and to highlight potential synergies (Fu et al., 2012).[48] Performance measuring approaches for CSFs need further examination. Whether the identified CSFs are actually CSFs and prioritizing (e.g. necessary and/or sufficient) needs further investigation.

Limitations of our study are self-evident. Our observations and findings are limited to two food supply chains. Further field studies may take place within differing industries and include companies with other characteristics in terms of sizes and resource levels. A subsequent large-scale quantitative (empirical) research approach will help to validate and generalize our research findings.

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C.8 Appendix

Interview guideline for the identification of critical success factors

Questions asked to the focal firm

- Which social and environmental corporate sustainability standards do you require from your suppliers and sub-suppliers?
- Are you aware of all your sub-suppliers? If not, what are challenges?
- Which sub-suppliers do you know, which not? Why?
- In which situation do your direct suppliers disclose their own suppliers (i.e. your sub-suppliers)? And in which situation they do not?
- What barriers do you face, when you seek to approach upper-tier sub-suppliers?

[48] For the evaluation of inter-relationships of the identified CSFs, see section 4.5 and Appendix D.

- In which situation are you able to assess your sub-suppliers?
- What enables you to manage sub-suppliers?
- In which situation do you not have any control of your sub-suppliers?
- What are factors allow you to develop your sub-supplier?
- What additional factors make it challenging or even impossible to assess or collaborate with sub-suppliers?
- What do you further consider as particularly important to manage sub-suppliers successfully?

Questions asked to the direct supplier

- Which social and environmental corporate sustainability standards are required by your direct customers? Are these standards understandable, and practicable for your producing region (e.g. required terms of working, minimum wage) and for the one of your supplier?
- Do you support customers in their sub-supplier management initiatives? Please explain.
- Do your customers know your suppliers (i.e. their sub-suppliers)? Please explain.
- In which situations are you willing to disclose your suppliers and in which not?
- Please explain the relationships to your customer and supplier for the respective situations.
- What are reasons for giving your customers access to your suppliers?
- In situations in which you disclose your suppliers and allow access to them, what factors might enable or hinder your customers' success in managing these suppliers?
- What are the prerequisites?
- How would you describe your role within your customers' sub-supplier management approach?

Questions asked to the indirect sub-supplier

- Which social and environmental corporate sustainability standards are required by your direct customers (or customers' customers)? Are these standards understandable, and practicable for your producing region (e.g. required terms of working, minimum wage)?
- In general, are you willing to cooperate with a focal company (your customer's customer) in terms of sustainability compliance? Please explain.
- Under which circumstances are you willing to collaborate with a focal company which requests your compliance with its social and environmental corporate sustainability standards? What kind of collaboration do you accept (e.g. self-

assessment questionnaire, informal site-visits, audits, etc.)? What are reasons not to cooperate with a focal company?

- Do you insist on the involvement of your direct customer in this context? Please explain.
- In the case you are willing to cooperate. What are critical factors: (1) which hinder/complicate the implementation of social and environmental corporate sustainability standards during the collaboration? (2) which enable/promote the collaboration performance?
- Could you describe the relationship between you and your direct customer for both: (1) a case in which you are willing to cooperate with the focal company and (2) a case in which you are not?
- In case of any identified non-compliance with a social and environmental sustainability standard at your company: Do you take counter-measures, responding to focal company's requests? Please explain.
- Would you rather take counter-measures, if your direct customer encourages you together with the focal company?
- What are the critical factors for the implementation of social and environmental corporate sustainability factors in general?

D. Evaluating critical success factors to sub-supplier management for sustainability compliance

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Past cases have documented how a firm's brand can suffer from any sub-supplier's non-compliance with firm's corporate sustainability standards (CSS). However, managing indirect supplier relationships (i.e. sub-suppliers) posit unique challenges to the focal firm such as a lack of contractual relationships to sub-suppliers, few opportunities to put direct pressure on sub-suppliers, or non-transparency concerning the involvement sub-suppliers in a focal firm's supply chains. Consequently, we seek to increase our understanding of the inter-relationships and strengths of critical success factors (CSFs) that enable the success of sub-supplier management initiatives, ultimately ensuring sub-suppliers' compliance with the firm's CSS. Embedded in a field study, this paper first provides a theoretical underpinning for CSFs to sustainable supply chain management and particularly to the management of sub-suppliers for CSS compliance. Then using supply chain partners from a multi-tier supply chain, i.e. a focal firm, a supplier and a sub-supplier, a structured DEMATEL ("decision making trial and evaluation laboratory") analysis is completed to evaluate the CSFs considering the individual perspectives as well as deriving aggregated results. Our findings show that significant relationships amongst CSFs exist. Besides the overall importance of the CSFs to the management of sub-suppliers for CSS compliance, our results indicate that sub-supplier management assessment and collaboration practices are significantly influenced by three specific CSFs: (1) the focal firm's buyer-power over the direct supplier, (2) the committed long-term relationship between the direct supplier and sub-supplier, and (3) the involvement of the respective direct supplier. The sub-supplier management practices themselves influence a set of CSFs in a feedback loop.

Key words: Sustainable supply chain management, sub-supplier management, theory of critical success factors, DEMATEL, field study research.

D.1 Introduction

External stakeholder pressures increasingly force focal firms to maintain sustainable supply chains. In response, focal firms incorporate social and environmental requirements into their corporate sustainability standards (CSS) and issue these CSS to their suppliers as contractual elements and codes of conduct (Bansal and Hunter, 2003; Barnett and King, 2008). Stakeholder requirements typically diffuse to indirect sub-suppliers. Past cases of CSS non-compliances in Nike's, Nestlé's or Mattel's supply chains highlight how firms' brands can suffer from their sub-suppliers' misbehaviors (Barnett and King, 2008; Choi and Linton, 2011; Wagner et al., 2009).

Sustainable supply chain management (SSCM) is the management of material, information and capital flows while considering the triple-bottom-line of sustainable development, i.e. economic, environmental and social (Seuring and Mueller, 2008b).

SSCM literature describes practices on how focal firms might ensure that their suppliers comply with CSS. These practices can be classified into assessment (e.g. auditing and monitoring) and collaboration (e.g. training and workshops) practices (Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008). However, past SSCM research mainly focused on direct supplier relationships and neglected the examination of similar practices in the application context with sub-suppliers (Gimenez and Tachizawa, 2012; Lee, 2008; Mena et al., 2013; Millington, 2008; Seuring and Mueller, 2008a).

The management of sub-suppliers within a firm's SSCM initiatives bears unique challenges that are reflected by a lack of contractual relationships to sub-suppliers, few opportunities to put direct pressure on sub-suppliers, and non-transparency concerning the involvement sub-suppliers in focal firm's supply chains (Choi and Linton, 2011).

To be successful in diffusing CSS and ensuring compliance beyond the tier-1 supplier level, firms require more knowledge about factors that influence their success within the management of sub-suppliers. Therefore, our research questions are:

1) *What are the critical success factors (CSFs) for the management of sub-suppliers to ensure their compliance with corporate sustainability standards in supply chains?*

2) *What are the inter-relationships among the identified CSFs and their influence on the sub-supplier management?*

3) *What are the different perceptions of various players (i.e. focal firm, supplier, and sub-supplier) in the multi-tier supply chains related to these CSFs?*

Our contribution to the literature is to answer these questions and provide research and practical implications. To achieve these goals, this paper is structured as follows. In the next section, we present the background of sub-supplier management within SSCM and provide an overview of CSFs to SSCM. In particular, we identify/introduce 14 CSFs for sub-supplier management for CSS compliance. Section three describes our research within the theory of CSFs. Section four describes our sample and methodology, based on a Grey-DEMATEL methodology, followed by an evaluation of the results in section five. The implications and further analysis of the results are presented in section six. Section seven summarizes our research findings, discusses limitations and directions for future research.

D.2 Background

D.2.1 Sub-supplier management within sustainable supply chain management

SSCM literature has extensively discussed managerial practices for managing direct suppliers (i.e. tier-1 suppliers) with the objective to improve supplier's sustainability performance (Bai and Sarkis, 2010a; Brammer et al., 2011; Gimenez and Tachizawa, 2012). In general, these managerial practices can be classified into assessment and collaboration practices (Klassen and Vachon, 2003; Vachon and Klassen, 2006, 2008). Assessment practices such as supplier audits or monitoring seek to identify deficiencies between focal firm's sustainability requirements defined in their CSS and supplier's actual performance. During supplier selection phases assessment practices aid choice of "capable" suppliers (Foerstl et al., 2010; Reuter et al., 2010). Certifications and meeting standards is a signaling means that can ease supplier assessment (Delmas and Montiel, 2009). If assessment practices reveal supplier deficiencies, collaboration practices (e.g. supplier trainings, workshops, and employee transfers) can be initiated by the focal firm to address these deficiencies (Bai and Sarkis, 2010a).

Even though sub-suppliers play a critical role in SSCM relatively little research has focused on sub-supplier management. Existent literature acknowledges that similar practices of "traditional supplier management" can be applied to sub-suppliers. For example, Hewlett-Packard initiated specific sub-supplier management programs including assessment and collaboration practices (DCCA, 2008). Focal firms also gather information from sub-suppliers for risk evaluation purposes or calculation of carbon emissions for their multi-tier supply chain (Spence and Bourlakis, 2009; Wolf, 2011).

Comparing traditional supplier management with the management of sub-suppliers reveals several unique challenges. First, focal firms need to identify their sub-suppliers. Usually they do not have any contractual direct relationships with sub-suppliers. Consequently, firms must rely on direct suppliers' willingness to disclose their own suppliers. Due to missing contractual relationships with sub-suppliers, focal firms may not have any means to coercively pressure sub-suppliers. To conduct assessment or collaboration practices, sub-suppliers' willingness is needed. The complexity of identifying and further actively managing sub-suppliers leads many firms to rely on their tier-1 suppliers to manage the further upstream supply chain (Gonzalez et al., 2008; Lee, 2008; Spence and Bourlakis, 2009).

The unique challenges of approaching sub-suppliers need further knowledge on factors that enable the success of sub-supplier management.

D.2.2 Critical success factors to the management of sub-suppliers

SSCM literature provides initial guidance about enablers and barriers of implementing sustainability within supply chains (Ageron et al., 2012; Walker et al., 2008) which we refer to as critical factors to SSCM. Reviewing the literature identifies internal critical factors that are rooted within focal firm's organizational boundaries:

- *Cost, lack of financial resources* (Ageron et al., 2012; Hervani et al., 2005; Min and Galle, 1997, 2001; Walker et al., 2008; Wycherley, 1999)
- *Investment reluctance (defining scope and evaluating return-on-investment)* (Ageron et al., 2012; Peters et al., 2011; Walker et al., 2008)
- *(Lack of) competences, and skills* (Bowen et al., 2001)
- *(Lack of) personnel commitment* (Cooper et al., 2000; Walker et al., 2008)

- *Training* (Bowen et al., 2001; Carter and Dresner, 2001; Cooper et al., 2000)
- *Top management support* (Carter and Dresner, 2001; Zhu et al., 2008)

Further external critical factors can be identified within relationships to supply chain partners or within the organizational context:

- *(Lack of) power* (Ciliberti et al., 2008)
- *Stakeholder partnerships (e.g. with NGOs, suppliers or industry fellows)* (Granek and Hassanali, 2006; Grimm et al., 2011; Pesonen, 2001; Walker and Preuss, 2008)
- *Stakeholder pressures* (e.g. regulatory incentives, NGO pressures, or customer demands) (Argenti, 2004; Peters et al., 2011; Seuring and Mueller, 2008b)
- *(Lack of) commitment and trust between supply chain partners* (Jenkins, 2006; Walker et al., 2008; Wycherley, 1999)
- *(Lack of) supplier competences* (Ageron et al., 2012)
- *(Lack of) information and transparency* (Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
- *Cultural and language differences* (Awaysheh and Klassen, 2010; Ciliberti et al., 2008)
- *Geographical distance* (Awaysheh and Klassen, 2010)

The listed critical factors mainly refer to general SSCM settings without concerning concrete supplier management settings. Thereby, existent literature does not fully distinguish between dyadic relationships and extended perspectives that include further existing dyads in the upstream supply chain beyond the tier-1 level. Thus, existent literature can only explain unique challenges of managing sub-suppliers to a little extent.

Recent research analyzed critical success factors (CSFs) to the management of sub-suppliers at sites of focal firms, direct tier-1 suppliers and indirect tier-2 sub-suppliers (Grimm et al., 2012; Grimm, Hofstetter, et al., 2013). The research consequently identified 14 CSFs that might contribute to higher success rates of sub-supplier management practices within SSCM, particularly ensuring sub-suppliers' compliance with CSS. The 14 CSFs are summarized together with a definitional description in Table D - 1.

These 14 CSFs relevant to the management of sub-suppliers can be categorized along four characteristics:

- *Internal focal firm-related CSF (C6)*
- *Relationship-related CSF (C1, C2, C3, C4, C5, C9, C10, and C11)*
- *Supply chain partner-related CSF (C7, and C12), and*
- *Context-related CSF (C8, C13, C14).*

Contrary to the first category (i.e. focal firm-related CSFs), the CSFs of the other categories are outside of the firm's organizational boundaries and thereby potentially less observable and measureable by the focal firm. However, inter-relations and dependencies amongst the CSFs can exist. For example, "direct supplier involvement" (C8) may depend on "firm's buyer-power" (C3) or on "supplier's perceived value" (C9). Further knowledge about such inter-relationships of CSFs and their individual strengths improves the possibility to influence specific CSFs, ultimately increasing success rates of sub-supplier management initiatives for CSS compliance. This paper seeks to make a contribution by identifying causal relationships between the CSFs (and the two sub-supplier management dimensions assessment and collaboration) by determining the importance of individual factors for the overall network of CSFs. This aspect will also be highlighted by our theoretical perspective as outlined in the following section.

Table D - 1. Critical success factors to the management of sub-suppliers for sustainability compliance (adapted from Grimm et al., 2012; Grimm, Hofstetter, et al., 2013)

	Critical success factors	Description
C1	Trust between focal firm and direct supplier	The trust between a buying firm and its direct supplier can be described by the relationship in which the two parties perceive each other as credible and benevolent (Doney and Cannon, 1997). Trust is critical for strategic supply chain partnerships (Handfield and Bechtel, 2002).
C2	Trust between direct supplier and sub-supplier	Similar to the focal firm–direct supplier relationship, trust between the supplier and sub-supplier is considered a critical factor. Trust in this situation is defined in the same way as in C1.
C3	Focal firm's buyer-power (over direct supplier)	The focal firm's buyer-power over its direct supplier is determined by a direct supplier's dependence on the focal firm for valued resources (e.g. revenue) (Cox, 2001).
C4	Direct supplier's buyer-power (over sub-supplier)	Similar to trust as a double-link factor, buyer-power can be defined in a similar context. Whereas C4 enables the focal firm to reveal a sub-supplier's identity (i.e. disclosure of sub-suppliers due to focal firm pressure), a direct supplier's buyer-power is an important factor that allows for greater focal firm–sub-supplier access for direct interactions. The joint approach of a focal firm's CSS requirements and direct suppliers' assistance combined with buyer power will result in higher response rates by sub-suppliers.
C5	Committed long-term relationship between direct supplier and sub-supplier	Well-established business relationships that partners consider so important that they require significant effort and resources, exemplify committed long-term relationships (Ganesan, 1994; Morgan and Hunt, 1994).
C6	Supply know-how of focal firm	The supply know-how of the focal firm reflects the firm's comprehensive knowledge of its supply chain—including knowledge of procured products, related processes, and characteristics of sourcing markets (e.g. cultural specificities).
C7	Direct supplier's willingness to disclose sub-suppliers	C7 describes the willingness of the direct supplier to reveal its sub-suppliers to the focal firm.
C8	Involvement of direct supplier	The involvement of the direct supplier reflects a direct supplier's active mediating role in the sub-supplier management activities. The coordination and processing of the sub-supplier management initiative is not left to the focal firm itself; rather, the direct supplier's support is required.
C9	Perceived value for direct supplier	C9 focuses on the direct supplier's perceived value from the execution of sub-supplier management activities or from further aspects in sub-supplier related activities with the focal firm. Value can be described as a trade-off between the benefits and sacrifices and includes both monetary and non-monetary elements (Walter and Ritter, 2003; Walter et al., 2001).
C10	Perceived value for sub-supplier	The sub-supplier's perceived value in being involved in its customers' initiatives can be defined similarly to C9. It can be the direct or indirect benefits that it perceives or accrues, but a cost/benefit evaluation is probably needed.
C11	Low risk of supplier by-passing	The risk of supplier by-passing is the risk that the focal firm will terminate a business relationship with the direct supplier and start to source directly from the sub-supplier. This activity has also been defined as disintermediation in the literature (Rossetti and Choi, 2008; Spekman et al., 2002).
C12	Sub-supplier's capability to comply with requested sustainability standards	C12 focuses on a sub-supplier's sustainability performance and its ability to fulfill a focal firm's sustainability standards (e.g. working hours, wages, or biodiversity).
C13	Little geographical distance between supply chain partners	C13 refers to the geographical (physical) proximity between the locations of a focal firm, direct supplier, and sub-supplier.
C14	Little cultural distance between supply chain partners	The culture and society in which the supply chain partners are embedded play important roles in the sustainability compliance dimensions (Awaysheh and Klassen, 2010; Hofstede, 1980).

D.3 Theoretical positioning of the research

The theory of critical success factors is rooted within the field of strategic management research (Daniel, 1961; Dinter, 2013; Rockart, 1979). This theory acknowledges that firms, which build up certain CSFs can improve their competitive performance. In the absence of respective CSFs, firms achieve worsened results. Thus, CSFs determine "the areas in which good performance is necessary to ensure attainment of those goals" (Rockart, 1979, p. 85).

After having identified CSFs, they should be consistently monitored by performance indicators as basis for proper management decisions to enable the targeted success. Less pronounced CSFs require further knowledge about means on how to achieve or build up respective CSFs and about their embeddedness within causal relationships (Kaplan and Norton, 1992, 1996).

Besides the explanation of overall firm performance, the theory of CSFs has been applied to other research areas such as project or information systems management (Belassi and Tukel, 1996; Poon and Wagner, 2001; Shenhar et al., 2002; Zwikael and Globerson, 2006). The presence of respective CSFs enabled firms to achieve higher success rates of project implementations, which can further lead to firms' overall performance (Dinter, 2013). Literature on CSF theory acknowledges that CSFs are contingent on differing settings idiosyncrasies. That makes it more difficult to determine relevant CSFs and their relative contribution to accomplish the targeted objectives (Leidecker and Bruno, 1984). Even defining "success" might not be that easy and can differ among the various perspectives of involved stakeholders (Chan et al., 2002).

In our research setting, focal firms are "successful" when they can ensure sub-supplier's compliance with firms' CSS. To achieve this objective, focal firms might apply assessment and collaboration practices with sub-suppliers that imply unique challenges of sub-supplier management as described in section D.2.1. Literature on CSF theory and SSCM has not reported CSFs that contribute to the implementation success of SSCM strategies beyond the tier-1 supplier level. Recently, Grimm, Hofstetter, and Sarkis (2012; 2013) proposed 14 CSFs to sub-supplier management for sustainability compliance within the SSCM context. Several identified CSFs have complex inter-relations with other CSFs. However, their relative strengths and

embeddedness within causal relationships amongst other CSFs is not explored yet. The present research seeks to close this gap by evaluating CSF inter-relationships through the application of Grey-DEMATEL as presented in the following sections.

D.4 Methodology

To evaluate inter-relations amongst the 14 management of sub-suppliers CSFs, we have chosen a "mixed approach" of quantifying qualitative data, using a structured analysis tool called "decision making trial and evaluation laboratory" (DEMATEL). DEMATEL helps determine causal relationships amongst factors in small sample size settings (Fu et al., 2012).

D.4.1 Sample and participant background

We selected the food industry since we wanted to include field study participants that can collectively oversee the entire product-specific supply chain from the raw material to the final product (cf. Mena et al., 2013). Furthermore, the food industry and its supply chains have recognizable sustainability implications that urge firms to achieve traceability and to engage in SSCM beyond the tier-1 supplier level (Maloni and Brown, 2006). Consequently, we selected a multi-tier food supply chain, including a focal firm, direct supplier (tier-1), and an indirect sub-supplier (tier-2) that are actively involved in settings corresponding to our research phenomena, to evaluate the inter-relationships amongst the 14 CSFs and the two sub-supplier management dimensions assessment and collaboration.

The focal firm *«Maestrani»* is a Swiss producer of chocolate and confectionery specialties. The company is a relatively small player in the chocolate market. Their major supply products are cocoa butter and cocoa paste which - besides sugar, milk powder and flavoring - account for the main ingredients.

«ZMR», one of the strategic Swiss-based direct suppliers of Maestrani, operates a sugar mill in Switzerland and specializes in the production and trading of sugar products. They offer white refined sugar, cane sugar, and bio-sugar. Their suppliers are from Switzerland, European neighboring countries, and overseas.

«ZAF», a direct supplier to ZMR and an indirect sub-supplier to Maestrani, operates two major sugar mills in Switzerland. ZAF is the only processor of sugar beets and has a leading position in the Swiss sugar market.

The characteristics of the field study companies and informants are summarized in Table D - 2.

Table D - 2. Field study companies of the multi-tier supply chain

Role / tier	**Field study companies and informants**
Focal firm	Maestrani (Maestrani Schweizer Schokoladen AG) www.maestrani.ch turn-over: ca. CHF 45-50 mio. employees: ca. 150 Interviewees/informants: Chief Operations Officer Head of Procurement (*)
Direct supplier (tier-1)	ZMR (Zuckermühle Rupperswil AG) www.zuckermuehle.ch turn-over: n/a employees: ca. 55 Interviewees/informants: Chief Executive Officer Senior Sourcing Manager (*) Quality Manager
Indirect sub-supplier (tier-2)	ZAF (Zuckerfabriken Aarberg + Frauenfeld AG) www.zucker.ch turn-over: ca. CHF 210 mio. employees: ca. 270 Interviewees/informants: Head of Quality & Sustainability (*)

(*) Informants for structured interview for DEMATEL evaluation

D.4.2 Data collection and analysis (the Grey-DEMATEL methodology)

To structure and to illustrate the causal relationships between identified CSF, we combine DEMATEL with grey system theory and a Euclidean distance approach to evaluate differences amongst the respondents.

DEMATEL is a structural causal mapping approach, developed at the Geneva Research Centre of the Battelle Memorial Institute (Fontela and Gabus, 1976; Gabus and Fontela, 1973). It enables the development of complex structural models based on cognitive information provided by informants. Compared to other structural causal mapping approaches such as Interpretative Structural Modeling (ISM) or the Analytic

Hierarchy Process (AHP), which focus on hierarchical structures, DEMATEL reveals more network-oriented results (Tzeng et al., 2007; Zhu et al., 2011). DEMATEL can graphically model the structure of complicated causal relationships by means of matrices or digraphs. These inputs help illustrate relationships amongst considered factors and their respective strengths (Fu et al., 2012).

The DEMATEL approach considers a set of components that are under consideration, in our case a set of CSFs to sub-supplier management within SSCM. For these CSFs, the inter-relationships are evaluated pairwise by our informants. The definitional foundation of CSFs presented in Table D - 1 is used to inform respondents for the evaluation of the inter-relationships between the CSFs. Additionally, we integrated the two dimensions of sub-supplier management (see section D.2.1), namely assessment (T_1) and collaboration (T_2) practices into the pairwise comparison approach, eventually enabling us to reveal any potential effects of CSFs on the two "target" dimensions (T_1 and T_2) and vice versa. Within each field study company of the multi-tier supply chain, we individually conducted one interview with the manager that was the most experienced with respect to sub-supplier management challenges. Field study interviews for the relationship evaluation lasted between 60 and 120 minutes per respondent. Follow-up interviews enabled us to verify any inconsistencies that were revealed during the subsequent DEMATEL analysis.

Our DEMATEL approach follows well established research procedures for DEMATEL (Fu et al., 2012; Tzeng et al., 2007) complemented by a novel distance calculation, that allows for a cross-organization comparison. The approach is divided into six major process steps:

Step 1: *Derive a linguistic and grey direct-relation matrix through informant input (see Table D - 19 in the Appendix for an overview of the applied linguistic scales)*

Step 2: *Calculate the total-relation matrix T (including direct and indirect relations amongst CSFs and the two sub-supplier management dimensions)*

Step 3: *Calculate the cause/effect relationships amongst the CSFs and sub-supplier management dimensions, and their relative strengths*

Step 4: *Determine the DEMATEL prominence-causal diagram*

Step 5: *Determine the aggregated (1) total-relation matrix T, (2) cause/effect relationships amongst CSFs and sub-supplier management dimensions, and (3) DEMATEL prominence-causal diagram for all informants of the multi-tier supply chain members*

Step 6: *Determine evaluation distances (differences) among informants*

Since our research setting focuses on a small sample size and deals with incomplete information and high factor variability, we integrate grey system theory into the DEMATEL process steps 1 and 2. The application of grey system theory enables us to transform informants' discrete linguistic evaluation judgments into grey numbers. Grey system theory also allows for transformation into crisp values for aggregation purposes at later steps. In such settings, grey systems theory helps achieve satisfactory outcomes, despite limitations such as sample size, incomplete information and high factor variability (Fu et al., 2012; Li et al., 1997).

To arrive at comparable cross-respondent cause/effect relationships we introduce a Euclidean distance calculation to the DEMATEL approach in step 6.

Each of the six above mentioned process steps require several sub-steps with mathematical operations. These together with the integration of grey system theory and Euclidean distance calculation are detailed in the Appendix (see section D.8).

In the following section we will present the results of the above outlined Grey-DEMATEL methodology including Euclidean distance.

D.5 Grey-DEMATEL application and results

The above described methodological process (with detailed process steps explanations in D.8 Appendix) was completed for three field study companies to determine the relationships amongst the identified CSFs to the management of sub-suppliers for CSS compliance within SSCM.

Table D - 3, Table D - 4, and Table D - 5 show the initial linguistic direct-relation matrices for CSFs that were derived from the field study respondents. An initial glance at the *linguistic results* highlights that all informants reported some influences amongst CSFs as "high" and "very high" (Table D - 19 in D.8 Appendix for an overview of the applied linguistic scales). This initial response indicates essential relations between the

individual CSFs – and in line with the theory of critical success factors – important implications for the effectiveness of the management of sub-suppliers for CSS compliance.

By applying grey system theory, the linguistic described relationships amongst CSFs and the two sub-supplier management dimensions were transferred into grey numbers for each informant as illustrated by Table D - 6, Table D - 7, and Table D - 8 (see D.8 Appendix, steps 1a-b). The *direct-relation grey number matrices* were the foundation to calculate the crisp total-relation matrices (see D.8 Appendix, step 2), ultimately describing direct and indirect relationships (i.e. total-relations) amongst the 14 CSFs and the two sub-supplier management dimensions, which are shown in Table D - 9, Table D - 10, and Table D - 11. The bolded, underlined values in these tables describe significant relationships amongst the considered factors. In those cases the influences/effects t_{ij} of CSF C_i on CSF C_j exceed a pre-defined threshold value (see D.8 Appendix, step 4).

Table D - 12, Table D - 13, and Table D - 14 illustrate the *prominence and effect values*[49] for each CSF that were determined based on the respective crisp total-relation matrices of each informant (see D.8 Appendix, step 3). Their graphical illustrations as *DEMATEL prominence-causal diagrams* are shown in Figure D - 1, Figure D - 2, and Figure D - 3 (see D.8 Appendix, step 4). The described logic also holds true for the targeted sub-supplier management dimensions T_1 (sub-supplier assessment) and T_2 (sub-supplier collaboration).

By drawing our focus on the *aggregated crisp total-relation matrix* (see D.8 Appendix, step 5), which includes the average information of all supply chain partners (i.e. focal firm, supplier, and sub-supplier), 40 significant relations can be identified as illustrated by the bolded underscored values in Table D - 15. Out of these significant inter-relationships, 23 relations are exclusively amongst CSFs, 3 CSFs significantly influence the target dimensions "sub-supplier assessment" and "sub-supplier collaboration", and 7 CSFs are influenced by the two target dimensions assessment and collaboration in a feedback loop. CSFs' *aggregated prominence and net effect*

[49] The prominence value P_i sums up the overall effects for a CSF from other CSFs, as well as how the CSF influences other CSFs. The value Ei describes the net effects of a CSF C_i. If Ei > 0, the CSF C_i is a net cause, i.e. influencing factor for other CSFs. If Ei < 0, the CSF C_i is a net cause and can be characterized as a resulting factor of other CSFs.

values are summarized in Table D - 16. The graphical illustration is shown in Figure D - 4.

In the following section we will discuss the results for the entity of CSFs in general and for the individual relationships amongst CSFs and sub-supplier management practices, respectively.

Table D - 3. The linguistic scale direct-relation matrix for CSFs by the focal firm

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	N	VL	VL	VL	VL	N	VL	VL	L	VL	L	VL	N	N	L	L
C2	H	N	N	VL	L	N	VL	L	L	L	VL	L	N	N	VL	VL
C3	L	L	N	N	N	N	H	H	H	H	H	H	N	N	H	H
C4	N	L	N	N	H	N	L	VL	VL	VL	VL	VL	N	N	VL	VL
C5	H	H	VL	VL	N	N	H	H	H	L	L	L	VL	VL	L	L
C6	VL	VL	H	VL	VL	N	VL	H	L	VL	VL	VL	N	N	VL	VL
C7	H	VL	H	VL	L	H	N	H	H	VL	H	VL	N	N	VL	VL
C8	H	H	L	H	H	VL	H	N	H	H	VL	H	L	L	H	H
C9	H	VL	H	VL	L	VL	VL	H	N	VL	VL	L	VL	VL	VL	L
C10	N	H	VL	L	H	VL	L	L	H	N	VL	L	VL	L	H	H
C11	H	H	VL	H	VL	L	N	VL	VL	H	N	H	L	L	H	H
C12	L	H	VL	H	H	VL	VL	L	L	H	VL	N	N	N	H	H
C13	N	N	N	N	N	N	N	N	N	N	L	N	N	N	N	L
C14	VL	VL	N	N	N	N	N	N	N	N	N	N	N	N	VL	L
T1	VL	H	VL	L	L	VL	VL	VL	VL	H	VL	H	VL	VL	N	H
T2	L	H	VL	H	H	VL	H	H	H	H	L	H	L	L	H	N

Table D - 4. The linguistic scale direct-relation matrix for CSFs by the supplier (tier 1)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	N	H	L	L	VL	N	L	H	VL	VL	H	VL	N	N	VL	VL
C2	H	N	N	L	H	N	L	L	L	L	H	L	N	N	L	H
C3	N	N	N	VL	H	N	VL	H	VH	VH	L	H	VL	VL	H	H
C4	VL	VH	L	N	VH	N	H	N	H	L	L	H	VL	VL	H	H
C5	H	VH	N	H	N	N	H	N	VH	VH	VL	H	N	N	VH	VH
C6	H	N	N	N	N	N	L	L	N	L	VH	H	N	N	H	H
C7	H	N	N	N	N	VH	N	N	L	H	VH	L	N	N	L	VL
C8	H	H	N	H	H	VL	H	N	VL	L	VL	L	N	N	H	VH
C9	VL	L	N	L	H	N	L	H	N	H	N	VL	N	VL	H	H
C10	N	VL	N	N	N	N	L	H	H	N	N	H	N	N	L	L
C11	VL	H	N	L	H	N	VH	L	N	H	N	N	N	N	N	N
C12	H	VH	N	H	H	N	L	H	H	H	N	N	N	N	H	H
C13	H	H	N	VL	N	H	VL	N	N	N	H	N	N	H	L	VL
C14	H	VH	N	N	N	H	VL	N	N	N	H	N	H	N	H	L
T1	VH	H	N	L	H	VH	N	H	H	VH	H	N	N	N	N	H
T2	VH	VH	N	L	H	VH	N	H	H	VH	H	VH	N	N	H	N

Table D - 5. The linguistic scale direct-relation matrix for CSFs by the sub-supplier (tier 2)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	N	H	VL	N	N	L	H	H	H	L	H	VL	N	N	L	H
C2	H	N	N	VL	VH	L	H	VH	VH	VH	H	H	N	N	VH	VH
C3	VH	L	N	VH	L	H	H	H	VH	L	H	H	VL	VL	H	H
C4	H	VH	VL	N	VH	VL	H	H	H	VH	H	VH	H	VL	H	H
C5	VH	VH	VL	VL	N	H	L	H	VH	VH	L	H	VH	VH	H	VH
C6	L	L	VL	VL	VL	N	H	H	H	L	H	H	VL	VH	H	VH
C7	H	VH	VL	VL	H	5	N	H	L	VH	H	H	VL	VL	H	H
C8	L	VH	VL	VL	VH	H	H	N	H	H	H	H	VL	VL	H	H
C9	H	H	L	L	H	L	L	H	N	VL	L	L	N	N	H	H
C10	VL	H	VL	VL	H	VL	VL	H	L	N	N	H	N	N	VL	H
C11	L	L	VL	VL	H	H	VH	VH	H	H	N	H	VL	VL	L	H
C12	VH	VH	VL	VL	H	L	L	VL	VH	H	VL	N	VL	N	N	VL
C13	H	H	VL	VL	H	VH	VH	H	H	H	H	H	N	H	H	VH
C14	H	H	L	L	H	H	H	H	L	L	H	H	N	N	H	H
T1	L	H	N	N	VL	L	H	H	L	H	VL	VH	N	VL	N	H
T2	L	H	VL	VL	VH	H	VL	H	H	H	H	H	N	N	H	N

Table D - 6. The grey direct-relation matrix for CSFs by the focal firm

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	.00	.00	.00	.25	.00	.25	.00	.25	.00	.25	.00	.00	.00	.25	.00	.25	.25	.50	.00	.25	.25	.50	.00	.25	.00	.00	.00	.00	.25	.50	.25	.50
C2	.50	.75	.00	.00	.00	.00	.00	.25	.25	.50	.00	.00	.00	.25	.25	.50	.25	.50	.25	.50	.00	.25	.25	.50	.00	.00	.00	.00	.00	.25	.00	.25
C3	.25	.50	.25	.50	.00	.00	.00	.00	.00	.00	.00	.00	.50	.75	.50	.75	.50	.75	.50	.75	.50	.75	.50	.75	.00	.00	.00	.00	.50	.75	.50	.75
C4	.00	.00	.25	.50	.00	.00	.00	.00	.50	.75	.00	.00	.25	.50	.00	.25	.00	.25	.00	.25	.00	.25	.00	.25	.00	.00	.00	.00	.00	.25	.00	.25
C5	.50	.75	.50	.75	.00	.25	.00	.25	.00	.00	.00	.00	.50	.75	.50	.75	.50	.75	.25	.50	.25	.50	.25	.50	.00	.25	.00	.25	.25	.50	.25	.50
C6	.00	.25	.00	.25	.50	.75	.00	.25	.00	.25	.00	.00	.00	.25	.50	.75	.25	.50	.00	.25	.00	.25	.00	.25	.00	.00	.00	.00	.00	.25	.00	.25
C7	.50	.75	.00	.25	.50	.75	.00	.25	.25	.50	.50	.75	.00	.00	.50	.75	.50	.75	.00	.25	.50	.75	.00	.25	.00	.00	.00	.00	.00	.25	.00	.25
C8	.50	.75	.50	.75	.25	.50	.50	.75	.50	.75	.00	.25	.50	.75	.00	.00	.50	.75	.50	.75	.00	.25	.50	.75	.25	.50	.25	.50	.50	.75	.50	.75
C9	.50	.75	.00	.25	.50	.75	.00	.25	.25	.50	.00	.25	.00	.25	.50	.75	.00	.00	.00	.25	.00	.25	.25	.50	.00	.25	.00	.25	.00	.25	.25	.50
C10	.00	.00	.50	.75	.00	.25	.25	.50	.50	.75	.00	.25	.25	.50	.25	.50	.50	.75	.00	.00	.00	.25	.25	.50	.00	.25	.25	.50	.50	.75	.50	.75
C11	.50	.75	.50	.75	.00	.25	.50	.75	.00	.25	.25	.50	.00	.00	.00	.25	.00	.25	.50	.75	.00	.00	.50	.75	.25	.50	.25	.50	.50	.75	.50	.75
C12	.25	.50	.50	.75	.00	.25	.50	.75	.50	.75	.00	.25	.00	.25	.25	.50	.25	.50	.50	.75	.00	.25	.00	.00	.00	.00	.00	.00	.50	.75	.50	.75
C13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.25	.50	.00	.00	.00	.00	.00	.00	.00	.00	.25	.50
C14	.00	.25	.00	.25	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.25	.25	.50
T1	.00	.25	.50	.75	.00	.25	.25	.50	.25	.50	.00	.25	.00	.25	.00	.25	.00	.25	.50	.75	.00	.25	.50	.75	.00	.25	.00	.25	.00	.00	.50	.75
T2	.25	.50	.50	.75	.00	.25	.50	.75	.50	.75	.00	.25	.50	.75	.50	.75	.50	.75	.50	.75	.25	.50	.50	.75	.25	.50	.25	.50	.50	.75	.00	.00

Table D - 7. The grey direct-relation matrix for CSFs by the supplier (tier 1)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	.00	.00	.50	.75	.25	.50	.25	.50	.00	.25	.00	.00	.25	.50	.50	.75	.00	.25	.50	.75	.00	.25	.00	.00	.00	.00	.00	.25	.00	.25
C2	.50	.75	.00	.00	.00	.00	.25	.50	.50	.75	.00	.00	.25	.50	.25	.50	.25	.50	.25	.50	.50	.75	.25	.50	.00	.00	.00	.00	.25	.50	.50	.75
C3	.00	.00	.00	.00	.00	.00	.00	.25	.50	.75	.00	.00	.00	.25	.50	.75	.75	1.00	.75	1.00	.25	.50	.50	.75	.00	.25	.00	.25	.50	.75	.50	.75
C4	.00	.25	.75	1.00	.25	.50	.00	.00	.75	1.00	.00	.00	.50	.75	.00	.00	.50	.75	.25	.50	.25	.50	.50	.75	.00	.25	.00	.25	.50	.75	.50	.75
C5	.50	.75	.75	1.00	.00	.00	.50	.75	.00	.00	.00	.00	.50	.75	.00	.00	.75	1.00	.75	1.00	.00	.25	.50	.75	.00	.00	.00	.00	.75	1.00	.75	1.00
C6	.50	.75	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.25	.50	.25	.50	.00	.00	.25	.50	.75	1.00	.50	.75	.00	.00	.00	.00	.50	.75	.50	.75
C7	.50	.75	.00	.00	.00	.00	.00	.00	.00	.00	.75	1.00	.00	.00	.00	.00	.25	.50	.50	.75	.75	1.00	.25	.50	.00	.00	.00	.00	.25	.50	.00	.25
C8	.50	.75	.50	.75	.00	.00	.50	.75	.50	.75	.00	.25	.50	.75	.00	.00	.00	.25	.25	.50	.00	.25	.25	.50	.00	.00	.00	.00	.50	.75	.75	1.00
C9	.00	.25	.25	.50	.00	.00	.25	.50	.50	.75	.00	.00	.25	.50	.50	.75	.00	.00	.50	.75	.00	.00	.00	.25	.00	.00	.00	.25	.50	.75	.50	.75
C10	.00	.00	.00	.25	.00	.00	.00	.00	.00	.00	.00	.00	.25	.50	.50	.75	.50	.75	.00	.00	.00	.00	.50	.75	.00	.00	.00	.00	.25	.50	.25	.50
C11	.00	.25	.50	.75	.00	.00	.25	.50	.50	.75	.00	.00	.75	1.00	.25	.50	.00	.00	.50	.75	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C12	.50	.75	.75	1.00	.00	.00	.50	.75	.50	.75	.00	.00	.25	.50	.50	.75	.50	.75	.50	.75	.00	.00	.00	.00	.00	.00	.00	.00	.50	.75	.50	.75
C13	.50	.75	.50	.75	.00	.00	.00	.25	.00	.00	.50	.75	.00	.25	.00	.00	.00	.00	.00	.00	.00	.00	.50	.75	.00	.00	.00	.00	.50	.75	.25	.50	.00	.25
C14	.50	.75	.75	1.00	.00	.00	.00	.00	.00	.00	.50	.75	.00	.25	.00	.00	.00	.00	.00	.00	.00	.00	.50	.75	.00	.00	.50	.75	.00	.00	.50	.75	.25	.50
T1	.75	1.00	.50	.75	.00	.00	.25	.50	.50	.75	.75	1.00	.00	.00	.50	.75	.50	.75	.75	1.00	.50	.75	.00	.00	.00	.00	.00	.00	.00	.00	.50	.75
T2	.75	1.00	.75	1.00	.00	.00	.25	.50	.50	.75	.75	1.00	.00	.00	.50	.75	.50	.75	.75	1.00	.50	.75	.75	1.00	.00	.00	.00	.00	.50	.75	.00	.00

Table D - 8. The grey direct-relation matrix for CSFs by the sub-supplier (tier 2)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	.00	.00	.50	.75	.00	.25	.00	.00	.00	.00	.25	.50	.50	.75	.50	.75	.50	.75	.00	.25	.00	.00	.00	.00	.25	.50	.50	.75
C2	.50	.75	.00	.00	.00	.00	.00	.25	.75	1.00	.25	.50	.50	.75	.75	1.00	.75	1.00	.75	1.00	.50	.75	.50	.75	.00	.00	.00	.00	.75	1.00	.75	1.00
C3	.75	1.00	.25	.50	.00	.00	.75	1.00	.25	.50	.50	.75	.50	.75	.50	.75	.75	1.00	.25	.50	.50	.75	.50	.75	.00	.25	.00	.25	.50	.75	.50	.75
C4	.50	.75	.75	1.00	.00	.25	.00	.00	.75	1.00	.00	.25	.50	.75	.50	.75	.50	.75	.75	1.00	.50	.75	.75	1.00	.50	.75	.00	.25	.50	.75	.50	.75
C5	.75	1.00	.75	1.00	.00	.25	.00	.25	.00	.00	.50	.75	.25	.50	.50	.75	.75	1.00	.75	1.00	.25	.50	.50	.75	.75	1.00	.75	1.00	.50	.75	.75	1.00
C6	.25	.50	.25	.50	.00	.25	.00	.25	.00	.25	.00	.00	.50	.75	.50	.75	.50	.75	.25	.50	.50	.75	.50	.75	.00	.25	.75	1.00	.50	.75	.75	1.00
C7	.50	.75	.75	1.00	.00	.25	.00	.25	.50	.75	1.00	1.25	.00	.00	.50	.75	.25	.50	.75	1.00	.50	.75	.50	.75	.00	.25	.00	.25	.50	.75	.50	.75
C8	.25	.50	.75	1.00	.00	.25	.00	.25	.75	1.00	.50	.75	.50	.75	.00	.00	.50	.75	.50	.75	.50	.75	.50	.75	.00	.25	.00	.25	.50	.75	.50	.75
C9	.50	.75	.50	.75	.25	.50	.25	.50	.50	.75	.25	.50	.25	.50	.50	.75	.00	.00	.00	.25	.25	.50	.25	.50	.00	.00	.00	.00	.50	.75	.50	.75
C10	.00	.25	.50	.75	.00	.25	.00	.25	.50	.75	.00	.25	.00	.25	.50	.75	.25	.50	.00	.00	.00	.00	.50	.75	.00	.00	.00	.00	.00	.25	.50	.75
C11	.25	.50	.25	.50	.00	.25	.00	.25	.50	.75	.50	.75	.75	1.00	.75	1.00	.50	.75	.50	.75	.00	.00	.50	.75	.00	.25	.00	.25	.25	.50	.50	.75
C12	.75	1.00	.75	1.00	.00	.25	.00	.25	.50	.75	.25	.50	.25	.50	.00	.25	.75	1.00	.50	.75	.00	.25	.00	.00	.00	.25	.00	.00	.00	.00	.00	.25
C13	.50	.75	.50	.75	.00	.25	.00	.25	.50	.75	.75	1.00	.75	1.00	.50	.75	.50	.75	.50	.75	.50	.75	.50	.75	.00	.00	.50	.75	.50	.75	.75	1.00
C14	.50	.75	.50	.75	.25	.50	.25	.50	.50	.75	.50	.75	.50	.75	.50	.75	.25	.50	.25	.50	.50	.75	.50	.75	.00	.00	.00	.00	.50	.75	.50	.75
T1	.25	.50	.50	.75	.00	.00	.00	.00	.00	.25	.25	.50	.50	.75	.50	.75	.25	.50	.50	.75	.00	.25	.75	1.00	.00	.00	.00	.25	.00	.00	.50	.75
T2	.25	.50	.50	.75	.00	.25	.00	.25	.75	1.00	.50	.75	.00	.25	.50	.75	.50	.75	.50	.75	.50	.75	.50	.75	.00	.00	.00	.00	.50	.75	.00	.00

Table D - 9. The total-relation matrix for CSFs by the focal firm

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	0.029	0.041	0.021	0.032	0.036	0.007	0.027	0.034	0.072	0.038	0.059	0.039	0.011	0.012	0.072	0.076
C2	0.121	0.042	0.018	0.036	0.084	0.007	0.035	0.080	0.087	0.079	0.028	0.079	0.011	0.014	0.047	0.051
C3	**0.137**	**0.146**	0.044	0.075	0.095	0.026	**0.142**	**0.165**	**0.175**	**0.171**	0.128	**0.171**	0.030	0.037	**0.171**	**0.180**
C4	0.032	0.072	0.013	0.016	0.106	0.008	0.065	0.036	0.038	0.031	0.024	0.031	0.007	0.008	0.030	0.031
C5	**0.162**	**0.158**	0.047	0.063	0.075	0.021	0.130	**0.151**	**0.160**	0.114	0.085	0.115	0.033	0.038	0.114	0.122
C6	0.048	0.048	0.103	0.035	0.044	0.008	0.040	0.119	0.087	0.047	0.030	0.048	0.012	0.014	0.047	0.051
C7	**0.152**	0.075	0.120	0.054	0.100	0.098	0.048	**0.147**	**0.151**	0.071	0.120	0.074	0.022	0.025	0.074	0.081
C8	**0.179**	**0.187**	0.090	**0.150**	**0.183**	0.031	**0.152**	0.098	**0.186**	**0.171**	0.065	**0.172**	0.076	0.083	**0.172**	**0.184**
C9	**0.137**	0.068	0.106	0.049	0.096	0.018	0.053	**0.134**	0.063	0.064	0.042	0.099	0.027	0.030	0.066	0.106
C10	0.078	**0.161**	0.042	0.097	**0.157**	0.024	0.098	0.117	**0.157**	0.070	0.045	0.115	0.032	0.075	**0.145**	**0.154**
C11	**0.141**	**0.160**	0.033	**0.135**	0.084	0.057	0.047	0.070	0.078	**0.147**	0.034	**0.145**	0.069	0.075	**0.147**	**0.155**
C12	0.115	**0.165**	0.037	**0.134**	**0.160**	0.021	0.064	0.113	0.122	**0.150**	0.044	0.071	0.022	0.028	**0.148**	**0.154**
C13	0.013	0.016	0.004	0.013	0.012	0.004	0.009	0.011	0.012	0.014	0.052	0.014	0.007	0.007	0.014	0.058
C14	0.016	0.018	0.003	0.008	0.010	0.002	0.008	0.009	0.010	0.010	0.005	0.010	0.004	0.004	0.017	0.052
T1	0.061	**0.146**	0.027	0.089	0.108	0.018	0.049	0.063	0.069	**0.135**	0.035	**0.133**	0.026	0.031	0.055	**0.137**
T2	**0.143**	**0.186**	0.053	**0.151**	**0.181**	0.032	**0.148**	**0.170**	**0.180**	**0.169**	0.095	**0.170**	0.077	0.083	**0.168**	0.103

Table D - 10. The total-relation matrix for CSFs by the supplier (tier 1)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	0.058	0.142	0.057	0.089	0.071	0.027	0.096	0.131	0.059	0.078	0.125	0.055	0.001	0.002	0.065	0.071
C2	0.168	0.116	0.014	0.117	0.166	0.049	0.121	0.131	0.127	0.154	0.149	0.117	0.001	0.002	0.134	0.171
C3	0.111	0.131	0.010	0.094	0.182	0.057	0.093	**0.188**	**0.215**	**0.244**	0.115	0.164	0.009	0.011	**0.191**	**0.197**
C4	0.134	**0.249**	0.061	0.093	**0.228**	0.068	0.170	0.116	**0.196**	**0.196**	0.140	0.175	0.009	0.011	**0.201**	**0.207**
C5	**0.212**	**0.264**	0.019	0.178	0.134	0.077	0.177	0.136	**0.238**	**0.270**	0.120	**0.185**	0.002	0.003	**0.243**	**0.250**
C6	0.160	0.100	0.011	0.064	0.080	0.047	0.110	0.126	0.070	0.139	0.178	0.136	0.001	0.001	0.149	0.153
C7	0.136	0.071	0.009	0.046	0.058	0.140	0.061	0.070	0.091	0.150	0.168	0.090	0.001	0.001	0.101	0.070
C8	**0.192**	**0.208**	0.018	0.162	0.181	0.071	0.161	0.102	0.113	0.173	0.104	0.135	0.002	0.002	**0.185**	**0.223**
C9	0.102	0.146	0.011	0.111	0.160	0.053	0.110	0.160	0.087	0.182	0.072	0.084	0.002	0.009	0.167	0.173
C10	0.066	0.078	0.006	0.050	0.062	0.035	0.087	0.138	0.128	0.074	0.045	0.121	0.001	0.001	0.104	0.109
C11	0.071	0.142	0.008	0.088	0.130	0.035	0.165	0.094	0.063	0.150	0.055	0.057	0.001	0.001	0.066	0.068
C12	**0.200**	**0.253**	0.018	0.173	**0.196**	0.063	0.139	**0.193**	**0.190**	**0.218**	0.100	0.102	0.002	0.003	**0.200**	**0.210**
C13	0.138	0.145	0.009	0.047	0.051	0.109	0.056	0.054	0.040	0.061	0.140	0.040	0.007	0.083	0.094	0.062
C14	0.159	**0.196**	0.010	0.053	0.068	0.121	0.067	0.071	0.055	0.082	0.156	0.054	0.083	0.008	0.141	0.112
T1	**0.229**	**0.215**	0.018	0.135	**0.188**	0.164	0.108	**0.197**	0.180	**0.249**	0.177	0.106	0.001	0.003	0.124	**0.206**
T2	**0.256**	**0.278**	0.020	0.157	**0.214**	0.172	0.126	**0.222**	**0.204**	**0.277**	**0.192**	**0.225**	0.002	0.003	**0.221**	0.162

Table D - 11. The total-relation matrix for CSFs by the sub-supplier (tier-2)

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	0.078	0.166	0.025	0.015	0.095	0.110	0.137	0.162	0.159	0.127	0.140	0.098	0.013	0.023	0.117	0.164
C2	0.193	0.178	0.028	0.027	**0.237**	0.155	0.181	**0.249**	**0.250**	**0.243**	0.180	0.212	0.029	0.043	0.219	**0.256**
C3	**0.225**	0.211	0.029	0.116	0.183	0.181	0.189	**0.224**	**0.253**	0.189	0.188	0.214	0.035	0.046	0.195	**0.230**
C4	0.210	**0.283**	0.038	0.025	**0.255**	0.140	0.197	**0.237**	**0.242**	**0.262**	0.193	**0.254**	0.095	0.053	0.205	**0.246**
C5	**0.246**	**0.293**	0.044	0.035	0.176	0.205	0.182	**0.252**	**0.278**	**0.266**	0.180	**0.238**	0.118	0.142	0.219	**0.289**
C6	0.144	0.179	0.034	0.027	0.132	0.106	0.165	0.195	0.193	0.160	0.166	0.188	0.023	0.122	0.172	**0.225**
C7	0.186	**0.253**	0.034	0.026	0.201	**0.228**	0.119	0.217	0.191	**0.236**	0.178	0.206	0.030	0.051	0.187	**0.224**
C8	0.158	**0.248**	0.033	0.026	**0.225**	0.172	0.174	0.149	0.212	0.205	0.173	0.200	0.032	0.048	0.183	0.217
C9	0.164	0.193	0.060	0.053	0.172	0.125	0.129	0.183	0.125	0.124	0.129	0.148	0.023	0.033	0.164	0.189
C10	0.075	0.150	0.022	0.017	0.140	0.064	0.063	0.138	0.118	0.078	0.059	0.135	0.017	0.022	0.072	0.143
C11	0.146	0.183	0.032	0.025	0.187	0.165	0.190	**0.222**	0.197	0.191	0.101	0.188	0.029	0.044	0.145	0.202
C12	0.173	0.196	0.027	0.021	0.151	0.104	0.108	0.107	0.191	0.154	0.081	0.088	0.023	0.028	0.084	0.113
C13	0.211	**0.256**	0.041	0.032	**0.227**	**0.229**	**0.229**	**0.243**	**0.242**	**0.233**	0.202	**0.231**	0.029	0.114	0.211	**0.278**
C14	0.191	**0.228**	0.066	0.058	0.202	0.178	0.182	0.216	0.191	0.183	0.182	0.207	0.028	0.042	0.189	**0.222**
T1	0.116	0.171	0.017	0.013	0.101	0.107	0.134	0.157	0.135	0.157	0.079	0.181	0.014	0.028	0.080	0.161
T2	0.140	0.199	0.030	0.023	0.205	0.153	0.104	0.189	0.192	0.183	0.156	0.181	0.025	0.039	0.165	0.134

Table D - 12. Prominence and net effect values for each CSFs as evaluated by the focal firm

CSF	*R sum*	*D sum*	P_i *(R + D)*	E_i *(R – D)*
C1	0.607	1.564	2.170	-0.957
C2	0.820	1.687	2.507	-0.867
C3	1.892	0.760	2.652	1.132
C4	0.549	1.136	1.686	-0.587
C5	1.587	1.530	3.117	0.057
C6	0.782	0.380	1.162	0.401
C7	1.412	1.115	2.527	0.296
C8	2.177	1.518	3.695	0.658
C9	1.158	1.647	2.805	-0.489
C10	1.564	1.480	3.043	0.084
C11	1.576	0.891	2.466	0.685
C12	1.547	1.486	3.033	0.062
C13	0.260	0.464	0.723	-0.204
C14	0.185	0.564	0.749	-0.380
T1	1.181	1.487	2.668	-0.305
T2	2.109	1.696	3.805	0.413

Table D - 13. Prominence and net effect values for each CSFs as evaluated by the supplier

CSF	*R sum*	*D sum*	P_i *(R + D)*	E_i *(R – D)*
C1	1.127	2.390	3.518	-1.263
C2	1.737	2.734	4.471	-0.996
C3	2.011	0.300	2.311	1.712
C4	2.253	1.659	3.912	0.594
C5	2.508	2.170	4.677	0.338
C6	1.524	1.287	2.811	0.237
C7	1.264	1.847	3.111	-0.583
C8	2.031	2.130	4.161	-0.099
C9	1.628	2.056	3.684	-0.428
C10	1.106	2.698	3.804	-1.592
C11	1.194	2.035	3.229	-0.842
C12	2.261	1.845	4.106	0.417
C13	1.137	0.123	1.259	1.014
C14	1.436	0.144	1.580	1.292
T1	2.299	2.387	4.687	-0.088
T2	2.732	2.445	5.177	0.286

Table D - 14. Prominence and net effect values for each CSFs as evaluated by the sub-supplier

CSF	*R sum*	*D sum*	P_i *(R + D)*	E_i *(R – D)*
C1	1.629	2.658	4.288	-1.029
C2	2.681	3.387	6.068	-0.706
C3	2.709	0.558	3.268	2.151
C4	2.936	0.538	3.474	2.398
C5	3.163	2.888	6.051	0.275
C6	2.230	2.424	4.653	-0.194
C7	2.568	2.484	5.053	0.084
C8	2.455	3.141	5.596	-0.685
C9	2.014	3.169	5.183	-1.154
C10	1.312	2.990	4.302	-1.678
C11	2.244	2.387	4.631	-0.143
C12	1.649	2.968	4.617	-1.319
C13	3.008	0.564	3.572	2.443
C14	2.567	0.878	3.444	1.689
T1	1.651	2.608	4.258	-0.957
T2	2.118	3.294	5.412	-1.176

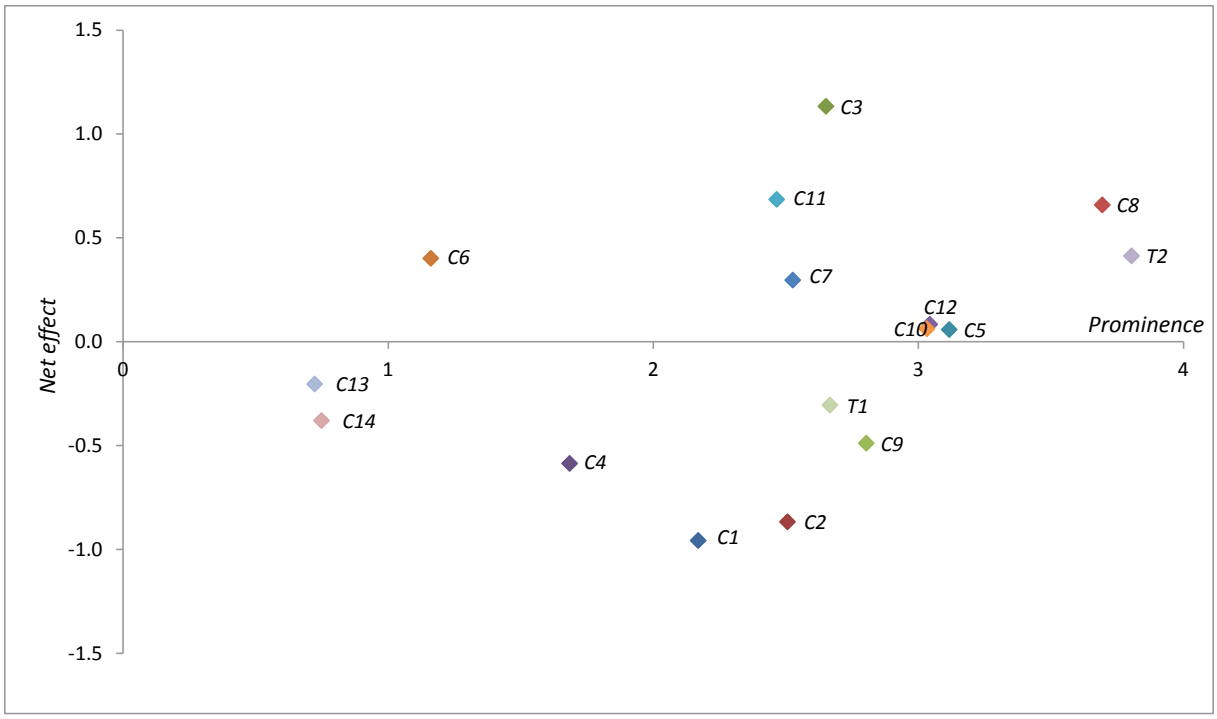


Figure D - 1. DEMATEL prominence-causal diagram for focal firm

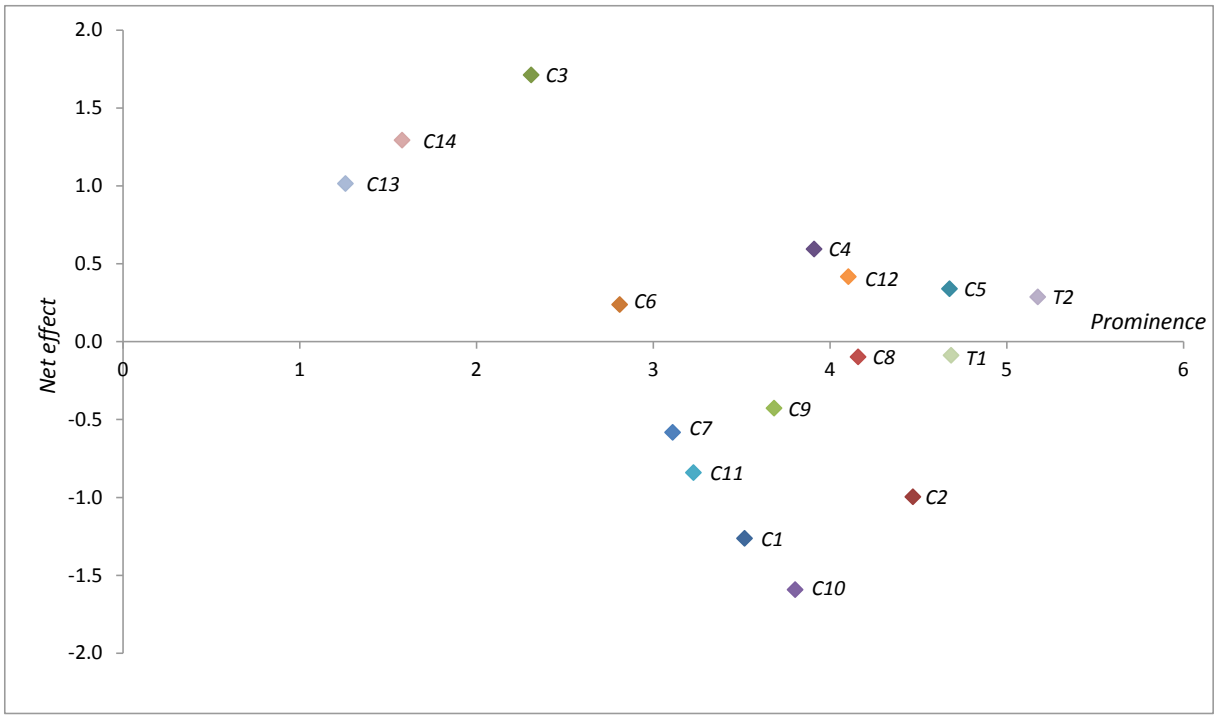


Figure D - 2. DEMATEL prominence-causal diagram for supplier (tier 1)

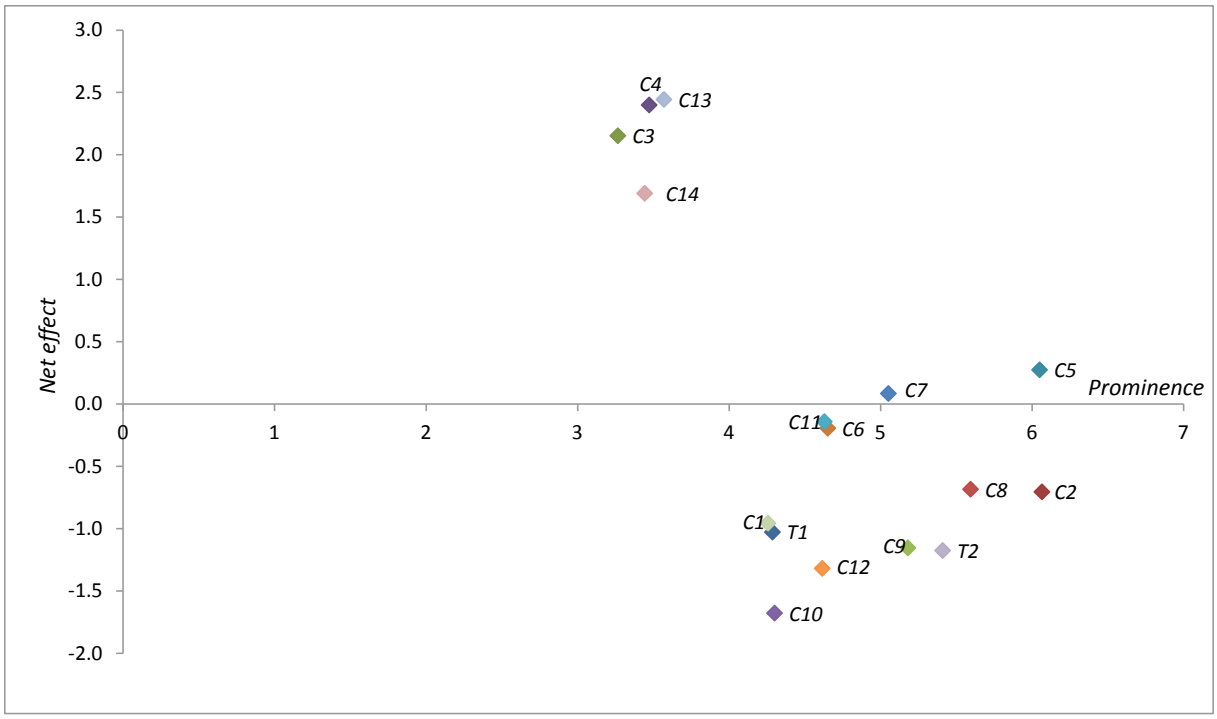


Figure D - 3. DEMATEL prominence-causal diagram for sub-supplier (tier 2)

Table D - 15. The aggregated total-relation matrix for CSFs for all supply chain partners

CSF	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	T1	T2
C1	0.105	0.175	0.053	0.077	0.109	0.072	0.132	0.167	0.149	0.137	0.148	0.108	0.018	0.021	0.137	0.160
C2	0.244	0.192	0.042	0.115	0.240	0.102	0.177	0.237	0.235	0.248	0.173	0.210	0.030	0.034	0.219	0.249
C3	0.244	**0.255**	0.050	0.154	0.233	0.131	0.214	**0.284**	**0.303**	**0.296**	0.207	**0.266**	0.040	0.045	**0.276**	**0.297**
C4	0.203	**0.292**	0.061	0.095	**0.273**	0.098	0.208	0.203	0.234	0.248	0.169	0.231	0.064	0.042	0.228	0.246
C5	**0.305**	**0.348**	0.060	0.152	0.208	0.142	0.237	**0.270**	**0.317**	**0.321**	0.188	**0.266**	0.081	0.087	**0.291**	**0.326**
C6	0.180	0.173	0.067	0.083	0.137	0.079	0.154	0.209	0.174	0.181	0.169	0.185	0.025	0.064	0.192	0.218
C7	0.236	0.216	0.074	0.093	0.187	0.201	0.129	0.217	0.214	0.239	0.210	0.193	0.029	0.037	0.201	0.208
C8	**0.278**	**0.333**	0.070	0.176	**0.295**	0.147	0.247	0.212	**0.269**	**0.297**	0.185	**0.265**	0.057	0.061	**0.287**	**0.321**
C9	0.204	0.215	0.082	0.119	0.212	0.095	0.152	0.232	0.152	0.195	0.123	0.173	0.029	0.036	0.205	0.232
C10	0.132	0.205	0.037	0.090	0.179	0.073	0.133	0.199	0.199	0.140	0.090	0.189	0.025	0.039	0.173	0.209
C11	0.202	**0.250**	0.046	0.135	0.210	0.127	0.202	0.218	0.189	**0.253**	0.116	0.200	0.048	0.052	0.195	0.224
C12	0.245	**0.294**	0.048	0.152	0.243	0.100	0.164	0.215	0.250	**0.259**	0.122	0.154	0.032	0.033	0.214	0.239
C13	0.173	0.189	0.033	0.071	0.137	0.133	0.137	0.148	0.142	0.154	0.163	0.136	0.022	0.084	0.159	0.190
C14	0.175	0.202	0.043	0.077	0.135	0.117	0.122	0.144	0.130	0.141	0.142	0.134	0.046	0.025	0.173	0.186
T1	0.212	**0.262**	0.041	0.117	0.199	0.138	0.153	0.220	0.205	**0.264**	0.145	0.212	0.029	0.038	0.155	**0.254**
T2	**0.282**	**0.341**	0.059	0.169	**0.301**	0.179	0.201	**0.301**	**0.298**	**0.326**	0.220	**0.294**	0.052	0.059	**0.293**	0.239

Table D - 16. Aggregated prominence and net cause/effect values for each CSFs as evaluated by all supply chain partners

CSF	*R sum*	*D sum*	P_i *(R + D)*	E_i *(R – D)*
C1	1.768	3.422	5.189	-1.654
C2	2.746	3.943	6.689	-1.197
C3	3.295	0.864	4.159	2.431
C4	2.894	1.875	4.769	1.019
C5	3.598	3.297	6.896	0.301
C6	2.290	1.935	4.225	0.355
C7	2.685	2.762	5.447	-0.077
C8	3.500	3.476	6.976	0.024
C9	2.455	3.459	5.914	-1.004
C10	2.113	3.698	5.811	-1.586
C11	2.666	2.569	5.235	0.098
C12	2.762	3.215	5.977	-0.454
C13	2.072	0.627	2.699	1.445
C14	1.992	0.759	2.751	1.233
T1	2.644	3.396	6.041	-0.752
T2	3.616	3.797	7.413	-0.181

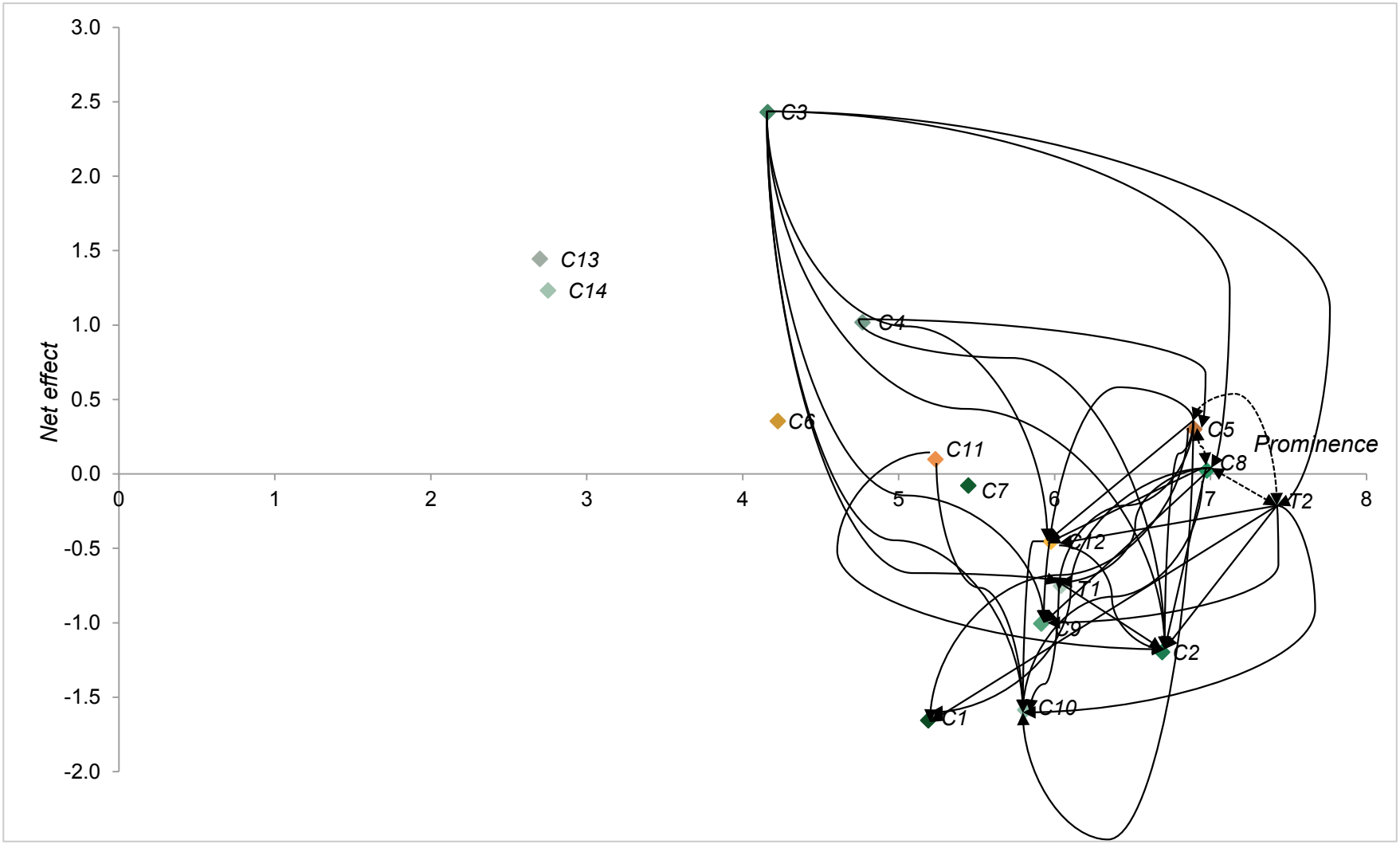


Figure D - 4. Aggregated DEMATEL prominence-causal diagram for all supply chain partners

D.6 Discussion

D.6.1 Overall

The CSF DEMATEL evaluation reveals two clusters. The “net cause cluster” comprises CSFs that mainly influence other CSFs, whereas the “net effect cluster” contains CSFs that are mainly influenced by others,

As indicated by Figure D - 1, the focal firm considers C3, C5, C6, C7, C8, C10, C11, and C12 as net cause factors, and C1, C2, C4, C9, C13, C14 as net effect factors. According to the supplier, the net cause cluster contains the factors C3, C4, C5, C6, C12, C13, C14 and the net effect cluster includes C1, C2, C7, C8, C9, C10, C11 (see Figure D - 2). Figure D - 3 illustrates that the sub-supplier informant regards C3, C4, C5, C7, C13, and C14 as net cause factors, and C1, C2, C6, C8, C9, C10, C11, and C12 as net effect factors. These clusters are summarized in Table D - 17.

Table D - 17. Allocation of critical success factors into cause and effect clusters

Evaluator	Cause cluster	Effect cluster
Focal firm	C3, C5, C6, C7, C8, C10, C11, C12	C1, C2, C4, C9, C13, C14
Supplier	C3, C4, C5, C6, C12, C13, C14	C1, C2, C7, C8, C9, C10, C11
Sub-Supplier	C3, C4, C5, C7, C13, C14	C1, C2, C6, C8, C9, C10, C11, C12
Aggregated	C3, C4, C5, C6, C8, C11, C13, C14	C1, C2, C7, C9, C10, C12
Intersection	C3, C5	C1, C2, C9

Whereas the three supply chain partners, the focal firm, supplier, and sub-supplier, may have partially differing perspectives on CSF influence relationships, a commonality may be determined evaluating the intersection of the defined clusters. The intersecting set of all three net cause clusters includes C3 (“Focal firm's buyer-power over direct supplier”) and C5 (“Committed long-term relationship between direct supplier and sub-supplier”). The net effect cluster intersection includes C1 (“Trust between focal firm and direct supplier”), C2 (“Trust between direct supplier and sub-supplier”), and C9 (“Perceived value for direct supplier”). Thus, CSFs C3 and C5 are perceived by all three stakeholders as foundational CSFs influencing the other

CSFs (see Table D - 17). This clustering is also in line with the aggregation results as indicated by Figure D - 4.

However, addressing CSFs C3 and C5 can be difficult for organizations. For example, the power situation between a buying firm and a supplier typically requires a long-term effort and change, such as through relation-specific investments (Handfield and Bechtel, 2002). Also, a committed long-term relationship between the supplier and sub-supplier is not easily influenced by a focal firm, if the focal firm is in a weak position (Choi and Linton, 2011).

The two trust-related CSFs C1 and C2 are considered by all three stakeholders as resulting (net effect) factors, influenced by other CSFs (see Table D - 17). This result is supported by previous research findings that report trust as path-dependent and underlines temporal aspects within relationships (Sharma and Vredenburg, 1998). Also the supplier's perceived value CSF (C9) is commonly determined by other factors (Walter and Ritter, 2003; Walter et al., 2001).

D.6.2 Key factors

In this section we discuss the results for key CSFs concerning their prominence (overall importance), their influence on other factors and how they are influenced by other factors. Due to the high number of CSFs, we mainly focus our discussion on the "top 3" CSFs (see Table D - 18). At the end of this section, the relationships between evaluated CSFs and the target dimensions of sub-supplier management practices (i.e. assessment and collaboration practices) are discussed.

Prominent factors. The aggregated prominence and net effect values (i.e. aggregated overall values as evaluated by all supply chain partners, see Table D - 16) highlight C2 ("Trust between direct supplier and sub-supplier"), C5 ("Committed long-term relationship between direct supplier and sub-supplier"), and C8 ("Involvement of direct supplier") as the three CSFs with the highest prominence values (*R+D)*. C5 and C8 are foundational factors within the overall network of CSFs since their values for *R* (sum of direct and indirect influences on other CSFs) and *D* (sum of direct and indirect effects from other CSFs) are relatively balanced. These factors not only largely influence other CSFs but are also influenced by these other CSFs. C5 and C8 act as significant mediators. C8 mediates the focal firm's buyer-power over its direct

supplier, whereas C5 mediates the supplier's buyer-power over its sub-supplier. Noticeably, C5 and C8 significantly influence each other. C2's strongly negative net effect value (*R-D*) indicates that, although the value is very "prominent" amongst CSFs, it is mainly influenced by others without having a significant impact on the CSF network.

Influencing factors. From the aggregated perspective (see Table D - 16), eight out of 14 CSFs are influencing factors with positive net cause scores (*R-D>0*). Thereby, the three most influencing factors with the highest net effect scores are C3 ("Focal firm's buyer-power over direct supplier"), C13 ("Little geographical distance between supply-chain-partners"), and C14 ("Little cultural distance between supply-chain-partners"). These factors are not only critical themselves but also influence other CSFs. Thus, managers striving for sub-supplier management success might focus on these highly influencing, foundational CSFs in order to improve the overall compilation of critical factors.

C3 was especially regarded as an influencing factor by all informants. C3 has a high influence on C2, C8, C9, C10 and C12. Power over the direct supplier (C3) enables a higher involvement of the dependent supplier (C8). Similarly, due to the supplier's dependent relationship to the focal firm, the supplier (C9) as well as the sub-supplier (C10) perceive value by focal firm's sub-supplier imitative. Also, the dyadic power-relationship between the focal firm and the supplier (C3) might "cross" these dyadic boundaries and does directly and indirectly impact sub-supplier's capabilities to comply with requested sustainability standards (C12). This result indicates that dyadic power-relations between the focal firm and the direct supplier might be passed through to the sub-supplier, thus enabling putting pressure on business partners to which no direct relationships exist (i.e. focal firm's power on the direct supplier has also an "observable" impact on the respective sub-supplier). Interestingly, the focal firm's power over the direct supplier (C3) might create a setting that drives trust building between the supplier and sub-supplier (C2).

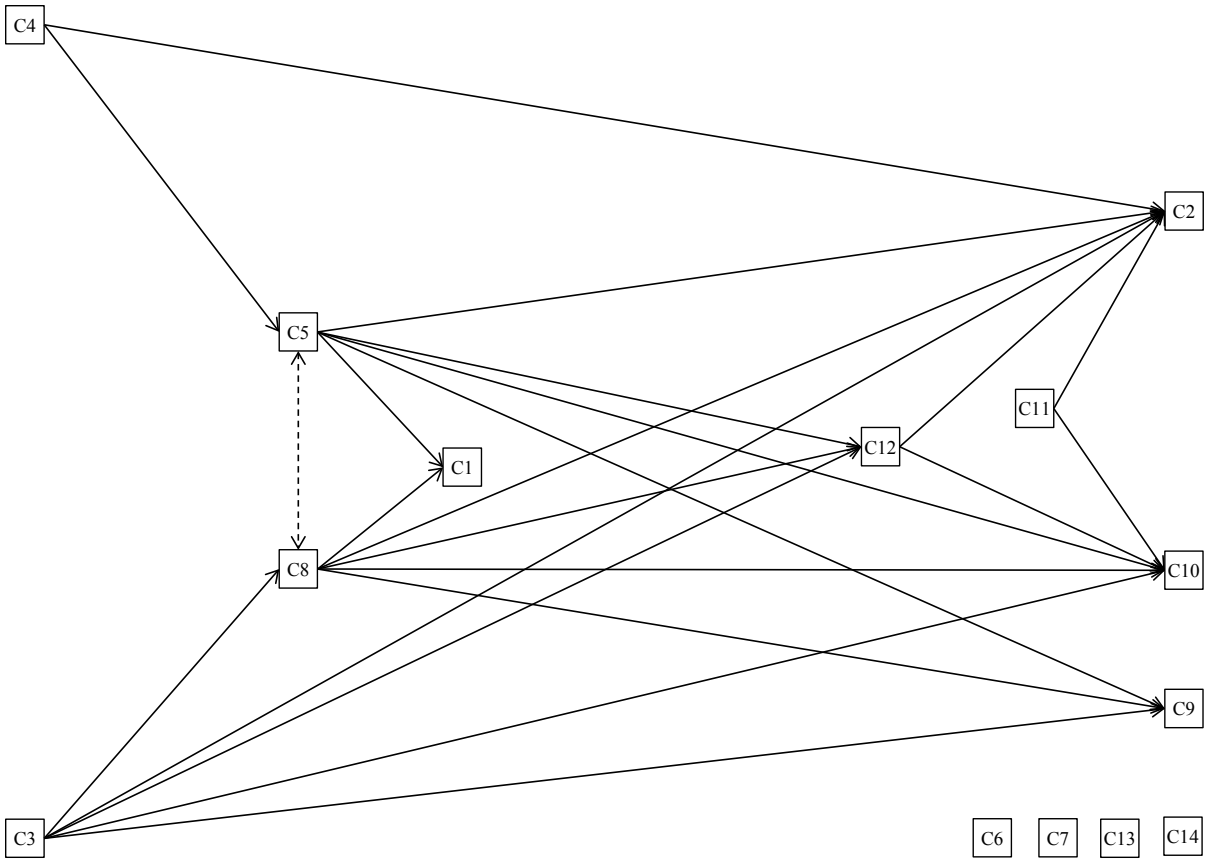
Although C13 and C14 are amongst the most influencing factors, they have no significant influence on one particular CSF (see Table D - 16). Their high net cause scores (*R-D>0*) could be explained from the observation that they are not influenced by any other CSF but influence nearly all other CSFs – at least to a little extant.

Resulting factors. The resulting factors indicate negative net effect scores (*R-D<0*). These CSFs are largely influenced by other factors. Table D - 16 highlights that six of 14 CSFs have negative net effect scores. The three most influenced factors are C1, C2 and C10. Considering their individual total direct and indirect influences on other CSFs, none of them significantly influences another CSF. Generally speaking, these CSF are the ones which could be lower prioritized compared to other CSFs and might be considered in later stages, maybe as the relationships in the multi-tier supply chain mature and other CSFs are addressed. They may also be used to evaluate how far along organizations are in addressing issues of sub-supplier management. If the most pervasive or remaining CSFs, which need to be addressed, fall into this later set, it may imply that earlier CSFs have been addressed.

Table D - 18. Overview of most prominent, influencing and resulting critical success factors

Evaluator	Top 3 prominent CSF (R+D)	Top 3 influencing CSF (R-D>0)	Top3 resulting CSF (R-D<0)
Focal firm	C5, C8, C12	C3, C8, C11	C1, C2, C4
Supplier	C2, C5, C8	C3, C13, C14	C1, C2, C10
Sub-Supplier	C2, C5, C8	C3, C4, C13	C9, C10, C12
Aggregated	C2, C5, C8	C3, C13, C14	C1, C2, C10
Intersection	C2, C5	C3 (intersection of all), C13 (intersection of supplier and sub-supplier)	C1, C2 (intersection of firm and supplier) C10 (intersection of supplier and sub-supplier)

Consequently, given these initial findings and insights, a structural model for the inter-relationships of the CSFs is illustrated in Figure D - 5. The structural model is determined by the aggregated total-relation matrix (Table D - 16) and aggregated DEMATEL prominence-causal diagram (Figure D - 4), and highlights our above discussion.



C1 Trust between focal firm and direct supplier
C2 Trust between direct supplier and sub-supplier
C3 Focal firm's buyer-power (over direct supplier)
C4 Direct supplier's buyer-power (over sub-supplier)
C5 Committed long-term relationship between supplier and sub-supplier
C6 Supply-know-how of focal firm
C7 Direct supplier's willingness to disclose sub-suppliers
C8 Involvement of direct supplier
C9 Perceived value for direct supplier
C10 Perceived value for sub-supplier
C11 Low risk of supplier-by-passing
C12 Sub-supplier's capability to comply with sustainability standards
C13 Little geographical distance between supply-chain-partners
C14 Little cultural distance between supply-chain-partners

Figure D - 5. Proposed structural model for critical success factors

The influence of CSFs on target dimensions. Table D - 15 shows that factors C3 ("Focal firm's buyer-power over direct supplier"), C5 ("Committed long-term relationship between direct supplier and sub-supplier"), and C8 ("Involvement of direct supplier") significantly influence assessment (T1) and collaboration (T2) practices with sub-suppliers. These findings support and underpin the observations of past research that identified the CSFs for sub-supplier management in SSCM (Grimm et al., 2012; Grimm, Hofstetter, et al., 2013). Firm's power (C3) is especially important for getting access to conduct assessment and collaboration practices. As previously observed in this study, C3 is also the most influential factor driving other CSFs and sub-supplier management success. Committed long-term relationship (C5) and direct supplier involvement (C8) were also revealed as "gatekeeping" factors with

the highest prominence values, and serving as significant mediators. The influences of these CSFs on sub-supplier assessment and practices are shown in in Figure D - 6.

The aggregated total-relation matrix further indicates “feedback loops” of the sub-supplier management target dimensions (see Table D - 15). The processing and outcome of sub-supplier assessment practices (T1) significantly influences trust between the supplier and sub-supplier (C2) as well as sub-supplier’s perceived value (C10) resulting of the sub-supplier management initiative. Impressively, sub-supplier collaboration (T2) significantly influences C1, C2, C5, C8, C9, C10, and C12. Not surprisingly, the two practices assessment and collaboration indicate significant mutual influences on each other. These findings are illustrated by Figure D - 7 (note that C5 and C8, close the loops with interdependent influences by and on T2).

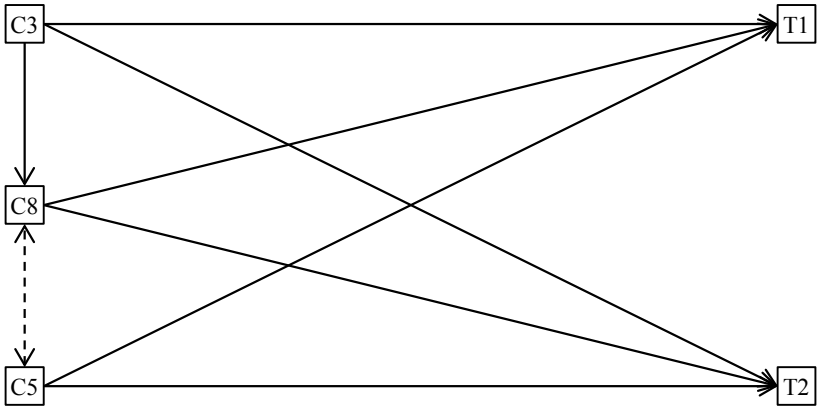


Figure D - 6. Significant critical success factors influences on sub-supplier assessment (T1) and collaboration (T2)

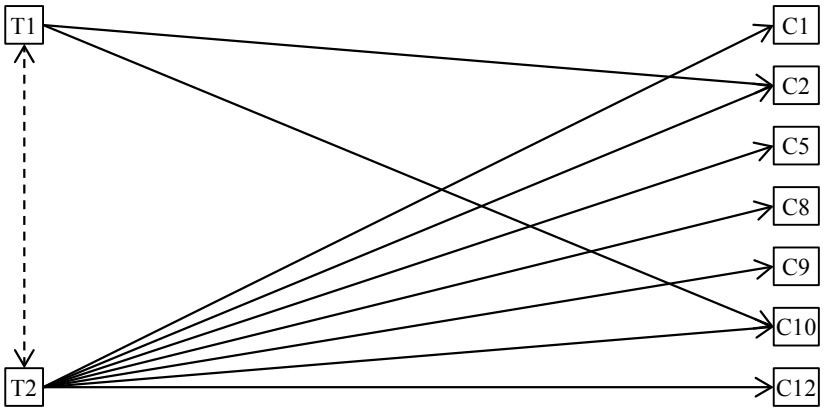


Figure D - 7. Significant influences of sub-supplier assessment (T1) and collaboration (T2) on critical success factors

D.6.3 Supply chain member comparisons

We introduce an additional dimension to DEMATEL analysis, not seen in any other DEMATEL publications, by incorporating Euclidean distance calculations to measure differences between informants' CSFs evaluation (see calculation step 5 in D.8 Appendix). Specifically, the prominence ($R+D$) and net effect scores ($R-D$), as they were initially illustrated in Figure D - 1, Figure D - 2, and Figure D - 3 for each informant, were compared. This comparison enables evaluation of similarities and differences in the factor valuations and perceptions amongst the individual perspectives of the study's supply chain members (i.e. focal firm, supplier, and sub-supplier). The distance comparison of the three supply chain member results is summarized in Figure D - 8.

The results of this comparative analysis show that the members of the different supply chain levels (firm vs. supplier vs. sub-supplier) emphasize different CSFs. Also evident is that parties with direct contractual relationships (less organizational distance) have greater similarities in their evaluations when compared to the parties that have no direct contractual relationship (i.e. firm vs. sub-supplier).

Figure D - 8. Distances of informants' CSF evaluations

Comparing the distances between the firm and the supplier shows that the factors C1 ("Trust between focal firm and direct supplier"), C5 ("Committed long-term relationship between direct supplier and sub-supplier"), C9 ("Perceived value for direct supplier") and C12 ("Little geographical distance between supply-chain-partners") have the greatest agreement on net influence. The supplier and sub-supplier show relatively little differences for C2 ("Trust between direct supplier and sub-

supplier"), C5 ("Committed long-term relationship between direct supplier and sub-supplier"), C11 ("Low risk of supplier-by-passing") and C14 ("Little cultural distance between supply-chain-partners").

The similarities for these factors further support the initial finding that the supply chain partners with less organizational distance (i.e. direct contractual relationship) have a closer common understanding about the importance of prominent CSFs. In the case of the focal firm and direct supplier, both parties evaluate the importance and influential characteristics of C1 ("Trust between focal firm and direct supplier") as critical factor for the successful management of sub-suppliers. Similarly, the direct supplier and the sub-supplier agree on C2 ("Trust between direct supplier and sub-supplier"). Specifically considering the individual prominence and net effect values (see Table D - 12, Table D - 13, and Table D - 14) indicates that the supplying companies perceive a stronger importance of "trust" than the buying companies do. This seems consistent with previous research that supplier trust in a buyer-supplier relationship tend to be more willing to participate in focal firm's SSCM initiatives (e.g. Walker et al., 2008). Although buying companies may not perceive this CSF as critical, raising their awareness of how vital it is to suppliers and sub-suppliers is important.

Between the focal firm and its sub-supplier, the two closest evaluation perceptions concern CSFs focused on the mediating effects of direct suppliers, namely C7 ("Direct supplier's willingness to disclose sub-suppliers") and C9 ("Perceived value for direct supplier"). Especially, the considerable amount of farer evaluation distances between the focal firm and sub-supplier underline that the focal firm needs a high sensibility for sub-suppliers behavior depending on different sets of characteristics of the respective CSFs.

This comparative evaluation amongst the multi-tier supply chain highlights that facets of sub-supplier management can be very differently perceived with respect to this family of CSFs. Careful consideration of these differing perceptions is necessary when setting up sub-supplier management initiatives. Even if this multi-tier supply chain may not be emblematic of all multi-tier situations, the observation that there are differences needs to be carefully managed, DEMATEL can help further manage these differences. Over time, the differences may evolve and re-investigating the relationships should be completed as the relationships mature.

D.7 Summary and conclusions

The present research highlighted the importance of considering CSFs for managing indirect supplier relationships (i.e. sub-suppliers) within SSCM initiatives. The identified CSFs seek to ensure sub-suppliers' compliance with CSS. Previous research indicates that CSFs have important interdependent relationships that may influence the successful outcome of SSCM initiatives (Grimm et al., 2012; Grimm, Hofstetter, et al., 2013). The relationships amongst the 14 identified CSFs and the two target dimensions of sub-supplier management, namely collaboration and assessment practices were examined. Using actual field study data for a multi-tier supply chain, a number of significant relationships were found to exist.

The results show that both "Focal firm's buyer-power over the direct supplier" and "Direct supplier's buyer-power over the sub-supplier" are fundamental in influencing the overall set of CSFs. Moreover, these exploratory results show that a "Committed long-term relationship between direct supplier and sub-supplier" as well as the "Involvement of direct supplier" tend to mediate the aforementioned influential factors over other CSFs.

Critical factors for the success of sub-supplier management outcomes in this field study that did not show significant relationships to any other CSF included "Supply-know-how of focal firm" , "Direct supplier's willingness to disclose sub-suppliers", "Little geographical", and "Little cultural distance between supply-chain-partners". Recent research supports the counter-intuitive result that "distance" aspects do not significantly affect sustainable supply chain management practices in direct business relationships (Awaysheh and Klassen, 2010).

Three CSFs showed significant influence on sub-supplier management assessment and collaboration, namely "Focal firm's buyer-power over direct supplier", "Committed long-term relationship between direct supplier and sub-supplier", and "Involvement of direct supplier". Focal firms might be especially aware of these factors when they assess the feasibility of assessment and collaboration practices. Interestingly, sub-supplier management practices themselves seem to influence an entire set of CSF in a feedback loop.

Distinctive to most existent (sustainable) supply chain management research (as an exception see: Cox et al. (2001) and Watson (2001)), central concepts such as power

and trust were not examined from a mere dyadic perspective, but were exclusively considered for each dyadic business relationship that is part of the multi-tier supply chain context (firm vs. supplier vs. sub-supplier).

This research used the theory of critical success factors lens and showed that the theory can be purposefully applied to this context. The theory's importance for multi-tier supply chain management is further emphasized by showing the inter-linkages of these CSFs and outcome success.

Our research provides practitioners with a good understanding of factors they should heed when seeking to integrate sustainability beyond the tier-1 supplier level. Practitioners might assess the presence of identified CSFs to help determine the feasibility of a successful sub-supplier management outcome. The indicated relationships amongst CSFs give therefore guidance how CSFs can be further positively influenced, i.e. what synergies amongst CSFs exist and how they might be prioritized. The implication here is that there is a sequential ordering of CSFs that practitioners should pursue to be able to successfully introduce sustainability within their extended supply chains. Poorly performing CSFs can help explain why failures or lack of success is occurring, and identifying and measuring how well these CSFs are being met.

The limitations within this field study research are the small sample sizes. Other industry settings including companies with varying characteristics (i.e. size and resources) might pinpoint other significant relationships amongst CSFs. Applying our findings to a field study action research approach could reveal additional insights. Subsequent quantitative large-scale research might test the generalizability of our findings. Scales for evaluating the existence of these CSFs would need to be developed and tested in these broader study scenarios. The exploratory findings of this study provide a number of research questions that can be pursued including direct and indirect influences of variables and factors amongst each other.

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D.8 Appendix

A Grey-based DEMATEL Involving Euclidean Distance Methodology

The following methodology description is partially taken from Fu et al. (2012) and Zhu et al. (2011) and modified to the present research context. The subsequently described process steps will be completed for each informant of the supply chain members (i.e. focal firm, supplier, sub-supplier).

Step 1: Derive a linguistic and grey direct-relation matrix through informants input

Step 1a: Define a grey pairwise influence comparison scale for the CSF

To receive informants' linguistic assessment of inter-relationships between the 14 identified CSFs $C = \{C_i \mid i = 1 \ldots 14\}$, we utilize the following linguistic scale characterized by five levels: "no influence" (N), "very low influence" (VL), "low influence" (L), "high influence" (H), and "very high influence" (VH).

The application of grey system theory enables us to transform informants' discrete linguistic evaluation judgments into grey numbers as well as to "de-grey" intervals into crisp values for aggregation purposes at later stages.

A grey number $\otimes x$ represents an interval with a defined lower bound $\underline{\otimes} x$ and an upper bound $\overline{\otimes} x$, whereas the distribution information for x within the interval is unknown (Deng, 1989). The grey number is consequently described as:

$$\otimes x = [\underline{\otimes} x, \overline{\otimes} x] = [x' \in x \mid \underline{\otimes} x \leq x' \leq \overline{\otimes} x]$$

The matching of the aforementioned linguistic terms and applied grey scales is illustrated in Table D - 19.

Table D - 19. The grey linguistic scale for the respondents' evaluations

Linguistic terms	**Grey numbers**
No influence (N)	[0,0]
Very low influence (VL)	[0,0.25]
Low influence (L)	[0.25,0.5]
High influence (H)	[0.5,0.75]
Very high influence (VH)	[0.75,1]

Step 1b: Develop the grey direct-relation matrix X based on informants' lingustic relationship evaluations

Separately each informant was requested to pairwise evaluate the relationships of all identified CSFs C_i by means of the linguistic terms. Whereas researchers commonly require their informants to directly fill in informants' inter-relationship assessment into the direct-relation matrix, we decided to make use of a multi-page questionnaire to handle the complexity of the magnitude of inter-relationships resulting from 14 CSFs. Resulting from a structured interview setting, a processed questionnaire by the informant of company k was transferred into a 14 x 14 linguistic direct-relation matrix X^k. All diagonal elements were set to the linguistic value "no influence" (N). The derived direct-relation matrices for the three supply chain members (informants) are shown in Table D - 3, Table D - 4, and Table D - 5.

Subsequently, grey direct-relation matrices X^k are obtained by matching the linguistic terms within X^k with corresponding grey number values (see Table D - 19). Consequently, the influence of C_i on C_j assessed by a company k is reflected by the grey numbers $\otimes x_{ij}^k \in X_{grey}^k$.

$$X^k = \begin{matrix} C_1 \\ C_2 \\ \vdots \\ C_n \end{matrix} \begin{bmatrix} [0,0] & \otimes x_{12}^k & \cdots & \otimes x_{1n}^k \\ \otimes x_{21}^k & [0,0] & \cdots & \otimes x_{2n}^k \\ \vdots & \vdots & \ddots & \vdots \\ \otimes x_{n1}^k & \otimes x_{n2}^k & \cdots & [0,0] \end{bmatrix}$$

Table D - 6, Table D - 7, and Table D - 8 show the derived grey direct-relation matrices for the three supply chain members (informants).

Step 2: Calculate the total-relation matrix T (including direct and indirect relations)

Step 2 seeks to calculate the total-relation matrix *T*. The matrix values will comprise scores for the direct and indirect relations (influences) of a CSF C_i on a CSF C_j. To obtain the total-relation matrix T, three sequential sub-steps are required as outlined by steps 2a – 2c.

Step 2a: Transform the grey direct-relation matrix X_{grey}^{k} into a crisp direct-relation matrix Z

For the transformation of a grey direct-relation matrix into a crisp matrix, some basic mathematical grey numbers operations are required:

$$\otimes x_1 + \otimes x_2 = [\underline{x}_1 + \underline{x}_2, \overline{x}_1 + \overline{x}_2] \tag{1}$$

$$\otimes x_1 - \otimes x_2 = [\underline{x}_1 - \overline{x}_2, \overline{x}_1 - \underline{x}_2] \tag{2}$$

$$\otimes x_1 \times \otimes x_2 = [\min(\underline{x}_1\underline{x}_2, \underline{x}_1\overline{x}_2, \overline{x}_1\underline{x}_2, \overline{x}_1\overline{x}_2),\ \max(\underline{x}_1\underline{x}_2, \underline{x}_1\overline{x}_2, \overline{x}_1\underline{x}_2, \overline{x}_1\overline{x}_2)] \tag{3}$$

$$\otimes x_1 \div \otimes x_2 = [\underline{x}_1, \overline{x}_1] \times [\frac{1}{\underline{x}_2}, \frac{1}{\overline{x}_2}] \tag{4}$$

To obtain a crisp matrix *Z*, we make use of the modified CFCS-method ("fuzzy data into crisp scores"), which has proven advantageous compared to other methods (Opricovic and Tzeng, 2003; Wu and Lee, 2007). This defuzzication method comprises three steps:

(i) Normalization of grey numbers:

$$\underline{\otimes}\widetilde{x_{ij}^{k}} = \left(\underline{\otimes} x_{ij}^{k} - \min_j \underline{\otimes} x_{ij}^{k}\right) / \Delta_{\min}^{\max} \tag{7}$$

$$\overline{\otimes}\widetilde{x_{ij}^{k}} = \left(\overline{\otimes} x_{ij}^{k} - \min_j \overline{\otimes} x_{ij}^{k}\right) / \Delta_{\min}^{\max} \tag{8}$$

where

$$\Delta_{\min}^{\max} = \max_j \overline{\otimes}\, x_{ij}^{k} - \min_j \underline{\otimes}\, x_{ij}^{k} \tag{9}$$

(ii) Calculation of the total normalized crisp values

$$Y_{ij}^{k} = \frac{\left(\underline{\otimes}\widetilde{x_{ij}^{k}}\left(1-\underline{\otimes}\widetilde{x_{ij}^{k}}\right)+\left(\overline{\otimes}\widetilde{x_{ij}^{k}}\times\overline{\otimes}\widetilde{x_{ij}^{k}}\right)\right)}{\left(1-\underline{\otimes}\widetilde{x_{ij}^{k}}+\overline{\otimes}\widetilde{x_{ij}^{k}}\right)} \tag{10}$$

(iii) Calculation of crisp values for all values in matrix Z

$$z_{ij}^{k} = \min_{j}\underline{\otimes}\, x_{ij}^{k} + Y_{ij}^{k}\Delta_{\min}^{\max} \tag{11}$$

Note: since in step 1b all diagonal elements were set to the linguistic value "no influence" (N), in all cases:

$\min_{j}\underline{\otimes}\, x_{ij}^{k} = 0$, that is $\otimes x_{ij} = [0,0]$ when $i = j$.

Step 2b: Determine the normalized direct-relation matrix N

The normalized direct-relation matrix *N* can be calculated by following operations:

$$N = s \cdot Z \tag{13}$$

$$s = \frac{1}{\max\limits_{1\le i\le n}\sum\limits_{j=1}^{n} z_{ij}}, \quad i, j = 1, 2, \ldots, n. \tag{14}$$

Step 2c: Determine the total-(direct/indirect-)relation matrix T

$$T = N + N^2 + N^3 + \cdots = \sum_{i=1}^{\infty} N^i = N(I-N)^{-1} \tag{15}$$

I represents an $n \times n$ identity matrix $I = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ 0 & 1 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 1 \end{bmatrix}$

The derived total-(direct/indirect-)relation matrices for the three supply chain members (informants) are shown in Table D - 9, Table D - 10, and Table D - 11.

Step 3: Calculate the cause/effect relationships amongst the CSFs and relative strengths

Step 3a: Calculate row (R_i) and column (D_j) sums for each row i and column j from the total-(direct/indirect-)relation matrix (T) by making use of expressions (16) and (17):

$$R_i = \sum_{j=1}^{n} t_{ij} \quad \forall \mathrm{i} \tag{16}$$

$$D_j = \sum_{i=1}^{n} t_{ij} \quad \forall \mathrm{j} \tag{17}$$

The row values R_i represent the overall direct and indirect influence of a CSF C_i on other CSFs. The column values D_j indicate the overall direct and indirect influences of all the other CSFs on C_j.

Step 3b: Calculate the overall importance/prominence (P_i) of a CSF C_i *and net effect (E_i) of* CSF C_i *through the following to expressions:*

$$P_i = \{R_i + D_j \mid i = j\} \tag{18}$$

$$E_i = \{R_i - D_j \mid i = j\} \tag{19}$$

The value P_i describes the overall prominence/importance of CSF C_i with respect to the overall relationships with other CSFs, i.e. a total of all received and provided influences. The larger the value of P_i, the greater the overall prominence of a CSF C_i. The value E_i describes the net effects of a CSF C_i. If $E_i > 0$, the CSF C_i is a net cause, i.e. influencing factor for other CSFs. If $E_i < 0$, the CSF C_i can be characterized as a resulting factor, i.e. C_i relies on the influence of other CSFs and is a net effect of those (Tzeng et al., 2007).

The overall prominence and net effect/cause values for the three supply chain members (informants) are shown in Table D - 12, Table D - 13, and Table D - 14.

Step 4: Determine the DEMATEL prominence-causal diagram

The previously calculated values P_i and E_i can be transferred onto a two-dimensional axis for each CSF: the prominence horizontal axis P_i *(R + D)* and the net cause/effect vertical axis E_i *(R - D)*, deriving an initial prominence-causal graph.

Based on the prominence-causal graph, a digraph relationship (i.e. directed arrow) can be determined for each CSF with respect to other CSFs by means of the total relation matrix T.

Since relationships potentially exist between all CSFs a threshold value θ should be defined. It can be agreed on a threshold value by discussions between the researchers, the informants or further experts (Liou et al., 2007). For the present research, we defined a relatively high threshold value in order to reduce the visual complexity due to the high number of CSFs. The value is defined by the following expression (Fu et al., 2012):

$$\theta = mean(T) + \sigma_T \tag{20}$$

$mean(T)$ represents the arithmetic mean of all values t_{ij} in the matrix T,

σ_T the one standard deviation.

Consequently, only if $t_{ij} > \theta$, the influences or effects of CSF C_i on CSF C_j will be considered as "significant" and incorporated as a digraph into the DEMATEL prominence-causal diagram.

Figure D - 1, Figure D - 2, and Figure D - 3 illustrate the DEMATEL prominence-causal graph for the three supply chain members (informants). For clarity reasons we only included digraphs in the aggregate DEMATEL prominence-causal diagram (see Figure D - 4). The determination of the aggregated results for all supply chain partners is explained in the subsequent step 5.

Step 5: Determine the aggregated (1) total-relation matrix $T_{aggregated}$, (2) cause/effect relationships amongst CSFs and relative strengths, and (3) DEMATEL prominence-causal diagram for all informants

Having multiple informants evaluating the CSF relationships, an aggregated overall perspective is determined by averaging the derived grey numbers that were obtained

by each informant as described in step 1b. Aggregated values can be concluded by calculating either the arithmetic means or weighted means of respective grey numbers (Fu et al., 2012). Latter would be chosen, if the informants are considered as not equally meaningful to the evaluation. In our case, we pursue an arithmetic averaging as we want to equally treat each perspective (i.e. focal firm, supplier and sub-supplier). Also, each informant is considered to have comparable experiences within the field study setting. After having calculated an aggregated grey direct-relation matrix $X^{k}_{grey,aggregated}$ by arithmetic averaging the grey numbers of the individual direct-relation matrices X^{k}_{grey}, the process steps 2 – 4 are applied/repeated in order to determine the aggregated (1) total-relation matrix $T_{aggregated}$, (2) cause/effect relationships amongst CSFs and relative strengths, and (3) DEMATEL prominence-causal diagram for all evaluators. The respective illustrations are shown in (1) Table D - 15, (2) Table D - 16, and (3) Figure D - 4.

Step 6: Determine evaluation distances between informants

The overall *importance/prominence* (P_i) and *net effect* (E_i) of a CSF C_i derived through informants' evaluation can be considered as a point (P_i, E_i) in the plane of the respective DEMATEL prominence-causal diagram (e.g. Figure D - 1, Figure D - 2, and Figure D - 3). To compare individual evaluation scores of two different respondents/informants, the distances between two respective points with the coordinates *(x, y)* and *(a, b)* can be measured by applying an Euclidean distance calculation as a basic mathematical operation.

$$dist((x,y),(a,b)) = \sqrt{(x-a)^2 + (y-b)^2} \tag{20}$$

To compare the *importance/prominence* (P_i) and *net effect* (E_i) scores of any two informants for a CSF C_i, their individual scores should be firstly normalized as follows:

$$\widetilde{P_j} = \frac{\left(\max_i P_i - P_j\right)}{\max_i P_i - \min_i P_i} \tag{21}$$

$$\widetilde{E_j} = \frac{\left(\max\limits_i E_i - E_j\right)}{\max\limits_i E_i - \min\limits_i E_i} \tag{22}$$

Consequently, for a CSF C_i and any two informants α and β, the distance $\tilde{\Delta}_i^{\alpha\beta}$ between their evaluation scores $\left(\widetilde{P_i^{\alpha}}, \widetilde{E_i^{\alpha}}\right)$ and $\left(\widetilde{P_i^{\beta}}, \widetilde{E_i^{\beta}}\right)$ can be calculated as stated by following expression:

$$\tilde{\Delta}_i^{\alpha\beta} = \sqrt{(\tilde{P}_i^{\alpha} - \tilde{P}_i^{\beta})^2 + (\tilde{E}_i^{\alpha} - \tilde{E}_i^{\beta})^2} \tag{23}$$

$$\alpha, \beta = 1, 2, 3, ..., m; \quad i = 1, 2, 3, ..., n$$

Subsequently, all distances of the pairwise informant comparisons can be visualized in one graph to highlight where the informants may have higher similarities or differences within their individual perceptions (see Figure D - 8).

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