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The role of interaction for corporate sustainability

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Abstract

Purpose – Most scholars acknowledge the role of firm-stakeholder relationship for enabling corporate sustainability (CS), but existing literature tends to apply a superficial understanding of interaction. Thus, the purpose of this paper is to advance knowledge by challenging classical stakeholder theory with fundamental insights from the IMP perspective, which in turn leads to a deeper conceptualization of interactive CS.

Design/methodology/approach – A typology framework is developed through an abductive research design grounded in the concepts of actors, resources, and activities. The authors illustrate the potential of the framework through a longitudinal case study. The empirical case revolves around an initiative for recycling of plastic material in a partly beforehand established supply chain, and the study reveals three main findings.

Findings – First, recycling solutions can result in major technological challenges. For example, using recycled material can jeopardize industrial quality standards. Second, third-party stakeholders represent critical knowledge and competence that can remedy technological challenges. Finally, R&D projects are important means for developing firm-stakeholder relationships.

Research limitations/implications – The paper introduces IMP concepts to the CS debate, which can illuminate the emerging literature on tensions and paradoxes related to CS phenomena. Further research is needed on the role of non-business actors as capacity generators for social and environmental change in traditional business networks.

Practical implications – The proposed framework can be used to analyze why some stakeholders (individuals and groups) turn into contributing actors in inter-organizational relationships, while others remain latent.

Originality/value – This paper illustrates the usefulness of actor bonds, resource ties and activity links as explanatory concepts. Moreover, developed relationships in terms of collaboration and networks represent a capacity to change, which is overlooked in current CS debates.

Keywords Case study, Corporate sustainability, Interaction, Tensions, ARA, Stakeholder relationships

Paper type Research paper

1. Introduction

The last three decades have shown an accelerating awareness and interest in dealing with the social and environmental consequences of business activities. Here referred to as “corporate sustainability” (CS), taking such consideration means engaging in “company activities – voluntary by definition – demonstrating the inclusion of social and environmental concerns in business operations and in interactions with stakeholders” (Van Marrewijk, 2003, p. 102). This popular definition emphasizes the stakeholder concept (Freeman, 2010), which is typically used to map requirements of individuals and groups that affect or are affected by a focal firm’s activities.

While the literature on CS consists of several streams and conceptualizations (Hahn, Figge, Aragón-Correa and Sharma, 2017; Baumgartner, 2014), stakeholder theory tends to dominate scientific discourse (Johnsen *et al.*, 2017). Some scholars enter the debate by normatively assuming that “ideal” CS activities should meet requirements of multiple stakeholders, such as shareholders, employees, clients, pressure groups and communities

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(Lozano *et al.*, 2015; Stubbs and Cocklin, 2008; Dyllick and Hockerts, 2002). A different entry point is to acknowledge that the realization of multiple actors' requirements creates tensions and paradoxes for firms and their managers (Van Der Byl and Slawinski, 2015; Smith and Lewis, 2011; Margolis and Walsh, 2003). However, most scholars in the area of CS agree that, given limited time and resources, every firm needs to prioritize social and environmental concerns that are most material to their business operations (Eccles and Krzus, 2015; Porter and Kramer, 2011). Turning to stakeholder theory (Mitchell *et al.*, 1997), it follows that CS activities in practice will reflect the stakeholders upon which the focal firm is dependent.

However, the weakness of classical stakeholder theory is that the focal firm, represented by its managers, is seen as the central actor of its surrounding network, while other stakeholders are seen as static entities (Johnsen *et al.*, 2017). Thus, by emphasizing the focal firm as the central actor and separate from other actors, classical stakeholder theory tends to underestimate the dynamics of inter-organizational relationships. As such, little systematic knowledge exists on the strategies chosen by actors when making challenging prioritizations on how to include social and environmental concerns in business operations. Recalling that the phenomena at hand are interactive by definition (Van Marrewijk, 2003), we regard this theoretical weakness as a limiting factor in ongoing CS debates.

Moreover, a substantial number of empirical studies in supply chain management (SCM) strongly suggest interactive learning as a key enabler for CS (e.g. Mollenkopf *et al.*, 2010; Seuring and Müller, 2008; Vermeulen and Ras, 2006). This typically concerns systems for information sharing (Van Bommel, 2011) and collaborative efforts for knowledge development (e.g. Young and Kielkiewicz-Young, 2001; Lamming and Hampson, 1996). However, few studies go in-depth into how such learning processes unfold, and rarely consider the role of the network context (Miemczyk *et al.*, 2012; Hoejmoose and Adrien-Kirby, 2012; Carter and Liane Easton, 2011; Walker *et al.*, 2008). Thus, while learning and knowledge development are considered key aspects of integrating social and environmental concerns in business operations, few investigations analyze the content of relationships in such efforts.

By using the IMP perspective, we find it intriguing to theorize CS from the standpoint that interaction indeed is a central business activity for firms, rather than a supplementary one. In this view, interaction enables adaptation and collective learning among the involved actors because of both confrontational and compromising processes. This makes the content, or substance (Håkansson and Waluszewski, 2002), of specific business relationships a key aspect of how CS initiatives can become an integrated part of existing or new business operations. Furthermore, interactive activities are key to understand the development of new relationships resulting from social and environmental concerns. With the ambition of gaining a deeper understanding of the role of interaction in such efforts, we ask the following research question:

RQ. How can we conceptualize the role of interaction for CS?

As part of introducing such a conceptualization, we also present a case study of an initiative for recycling plastic material in the Norwegian aquaculture industry. The case is used to both illustrate the relevance and potential of the proposed conceptualization, as well as to discuss the managerial challenges of business interaction being a central part of dealing with CS.

The remainder of the paper is organized as follows. Section 2 clarifies important conceptual boundaries and theoretical assumptions related to CS. Section 3 presents the IMP perspective and its implications for dealing with CS. We end this section by presenting a new typology for business interaction and the potential of coping with CS based on the actors, resources and activities (ARA) model. In Section 4, we give an account of the data collection and the case study approach connected to the case for plastic waste recycling.

Next, in Section 5, we present the empirical findings and discuss them by applying the typology for interaction. Finally, Section 6 returns to the research question by pinpointing some theoretical as well as managerial dilemmas encountered through the case study, and how the conceptualization can be developed further.

2. Clarifying conceptual boundaries and knowledge gaps

Before we can conceptualize the role of interaction for CS, we need to clarify theoretical boundary conditions. Thus, this section discusses fundamental aspects of CS as a construct, challenges the theoretical underpinnings of current debates and identifies related knowledge gaps.

2.1 Positioning in a blurred conceptual landscape

Before we explore how CS can be applied for the purpose of this paper, it is necessary to touch upon the related concept of “corporate social responsibility” (CSR). CSR has been discussed actively by scholars since the 1950s (Carroll, 1999), and emphasis has been put on the activities companies undertake in the social and environmental domains, going beyond legal requirements. Dahlsrud (2008) analyzes 37 definitions of CSR and finds that the concept mainly deals with the dimensions of stakeholder, social, economic and voluntariness, while the environmental dimension is less prominent in explicit definitions.

In recent debates, there are those who use CSR and CS as interchangeable umbrella concepts (e.g. Kudlak and Low, 2015; Strand *et al.*, 2015), and those who emphasize fundamental differences between the concepts (e.g. Hahn, Figge, Aragón-Correa and Sharma, 2017; Bansal and Song, 2017). As recommended by Montiel (2008), a certain level of pragmatism and flexibility is necessary when pursuing a common goal, that is advancing social, environmental and economic values in a holistic manner. This is in line with the approach of Strand *et al.* (2015, p. 2), who argue that CSR and CS are umbrella constructs that contain expressions such as “corporate citizenship” (Matten and Crane, 2005), “business ethics” (Bowie, 1999), “stakeholder engagement” (Freeman, 2010), “stewardship” (Davis *et al.*, 1997), “triple bottom line” (Elkington, 1997) and “creating shared value” (Porter and Kramer, 2011). However, in this paper we focus on CS as the fundamental concept for two main reasons.

First, and most importantly, the concept of CS contains an inherent ontological difference compared to, for example, CSR. This paper’s position is that the physical reality, i.e. material and energy flows, must be included as boundary conditions in scientific analysis of business operations. This adheres to the CS concept because while CSR can be understood as a social construct based on inter-subjective negotiations in a certain context (Dahlsrud, 2008), CS is influenced by a realist tradition where environmental and physical limitations of the planet are seen as fundamental for knowledge debates and scientific analysis (Bansal and Song, 2017; Whiteman *et al.*, 2013). Second, the CS concept resonates well with the emerging research agenda concerning the sustainable development goals adopted by the United Nations (UN, 2016). We believe these 17 goals will act as frame conditions for researching relationships between business and society in the years come. Mainstream management journals have already included the framework in recent calls for empirical research (Howard-Grenville *et al.*, 2017).

In essence, our contribution adheres to principles of “sustainable development” (SD) stemming from the publication, “Our Common Future” (WCED, 1987). Recent contributions in CS research (Williams *et al.*, 2017; Whiteman *et al.*, 2013) have emphasized the systemic nature by pointing to the ecological context of inter-organizational networks and business operations in general. This aligns with the seminal contribution of “planetary boundaries” (Rockström *et al.*, 2009), which Griggs *et al.* (2013) used to refine the definition of SD: “development that meets the needs of the present while safeguarding Earth’s life-support

system, on which the welfare of current and future generations depends” (p. 306). This definition establishes an ontological core of how the concept of CS should be interpreted, by putting environmental concerns at its center.

2.2 *Going beyond classical stakeholder theory*

Applying the macro-oriented definition by Griggs *et al.* (2013) in an (inter-) organizational context implies a paradoxical setting (Hahn, Figge, Pinkse and Preuss, 2017). One core puzzle lies in the treatment of environmental concerns, such as ecosystem services (Costanza *et al.*, 1997), in micro-level analysis of firms and their networks. Another issue lies in understanding the tension between efficiency of individual organizations and the ability of socio-economic systems to absorb shocks (Hahn *et al.*, 2015). In other words, the leap from macro to micro creates a theoretical dilemma that must be resolved.

A common methodological and analytical simplification to address the micro-macro issue is to apply the concept of stakeholder by assuming that there are some groups or individuals that can legitimately serve interests of the planet and society at large (Vildåsen *et al.*, 2017; Mitchell *et al.*, 2016). Stakeholder is defined by Freeman (2010, p. 46) as: “any group or individual who can affect or is affected by the achievement of the organizations’ objectives.” For example, by following this theoretical view one can assume that non-profit organizations will represent social and environmental concerns in industrial networks when interacting with traditional companies.

The stakeholder perspective provides us with a conceptual tool that links firm level activities with their wider societal context. Indeed, as seen by Van Marrewijk’s (2003) definition of CS, a central theoretical premise concerns interactive activities between a company and its stakeholders. This suggests that the IMP approach would be popular in existing CS literature. However, the review by Johnsen *et al.* (2017) shows the contrary, indicating a great potential for inter-disciplinary debates and future research projects. There seem to be two main reasons for the lacking conceptual depth related to interaction and network approaches in CS literature.

First, stakeholder theory tends to treat relationships from the perspective of the focal firm. This is linked to the managerial scope, i.e. how to prescribe decisions and actions related to social and environmental concerns that enhance organizational performance (Orlitzky *et al.*, 2003; Clarkson, 1995), meaning that stakeholders other than the managers are viewed as something to be “managed.” Conceptually, this leads to a focus on direct relationships, as opposed to the IMP approach where the focal firm is not assumed to be at the center of the network (Johnsen *et al.*, 2017; Håkansson and Snehota, 1995).

The second reason for limited focus on networks and interactions in CS is that stakeholder theory has developed in the context of strategic management since Freeman’s (1984) influential book *Strategic Management: A stakeholder Approach*. Its reissue shows its great popularity among management scholars (Freeman, 2010). Interestingly, “interacting with stakeholders” is discussed and Freeman argues, “The bottom line for stakeholder management has to be the set of transactions that managers in organizations have with stakeholders” (p. 69). A transactional view indicates yet another theoretical limitation as seen from the IMP perspective. This view is based on firms primarily acting opportunistically with their own self-interests in mind. Relationships, therefore, need to be managed mainly through formal contracts. In addition, focus is placed on single transactions rather than on the potential long-term benefits of relationships.

2.3 *The need for an interactive approach*

The definition by Van Marrewijk (2003) uses the phrase “demonstrating the inclusion of social and environmental concerns in business operations and in interactions with stakeholders,”

as a qualitative criteria for company activities that are within the CS scope. This opens up the debate regarding ambition levels and which stakeholders are taken into account.

Indeed, navigating between multiple values and stakeholder concerns is seen as a fundamental problem in the emerging literature streams on “tensions” (Van Der Byl and Slawinski, 2015) and “paradoxes” (Hahn, Figge, Pinkse and Preuss, 2017) in CS research. Similar debates can be found in classical literature on stakeholder theory (e.g. Mitchell *et al.*, 1997), where it is argued that social and environmental concerns tend to become “salient” if they are represented by stakeholders with certain features, such as power. This means the content and dynamics of specific firm-stakeholder relationships play a decisive role.

Early CS studies conceptualized firm-stakeholder relationships as an intangible resource that a focal firm possesses. Hart (1995, p. 992) established the construct of “stakeholder integration,” which was later refined through empirical research as the ability “[...] to establish trust-based collaborative relationships with a wide variety of stakeholders, especially those with noneconomic goals” (Sharma and Vredenburg, 1998, p. 735). The notion of collaborative relationships has received increasing attention recently through terms such as “creating shared value” (Porter and Kramer, 2011), and “cooperative advantage” (Strand and Freeman, 2015). Interestingly, this reframes the debate away from the classical perspective of competitive advantage and optimization of financial performance.

Relevant examples can also be found in SCM literature. A variety of studies focus on how to achieve more socially and environmentally responsible supply chains. Several studies state that it requires both “closer” (i.e. more intense collaboration) and “wider” relationships (i.e. collaboration regarding new processes), as well as information sharing further upstream and downstream (Mollenkopf *et al.*, 2010; Seuring and Müller, 2008; Vermeulen and Ras, 2006).

Tensions linked to CS, especially concerning what it means to implement it across a number of interrelated organizations, increase the need for knowledge sharing. As the required knowledge is mainly related to problem solving, this in turn creates a need for coordinating efforts among actors. Furthermore, as identified in several literature reviews, such collaborative activities should be informal rather than formal, and deep rather than superficial or at arm’s length (Rizzi *et al.*, 2013; Hojmosse and Adrien-Kirby, 2012; Solér *et al.*, 2010; Kumar and Malegeant, 2006). Lamming and Hampson (1996) argue that the goal is to achieve mutually favorable learning and teaching conditions, as well as developing new knowledge and ways of working based on collaboration.

The general state of the current literature is that few studies go into depth of how such collaborations unfold, and more precisely, that they do not analyze the specific interaction patterns they entail among firms and other types of organizations. As stated by Johnsen *et al.* (2017, p. 11), the dominant stakeholder theories have largely disregarded “[...] the mechanisms of interaction among actors [...]” and “[...] in reality have little to say about relationship management [...].” Thus, while existing literature on CS, both conceptual and empirical, calls for a more collaboration and network oriented view (e.g. Vermeulen and Witjes, 2016), the theoretical underpinnings of this literature are not well equipped to perform analysis on interactive phenomena in the context of CS.

3. Toward an IMP-grounded conceptualization

This section presents the first step toward a conceptualization of “interactive CS,” substantiating the definition given by Van Marrewijk (2003). The goal is to clarify the role of interactive relationships as part of dealing with social and environmental concerns.

3.1 Placing an IMP lens on CS

While not a central theme in IMP (see Johnsen *et al.*, 2017), there are several examples of studies investigating CS as part of coping with change in industrial networks (e.g. Crespin-Mazet and Dontenwill, 2012; Baraldi *et al.*, 2011; Andersson and Sweet, 2002).

From the perspective that firms are interdependent, these studies investigate what it means to implement change toward increased CS in terms of developing new and existing business relationships.

The assumption that important business relationships contain a number of interconnected resources and activities that have been shaped in relation to each other over time has particular implications for implementing CS. As with other types of changes, it means that several parties need to adapt to each other and combine their knowledge and technologies across firm boundaries (e.g. Håkansson and Waluszewski, 2002). It also reflects that not all parties might be willing to do so because of the “heaviness” of earlier investments. Furthermore, the connectedness of business relationships indicates a specific type of complexity when managing change; any changes that are made in one business relationship will affect other relationships directly as well as indirectly (Håkansson and Johanson, 1992). In general, previous studies tend to show that established business networks that initiate change toward increased CS will often appear quite different after such change is implemented.

Baraldi *et al.* (2011, p. 840) suggest that particular actors can be direct driving forces for others to work in more CS-oriented ways: “[...] the initiative of certain actors is important to induce other actors to combine their resources in new ways to devise new technical solutions, as well as to identify replicable and economically feasible ones.” Crespín-Mazet and Döntenwill (2012) inform us that CS practices require the individual firm to involve other types of actors than classical business organizations, for example non-governmental organizations (NGOs). They go on to state that collaboration with non-business actors is “a key success factor to develop the firm’s resources and legitimacy in sustainable development” (Crespín-Mazet and Döntenwill, 2012, p. 208). Another example is a case study by Andersson and Sweet (2002), who analyze a food supply network with both loose and tight couplings in which the initiating firm needs to manage these existing couplings (relationships) in different ways. They state that “[...] in order to change, i.e. implement a sustainable system for recycling, firms will need to build on, and adapt to, already existing patterns of bonds and relationships. It can also mean that new actor bonds and relationships will be established in the change process.” (p. 467). In essence, Andersson and Sweet (2002) contribute with a conceptual foundation for approaching the issue of introducing CS in an existing business network.

The conceptual foundation is based on stability and change being simultaneous states in the network during such initiatives, which in turn creates tensions that the involved firms need to handle. By focusing on the changing roles and positions that the involved actors adopted during the different phases of the recycling initiative, the authors conclude that any approach considering management of CS initiatives needs to pay attention to three main issues. These are: the tensions, conflicts and contradictions of requirements that any initiating firm needs to handle; that firms (to be able to alter their position in the network) are dependent on and must relate to both loose and tight couplings in the network, as well as direct and indirect relationships in order to identify new and beneficial connections within the network; and as relationships and relationship configurations change over time, the approach toward separate relationships in terms of exercise of power and conflict handling must also change.

From an IMP view, any initiative or change toward increased CS will be greatly affected by existing business relationships and the earlier adaptations made in these relationships over time. However, such initiatives also tend to create changes to these business relationships as well as require new ones are established. In this paper, we strive for a better understanding of these dynamics by attempting to conceptualize the relation between the way interaction takes place in business relationships and achieving increased CS. Next, we will outline the underpinnings of the ARA model and present a typology of interaction that we use as a way to relate types of interaction to the potential of coping with changes toward increased CS.

3.2 *The first step: a typology framework for interactive CS*

The ARA model captures both the content and interrelatedness of business relationships through and among three dimensions – Actors, Resources and Activities (Håkansson *et al.*, 2009). Business relationships are conceptualized as having three layers in which interdependencies are formed over time through mutual adaptations. Resource ties represent both material and immaterial resource combinations. This can for instance relate to features in products and production processes being co-developed or particular knowledge combinations being made between parties. Activity links represent efforts by firms to create more efficient inter-firm operations. For instance, mutual advantages can be achieved by linking the transportation services of one firm to the production processes of another. Relationships also have a social dimension in that they, over time, create actor bonds between counterparts regarding the attitudes and behaviors toward each other (e.g. Håkansson and Snehota, 1995; Håkansson and Johanson, 1992; Håkansson, 1987).

It should be noted that what constitutes an actor is related to how it affects any particular relationship or network, which can represent either business or non-business objectives and incentives (Crespin-Mazet and Dontenwill, 2012). Thus, in relation to our research objective, the framework does not only represent business actors, but also acknowledges the influence of non-business actors (i.e. various forms of stakeholders that can have a direct or indirect impact). In addition, the interrelatedness of business relationships suggests that changes to the ties, links or bonds of one relationship will have direct and indirect effects on other business relationships (including relationships to non-business actors) of the involved parties.

In analyzing the specific content of interaction, Håkansson and Prenkert (2004) and Cantillon (2010) develop typologies based on different levels of interaction in terms of changes that are made on each side of one or several relationships over time. The analytic assumption is that adaptation and learning among counterparts depends on the level of interaction between the actors involved. The interaction needs to have specific content or features to result in any substantial learning or change. These features are reflected in the changes that have been made to the ties, links and bonds of the specific relationships and which have brought specific knowledge to the involved parties. For the purpose of this paper, we single out three such interaction categories also used by Håkansson and Ingemansson (2011) listed below.

While the original typology developed by Håkansson and Prenkert (2004) contains more categories, we find that the following three are adequate to depict the relation between type of interaction and implementation of change toward CS. As our basis for relating interaction to CS presupposes that some form of substantial interaction has taken place, we only use the categories that presuppose an inter-organizational relationship containing adaptations. Therefore, developing the typology from how it is used by Håkansson and Ingemansson (2011), we have removed the first two categories – pure exchange and minor social exchange. In addition, while the original typology focused on the resource dimension we use all three layers of the ARA model to outline which type of change has taken place: in actor bonds, resource ties and activity links.

Technical exchange relates to a situation where adaptation takes place as an effect of how the exchanged object, such as a product, is to be related to the buying or selling party. There may be some adaptation needed in terms of how it fits into the existing operations of either party, and some minor changes can take place in related resources and activities. However, this occurs as part of internal changes in either party, and not necessarily through interactive learning situations due to joint changes. Therefore, it can only entail limited changes in either bonds, ties or links as an effect of one party implementing change.

Cooperation, on the other hand, entails joint projects and mutual adaptations in the sense that both parties will need to learn and adapt specific resources and activities in relation to each other to solve a problem. This type of exchange is based on openness to knowledge exchange and adaptation. As a result, both parties can engage in problem solving through

such interaction that would not be possible by working separately. In this category, changes are likely made in all three relationship dimensions: bonds, ties and links.

Networking contains the same interaction features as those of “Cooperation,” but also requires the involvement of (at least) one third party. Here, several parties have interests in solving the same issue and engage in mutual learning and adaptation processes. This causes the combination and confrontation of several actor-, resource- and activity interfaces, which in turn increases the level of complexity in the interaction and, thus, in the learning and adaptation processes.

We use these interaction categories to develop a typology for the interactive dimension of CS (see Table I). Higher levels of adaptation and learning between a firm and its stakeholders imply higher potential for coping with changes toward increased CS. By only involving limited elements of interaction, technical exchange results in limited capacity to enforce changes toward increased CS within a broader network. Cooperation denotes a more encompassing type of interaction as it involves adaptation and learning in relation to several layers. As such, it increases the commitment between parties and incentives to adapt to new

	Actor bonds	Resources ties	Activity links
Interaction elements: Technical exchange	Know how to work together in relation to a specific resource or activity	Minor changes in facilities and business units concerning specific resource. Often one-sided	Minor changes in related activities, often one-sided
Limited CS	The firm-stakeholder relationship is based on short-term needs, and flexibility is maintained. Third-party organizations can be relevant in the adaptation processes, but only indirectly		
Interaction elements: Cooperation	Know how to adapt to each other in relation to different types of resources and activities	Mutual changes in several types of resources	Mutual changes in joint and related activities
Potential CS	The firm-stakeholder relationship goes beyond short-term needs of individual actors. Both parties make a clear commitment to contribute towards mutual and long-term objectives. Third-party organizations can be relevant in the adaptation processes, but only indirectly		
Interaction elements: Networking	Know how to systematically relate to several parties in co-managing resources and activities	Mutual changes in relation to several parties in several types of resources	Mutual changes in relation to several parties in joint and related activities
Substantial CS	Third-parties are an integrated part of the firm-stakeholder relationship and decision-making processes are based on contributions from coalitions of actors. Employees from more than two organizations work together in cross-functional groups		

Table I.
A typology
framework for
interactive CS

situations and requirements. However, it still only involves mainly two parties. Networking, on the other hand, involves (at least) three parties that learn collectively from making changes. This denotes a greater capacity to enforce changes within a broader network collectively.

However, the single firm will be part of a variation of these interaction categories. As also noted by Andersson and Sweet (2002), to be able to change its position within the broader network as well as to influence the position of others, the firm will need to make use of these variations in terms of tight and loose couplings as well as direct and indirect relationships. In addition, the dynamic nature of business relationships implies that relationships can develop from a “lower” category to a “higher” interaction category over time.

Limited CS denotes a situation where a firm acknowledges a specific stakeholder. The organizations interact in relation to a specific resource or activity, for example the equipment needed in a production process. Small investments in terms of resources can be made, but flexibility is maintained. Short-term orientation limits the creation of actor bonds, resource ties and activity links. Third-party organizations are considered only indirectly, for example when a customer refers to environmental standards or a governmental agency’s regulations.

Potential CS is founded on an established relationship between a firm and a specific stakeholder. Both organizations adapt to each other’s needs, and there is mutual understanding of long-term development of resource ties and activity links. Several actors from different functions of the two organizations interact on a regular basis. This increases the likelihood that third-party organizations are considered, for example, representatives from sales and marketing bring the viewpoints of NGOs into decision-making processes.

Substantial CS reflects a situation of decision-making processes that are based on “coalitions” of actors representing different perspectives. This process happens over time, and more than two formal organizations work together in cross-functional groups. The incentives for passive stakeholders to become contributing actors in the network change over time based on adapted activity links and resource ties. For instance, willingness to invest in environmentally-friendly technology can change based on improved or new business relationships.

We propose that with this typology, it is possible to analyze the interactive processes of CS as specific relationships in the context of industrial networks. How this can be achieved is further elaborated in the data collection section, as well as practiced through the analysis of the case study in the Norwegian aquaculture industry.

4. Methodological considerations

The conceptualization presented in this paper draws on a case study of a developing supply network in the Norwegian aquaculture sector, and particularly in the salmon farming industry. The main actor in this case is a plastic components producer, *Plasto*, which aims to realize the potential of recycled material in its production. Such strategy represents an extended producer responsibility, which implies interaction and collaboration with several actors in relevant business networks. The case is structured as an analysis of three main actors (see Table II): *AKVA group* is a producer of fish farming equipment, *Plasto* is *AKVA group*’s main supplier of plastic components, and *Containerservice* supplies recycled plastic materials to *Plasto*.

The context of the research is a four-year academia-industry collaboration project concerning shared value creation and sustainable innovation in Norwegian industry,

Table II.
Main actors in
the case study

Actor	Main role in the case study	Phase I/II of the case study
Plasto	Produces plastic components	Phases I and II
AKVA group	Produces equipment for the fish farming industry	Phases I and II
Containerservice	Collects and recycles plastic materials	Phase II

financed 80 percent by the Norwegian Research Council. Plasto is a core partner and provides approximately 5 percent of the funding. As part of the project, the CEO of Plasto presented the idea of using recycled material at the kick-off meeting in May 2014. This is an idea that over more than three years (until today's date October 2017) have meant an interesting development for the firm and its existing and new partners about the formation of a "closed loop" for producing plastic components. It is this development, in terms of the interactions between the involved firms, which forms the basis for our case study.

Our data gathering started in May 2014 and continued until October 2017. It is based on 22 interviews with key managers and staff connected to the main events of the case, follow-up e-mail correspondence and 16 of the most significant observations made during company visits, project meetings and industry seminars/conferences, see details in the appendix. Moreover, secondary material, such as formal project documentation, was used for triangulation purposes. The data were collected by the authors of the paper, as well as two master students with a related project. The case study developed across two phases, as an additional actor, the firm Containerservice, became involved in September 2016 (see Table II).

The first phase of the case study consisted of semi-structured interviews and observations of Plasto and AKVA group. The purpose was to understand the relationship between the two organizations and how their collaboration had developed in the past, and continued to develop during the study as an effect of the initiative for extended producer responsibility. This involved mapping the initiation and development of bonds, ties and links in production and product development efforts both before and during the initiative for extended producer responsibility. There were also informal discussions between the authors and company representatives regarding the strategy of recycling and the opportunities and challenges involved.

The second phase was initiated as Containerservice, an additional firm, became involved in the initiative. This process started in September 2016 when Plasto got to know the activities of Containerservice through networking at a circular economy conference. It was then decided to allocate master students to the research process, supervised by the authors of this paper. The second phase of the research process was dedicated to continuing the investigation of the relationship between Plasto and AKVA group, as well as the additional relationship with Containerservice and the contribution of this actor to the ongoing development of a "closed loop" supply chain.

The authors of this paper have been discussion partners during the investigation of the ongoing process where Plasto is engaging in a new business strategy in collaboration with two other actors, which means that (inter)-subjective values and interpretations are an inherent part of the knowledge generation. This resonates with the qualitative and exploratory research design chosen (Alvesson and Sköldböck, 2009), along with a transdisciplinary and collaborative approach that has become common in recent debates on CS (e.g. Vermeulen and Witjes, 2016; Schaltegger *et al.*, 2013).

The study adheres to a methodological approach referred to as systematic combining (Dubois and Gadde, 2002). This implies an abductive logic in which the theoretical constructs and the interpretation of empirical findings co-develop. In this case, the typology framework was developed as data collection was still carried out, and, as such, the two processes supported each other. In turn, the conceptual framework in this paper enables external validity (Yin, 2013) as it links the specific findings of the case study to general theory. In the next section, the case findings are laid out.

5. Empirical findings and analysis

During the last few years, the aquaculture industry has experienced increased governmental pressure on producer responsibility for take-back solutions of fish farming equipment. In early 2014, Plasto, a small producer of plastic components, presented the idea of "closing the loop" to their research partners. As of October 2017, the idea has developed

into formal project initiatives with their most important customer, AKVA group, along with a supplier of recycled plastic materials, Containerservice. Moreover, Plasto's management group has established the goal to use 50 percent recycled materials by the end of 2020 for the products supplied to the aquaculture industry.

With the ambition of creating a "closed loop" for product components in collaboration with two other firms, Plasto is a pioneer in trying to strengthen environmental awareness in the aquaculture industry. If successful, it has the potential to re-shape the supply chain for production and use of fish farming equipment in Norway as well as in other countries. The following sections detail how the business relationship between Plasto and AKVA group has developed through interactive processes over several years, as well as how a third-party organization eventually became involved in the recycling initiative.

5.1 The initiation and development of an important customer relationship

The relationship between Plasto and AKVA group was initiated in 2008 when representatives from the two firms met at an aquaculture convention in Norway. The two Norwegian-owned firms found common ground in that AKVA group, a world-leading supplier of fish farming equipment, needed a supplier of high-end product components, and that Plasto was searching for new customers in the aquaculture sector. In 2009, they initiated a relationship based on the development and production of camera casings that were to hold camera equipment on the sea-based fish farming cages produced by AKVA group. This made Plasto a supplier of product components for the fish farming equipment produced by AKVA group, in turn sold to the global fish farming industry.

Before 2009, AKVA group had outsourced their plastic component production to China. Their relationships with the Chinese suppliers were functioning quite poorly, however, and there were trust-issues related to the suppliers having the ability to deliver the products in compliance with agreed terms. The advantages of using Plasto as a supplier appeared to be many. Being a small firm with a core competence in combining sophisticated production technology in injection molding with basic and easy accessed raw materials, AKVA group saw the potential in using the production capabilities of Plasto to increase the quality of their final products – the sea-based fish farming cages.

Besides their own production capabilities, Plasto was also part of an extensive R&D network involving several other firms, governmental actors and research institutions. Within which, Plasto was collaborating through several different R&D projects and product development efforts. This was an important resource for AKVA group, and when the development of the camera casings turned out to save substantial costs, Plasto was appointed main supplier of plastic components for the fish farming cages including several key components. For instance, the essential brackets that hold the cylinder-shaped cages together (with a maximum girth of 200 m), and walkways used by the fish farmers operating the cages out at rough seas.

The relationship between AKVA group and Plasto is described by both parties as a close partnership based on trust and transparency. With the decision to engage in collaboration with Plasto over several components of the cages, came an eight-year production contract. This was the longest-term contract that AKVA group had ever signed with a supplier. Among several formalities, the contract also specified that the two parties should engage in open dialogue and work in collaboration as partners. Between 2009 and 2016, this resulted in the development of several new models of the brackets, key components not only for holding the cage construction together, but also designed to anchor the cages at sea.

Based on the increasingly sophisticated requests of AKVA group's customers, and governmental regulations regarding quality, the requirements for the cages and these components became higher. While fish farming customers during this time requested increasingly larger cages, and, consequently, larger brackets to hold them together, governmental regulations also required that cages should last for at least 20 years and provide a safe work

environment for the fish farming operators. These regulations required necessary quality certificates for AKVA group as an equipment supplier to the global fish farming market.

The new bracket models, weighing up to 100 kg, and thus representing the biggest products ever molded by Plasto, were developed through close cooperation between Plasto and AKVA group. This required extensive development of the production equipment at Plasto's facilities, joint purchasing trips by Plasto and AKVA group to Plasto's sub-suppliers of molds in China, and a close dialogue between the R&D department at AKVA group and the engineers at Plasto.

5.2 *Recycled material as a CS approach*

Due to the political pressure placed on the aquaculture industry to take increased environmental responsibility, both AKVA group and Plasto recognized the likelihood of future regulations in terms of recycling requirements. Moreover, the possibility of alternative sourcing possibilities represented an important incentive. The idea to use recycled material for product components was therefore communicated by Plasto, on several occasions, at research conferences and seminars involving academics and industry participants.

Through networking at a conference in September 2016, Plasto was introduced to the company Containerservice, which specializes in collecting plastics from fish farming cages. Their ambition is to become a central actor in recycling as well. This demands competence in cleaning technology, for example filtering of melted plastic components. One of Containerservice's latest investments is a production line enabling them to recycle in-house. Their previous technology was based on the grinding of plastic material only, with the further handling completed by other firms. With their new solution based on filter technology, they expand their product scope to reach new markets. Containerservice has stated that their main priorities are access to plastic material and to satisfy what they perceive as an increasing market demand. Moreover, they are looking for long-term customers to secure stable quantities of orders.

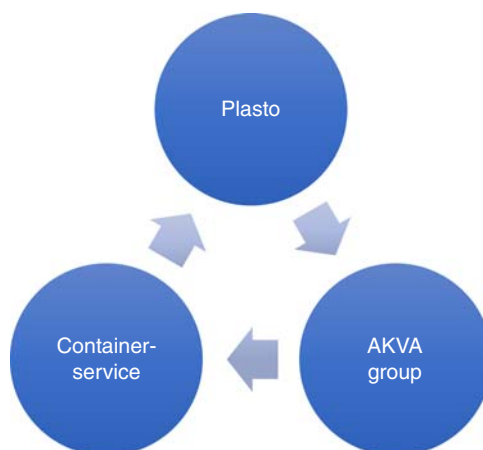
The relationship between Plasto and Containerservice reflects an initiation stage. An informal Skype meeting, facilitated by a close partner of AKVA group that was present at the conference, was the first step. A concrete activity was planned to test the quality of Containerservice's products. This was conducted in June 2017 with satisfactory results, the envisioned cost savings for Plasto are calculated to be as much as 30 percent. Moreover, they have collaborated on a funding application that was submitted in September 2017. This was sent to Innovation Norway, a governmental agency that supports different kinds of business development with the overall aim of increased competitiveness. The agency emphasizes the principles of SD, and promotes "interaction between enterprises, knowledge communities, and R&D institutions" (IN, 2017). If the project is funded, Containerservice can scale-up their recent technology, while Plasto can experiment with recycling solutions that fit their existing machinery and production process.

The role of AKVA group in this recycling initiative has, so far, only been indirect. They are, however, engaged in a new research project managed and owned by Plasto and financed by the Norwegian research council, a governmental actor like Innovation Norway. This is a four-year project that had its kick-off meeting in November 2016. The goal is to develop production technology that can produce larger plastic brackets, which in turn will enable larger fish farming cages. This R&D activity is based on the close cooperation between the R&D facilities at a subsidiary of AKVA group and the engineers at Plasto. One of the project work packages will focus on the economic and environmental potential of recycled plastics.

5.3 *The opportunities and challenges of "closing the loop"*

Plasto's project initiatives toward both AKVA group and Containerservice are based on the idea of a closed loop, which enables the possibility of using plastic material from existing products as a resource in the production of new products. Figure 1 illustrates the logic of

Figure 1.
A “closed loop”
business model of
plastic components



introducing Containerservice in the supply chain as a way of handling discarded plastic products from fish farming cages produced by AKVA group. The key element is to develop the production technology so that Plasto can use the recycled material in the production of new equipment.

The aim is to be able to collect the cages and reuse the material to produce new ones using so called secondary material. This in turn would require new production technology. A first step could be to develop this idea for components that are not as strictly regulated as the brackets, such as the walkways. Then, on a long-term basis, the production method could be developed further for the components with stricter regulation. Using secondary material, i.e. plastics that come from discarded fish farming equipment, would not only decrease the environmental effect, but also lower the material costs for both Plasto and AKVA group.

Using secondary material raises several challenges and implicates different requirements of the actors involved. To AKVA group, dependable material properties as well as cost benefits are key needs to be fulfilled. For the brackets to satisfy safety requirements and the regulated demands of durability (20 years), only dependable raw material can be used. Secondary material that is ground down can still contain remnants of sand, seashells and small rocks, and the properties of the material are compromised: strength and durability become more unpredictable. Also, if there are no substantial cost benefits, AKVA group is not prepared to make any investments in new material sources.

Plasto is mainly concerned with their production technology's ability to handle the impurities of secondary material, which must be seen in relation to AKVA group's quality requirements.

Moreover, Plasto's ideal future scenario is to become a self-reliant supplier through the development of technology and competence that can handle secondary materials directly. In other words, they would be able to utilize the discarded components from fish farms produced by AKVA group without the involvement of Containerservice. Containerservice has stated that the market demand is large, meaning that they are not dependent on Plasto as a customer, but that they see future collaboration as fruitful. At the current stage, both Plasto and Containerservice acknowledge their mutual interests and possibilities for learning, but are open about needs for flexibility.

A central strategy for all the actors is to use governmental support as means for risk reduction in R&D projects. Both Innovation Norway and the Norwegian Research Council

have proven to be central stakeholders in this regard. Overall, it becomes clear that the CS idea of “closing the loop” requires collaboration through the combination of resources and adjustment of activities between several actors. The following section analyzes these processes by using the new typology.

5.4 *Applying the typology*

The case describes three actors involved in a CS initiative, each organization representing a business model with economic value creation as a core need. The analysis is centered on Plasto as the initiator of the CS initiative, and this firm’s relationships with its most important customer and a key supplier. The typology framework in Table I is applied to describe core features of the relationships, and to classify the potential to cope with change toward increased CS, i.e. the level of CS realization.

Table III summarizes the core actors’ requirements in the context of the CS initiative. First, Plasto has the largest stake in the project based on their role as an initiator and risk taker. Second, some core interests of Plasto and AKVA group are aligned through their established customer-supplier relationship. Finally, the relationship between Plasto and Containerservice is characterized by complementary needs in the short run, but possible tensions in the longer run.

The next step concerns the CS typology found in Table I. To classify the realized CS in this context, we must analyze the bonds, ties and links that characterize the relationships. The logical starting point in this case is activity links, because they represent the foundation from which resource ties and actor bonds have developed.

The relationship between Plasto and Containerservice is grounded in their shared interest in the recycling of plastic material. As described earlier, they have recently adapted their production processes by quality testing. This implies that Plasto adjust their technology to test the products from Containerservice, i.e. some degree of developing resource ties. An important development is the recent application for funding to Innovation Norway, which can be seen as a driver for increased collaboration. However, the history of their relationship is short, social arenas are lacking, and only some social sentiments have developed so far between the organizations. Containerservice has also signaled limited dependency on Plasto’s resources, which indicates short-term orientation and flexibility. In general, limited learning has taken place and the relationship is characterized by technical exchange.

Although the relationship between Plasto and Containerservice is characterized by aligned CS objectives, the limited degree of adaptations that have taken place as of yet implies that this relationship is characterized by “Limited CS” according to the typology

Actors	Requirements in the context of the CS initiative
Plasto	Preparing for future regulations New sourcing alternatives Product quality
AKVA group	Dependable material properties Customer satisfaction Cost benefits
Containerservice	Access to plastics that fit their technology Meeting increasing market demand Long-term partners

Table III.
The actors
and their interests

framework (see Table IV). However, as we move on to discuss the relationship between Plasto and AKVA group, it will become clear that analyzing relationships without considering their network context provides limited insights into their CS potential. Rather, each relationship and its potential to contribute to increased CS must be viewed in the context of other relevant relationships.

Analyzing the relationship between Plasto and AKVA group reveals that they have developed bonds, ties and links through an almost decade-old relationship. More specifically, they have linked their respective R&D activities and departments through concrete joint projects. This, in turn, has resulted in resource ties between several products and specific production technology. Overall, their relationship is characterized by long-term mutual adjustments. They have started to actively include the needs of third-parties, for instance in their recent R&D project, but cross-functional groups with more than two organizations are not fully established.

However, the relationship is mainly characterized by “traditional” business goals in terms of developing new technology and activities for the sake of satisfying customer demands and producing a wider variety of products. As such, the relationship is not based on or driven by CS objectives. Rather, when one party in the relationship (Plasto) introduces such goals, tensions arise as AKVA group is not driven by the same ambition. Nevertheless, both parties are involved in mutual project initiatives for taking greater environmental concern. In addition, it is because of this relationship that Plasto takes the CS initiative in the first place. Without the increasing demand from the customers of AKVA group for larger products (brackets), the long withstanding R&D cooperation and the production adjustments, the initiative in its present form would not have been possible.

Thus, in the context of the relationship between Plasto and Containerservice, and what this might bring in terms of a closed loop supply chain with AKVA group as a key customer and partner, the cooperative relationship between Plasto and AKVA group is denoted as “Potential CS” in the typology framework (see Table V).

Analysis indicates that the highest level of realized CS does not exist in any one single relationship. It is the existence and dependence of the two relationships that creates the potential of forming a “Substantial CS” initiative with several contributing parties. Interestingly enough, the relationships play different roles in supporting each other. The relationship between AKVA group and Plasto does not contain mutually expressed CS goals, but years of mutual adaptations form the foundation for achieving trust and

Table IV.
The technical exchange between Plasto and Containerservice classified as “Limited CS”

Limited CS	Actor bonds	Resources ties	Activity links
Plasto ↔ Containerservice	Actors in each organization have agreed to work together	Some adjustment in Plasto’s production process	Quality testing of products. R&D initiatives have been made

Table V.
The cooperation between Plasto and AKVA group classified as “Potential CS”

Potential CS	Actor bonds	Resources ties	Activity links
Plasto ↔ AKVA group	Individuals from different functions work together on a regular basis Trust has developed between leading individuals	Resources are adapted based on the needs of both parties and technological opportunities R&D resources are shared with financial implications	Plasto’s production processes are aligned with the product needs of AKVA group A joint R&D project is established

commitment, technology development and adapted activities between a supplier and one of its key customers. The relationship between Plasto and Containerservice, on the other hand, is based on aligned CS objectives but shows little adaptation yet.

Thus, while one relationship is driven by mutual CS objectives, the other is required to eventually realize them in terms of production technology and a “receiving end” of a customer and end-users. Due to its character, the latter relationship (between Plasto and AKVA group) also has the potential to develop into “Substantial CS” by inviting third-parties into their ongoing activities and resource development. For example, if Containerservice were to be invited into the recent R&D project, this would be the first step toward an active network where different actors would contribute to achieve common objectives.

Thus, our case indicates that for CS to become a realized activity, at least one substantial and long-term business relationship is needed for a network of relationships to develop. This relationship may, however, not be the one that drives the CS objectives as such. In a sense, the long-term relationship between Plasto and AKVA group, involving several resource ties between central R&D, product and production resources, as well as joint activities, here forms the basis for a potentially realized CS initiative. However, it is also clear that this cannot be achieved in isolation but requires the existence of other relationships, such as the one with Containerservice, which can provide a necessary service in the proposed closed loop and is part of formulating mutual CS goals.

As the case shows, non-business actors can also play a central role in “activating” or supporting CS initiatives in existing inter-firm relationships and initiate or legitimate new ones. This is illustrated by Innovation Norway, the governmental agency providing funding for specific CS initiatives and thus playing a pivotal role in providing an arena for both business and technology development, which Plasto uses to move forward with their emerging CS strategy.

Developing a network is challenging. It demands negotiation between the needs and expectations of the actors involved, especially in terms of risks and financial contributions. The case illustrates that these dynamics can be facilitated, and potentially overcome, if there are stable relationships in the network that continue to build on earlier investments in resource combinations and ongoing activities. At the same time, however, such relationships can also act as hindrances. This is demonstrated in the case where the relationship with AKVA group acts both as a prerequisite for the CS initiative to take place, as well added skepticism to several of the elements of the initiative, which might not provide economic return instantly.

6. Discussion and conclusions

The role of interaction for CS is explicitly acknowledged in the popular definition of Van Marrewijk (2003), and this paper seeks to substantiate understanding of related phenomena. Fundamentally, we initiate a multi-disciplinary process by establishing a conceptual platform between two established research traditions. Such a debate takes place in a blurred landscape, since theoretical and epistemological dilemmas can be found in both IMP (De Boer and Andersen, 2016) and CS (Vildåsen *et al.*, 2017) literature. Thus, we hope to engage scholars in future research projects that will improve and refine our work.

In general, previous CS literature addresses firm-stakeholder relationships. However, there is a tendency to treat these as exogenous and static elements. As argued by Vermeulen and Witjes (2016), the “embedded nature” of CS is overlooked. Empirical phenomena are analyzed through the focal firm’s perspective – a weakness of classical stakeholder theory on which most CS literature is based – resulting in a static perception of other actors.

By taking the basic assumptions of the IMP perspective and building on the earlier work of Andersson and Sweet (2002), this paper contributes to the CS literature with a typology

framework that specifically addresses the content of firm-stakeholder relationships with regards to activity links, resource ties and actor bonds and its implications for coping with change toward CS. The typology suggests that based on existing links, ties and bonds, specific firms and relationships will have different capacities to induce change within a broader network. It also implies that as a basis for collective learning, adaptations taking place in several relationship dimensions and between more than two actors are a necessary condition for implementing substantial CS across supply networks. In relation to the research question, we pinpoint two theoretical implications.

First, while the stakeholder concept covers any individual or group affected by the actions of the firm (Freeman, 2010), from an IMP perspective an actor is an individual or organization that actively contributes in a relationship. This means that not all stakeholders are actors. For example, even though NGOs are arguably stakeholders in the recycling initiative of Plasto, no individuals or groups from such organizations are actors in the interactive activities. Thus, while much CS literature claims that non-business actors need to be part of CS initiatives and even often drive them, the typology helps reveal the ways different actors indeed are central to network changes. While a wide range of stakeholders might play a facilitating role in terms of providing funding, legitimacy or other types of resources, those actors that are part of the network through their adaptation of resources and activities in relation to each other over time represent a stronger capacity with which changes can be made.

Second, the role of the framework is to assess the potential and capacity to transition toward increased CS. Relationships based on substantial interaction have a higher potential for social and environmental improvements, compared to a setting based on technical exchange. However, the framework is not normative in the sense of indicating which activities are better than others in the context of CS. Rather it can be used to assess the basis on which change toward increased CS is taken, and the potential in specific and in sets of several relationships to implement such change within a broader network. Moreover, the typology can be used to pinpoint gaps between active actors and legitimate stakeholders such as NGOs, and thereby give important insights on the interactive challenges that emerge when firms implement CS strategies and approaches.

The delineation between actors and stakeholders, along with the notion of potential change, gives CS researchers several interesting avenues for further investigation. We believe this can be related to the emerging perspective in the field of CS that addresses fundamental tensions (Hahn, Figge, Pinkse and Preuss, 2017; Van Der Byl and Slawinski, 2015). This is based on the “theory of paradox” (Smith and Lewis, 2011), and posits CS as “[...] interrelated yet conflicting economic, environmental, and social concerns with the objective of achieving superior business contributions to sustainable development.” (Hahn, Figge, Pinkse and Preuss, 2017, p. 3). In our opinion, this perspective opens a debate on the tensions involved when passive stakeholders become actors, and which also represents a potential for change in terms of economic, environmental and social concerns.

The contribution of this paper to the ongoing CS debate is to provide a framework for understanding how tensions can be balanced and resolved by linking IMP concepts, i.e. ARA, to the emerging themes of collaboration (Strand and Freeman, 2015) and shared value (Porter and Kramer, 2011). As shown in the case, as part of making technical and organizational adaptations across firm boundaries, Plasto, AKVA group and Containerservice are learning about their different requirements and technologies. Not only are they learning about existing activities and resources, but also how they need to potentially be adapted in relation to each other. As such, over time they learn which changes are feasible and which are not.

Moreover, we identify that actors can make use of earlier investments in both technical and organizational adaptations. While the framework suggests that a higher level of interaction in terms of earlier adaptations and learning is positive for inducing change, it

also creates “heaviness” and inertia. Thus, firms need to find ways of making either minor improvements to existing resource and activity structures, or find new ways of combining resources and activities. The latter can be done either through forming new relationships or changing existing ones. This is shown in the case by the relationship between Plasto and Containerservice, which developed based on mutual interests in a supply chain structure. The initiation happened because existing supply relationships did not provide solutions that aligned with the requirements of a recycling initiative.

There is still more to learn about how interactive relationships between a firm and its stakeholders imply adaptation over time, and how this influences realized CS in terms of concrete resource and activity structures. For CS researchers addressing tensions and paradoxes, and in the context of the framework developed in this paper, the dynamic process of developing a relationship from “cooperation” to “networking” emerges as a relevant topic for further research. It is especially interesting with longitudinal case studies that explore the role of third-parties in established relationships, and especially how non-profit organizations influence classical processes of industrial networks. The interactive nature of CS is in literary infancy, and we hope our contribution engages scholars in upcoming debates.

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Appendix. Details on data collection

The data gathering was conducted from May 2014 to October 2017, and is based on interviews, e-mail correspondence and observations. Secondary sources such as formal project descriptions have also been analyzed.

The context of the research presented in this paper is the project called "Sustainable Innovation and Shared Value Creation in Norwegian Industry", see <https://sisvi.no/>. Plasto is an industry partner in this project, which means that there have been ongoing research activities throughout the period.

Tables AI and AII presents details on 22 interviews and the 16 most significant observations, respectively.

Date	Type	Interviewees	Comment
December 10, 2014	Open ended	Project manager and engineer	Two separate interviews with Plasto representatives
February 8, 2015	Open ended	Purchasing manager	Plasto representative
April 16, 2015	Open ended	CEO, Project manager, R&D manager, and Engineer	Four separate interviews with Plasto representatives
October 27, 2015	Open ended	Purchasing manager and R&D Manager	Two separate interviews with AKVA group representatives
February 19, 2016	Open ended	Project manager	Plasto representative
March 7, 2016	Open ended	Technical sales manager	Representative of AKVA group subsidiary
June 10, 2016	Open ended	Project manager	Plasto representative
March 9, 2016	Open ended	R&D manager	Representative of AKVA group subsidiary
September 19, 2016	Open ended	CEO, Project manager, Engineer and CFO	Four separate interviews with Plasto representatives
October 27, 2016	Semi-structured	Project manager	Plasto representative; transcriptions available
November 8, 2016	Semi-structured	CEO	Containerservice representative; transcriptions available
November 10, 2016	Semi-structured	Business developer	AKVA group representative; transcriptions available
November 22, 2016	Semi-structured	Project manager	Plasto representative; transcriptions available
April 5, 2017	Semi-structured	Project manager	Plasto representative; written summary available

Table AI.
Details on interviews

Table AII.
Details on
observations of Plasto

Date	Role of the researcher(s)	Company actors at Plasto	Comment
May 28, 2014	Passive participant	CEO	First formal meeting in the project; written minutes available
November 28, 2014	Passive participant	CEO Project manager	First research seminar in the project; written summary and company slides available
March 19, 2015	Passive participant	R&D manager	Company presentation in research seminar; slides available
May 21, 2015	Passive participant	Project manager	Discussions at research seminar; written summary available
September 28, 2015	Passive participant	Project manager COO	Research seminar at Plasto's facilities; written summary and company slides available
February 22, 2016	Passive participant	R&D manager engineer	Interactive workshop; written summary and company slides available
March 8, 2016	Passive participant	CEO	Company presentation at research seminar
May 18, 2016	Passive participant	Project manager	Discussions at research seminar; written summary available
September 2, 2016	Active participant	Project manager	Company presentations of Plasto and Nofir, networking was facilitated by researchers
September 23, 2016	Active participant	Project manager	Joint presentation and discussion at an industrial networking event
December 16, 2016	Active participant	Project manager	Presentation and group discussions at an industrial networking event
March 24, 2017	Active participant	Project manager	Interactive workshop; written summary and company slides available
May 23, 2017	Passive participant	Project manager	Presentation and discussions at an industrial networking event
June 2, 2017	Active participant	Management group	Interactive workshop; written summary available
June 8, 2017	Passive participant	Project manager	Presentation and group discussions at an industrial networking event
September 28, 2017	Passive participant	Project manager	Discussions at research seminar; written summary and company slides available

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