



Paper to be presented at the
35th DRUID Celebration Conference 2013, Barcelona, Spain, June 17-19

Greening an Industry through Coopetition: The role of Proximity in an R&D Alliance to create Environmental Innovations

Marianne Steinmo

University of Nordland
Bodø Graduate School of Business
marianne.steinmo@uin.no

Siri Jakobsen

University of Nordland
Bodø Graduate School of Business
siri.jakobsen@uin.no

Abstract

Cooperation is found to be particularly important in the development of environmental innovations. Cooperation with competitors (coopetition) is of special importance when firms face a common challenge, like environmental problems, where they can utilize their common knowledge base to solve these challenges. In this paper we explore how a coopetition alliance can facilitate increased environmental knowledge for firms with different size and R&D-intensity. By studying a Norwegian environmental coopetition alliance we found that such an alliance can increase the absorptive capacity for all involved firms by enhancing social, cognitive and technological proximities. Our findings shows that the less R&D intensive firms accumulate knowledge from universities and R&D-organizations through the competing partners. That is, they do not communicate well directly with the universities and R&D-organizations, but access the R&D results through their competitive partners which they have a closer technological proximity to.

How to green an Industry through “Coopetition:”

The role of Proximity in an R&D Alliance in creating Environmental Innovations

Siri Jakobsen*, Marianne Steinmo

University of Nordland, Bodø Graduate School of Business, Universitetsalleen 11, 8049 Bodø, Norway

* Corresponding author. Tel.: +47 751 29714. *E-mail addresses:* siri.jakobsen@uin.no (S. Jakobsen), marianne.steinmo@uin.no (M. Steinmo).

Acknowledgements

We thank the persons we interviewed for sharing their insights with us.

How to green an Industry through “Coopetition:”

The role of Proximity in an R&D Alliance in creating Environmental Innovations

Abstract

Cooperation has been found to be particularly important in the development of environmental innovations. Cooperation with competitors (coopetition) is of special importance when firms face a common challenge, such as environmental issues, and can use their common knowledge base to solve these challenges. In this paper, we explore how a coopetition alliance can facilitate increased environmental knowledge for firms with different absorptive capacities. We found that this type of alliance can increase the absorptive capacity for all involved firms by enhancing social, cognitive and technological proximities. Firms with high levels of absorptive capacity accumulate knowledge directly from universities and R&D organizations, whereas firms with low levels of absorptive capacity accumulate this knowledge through their competing partners. That is, they do not communicate well directly with universities and R&D organizations; rather, they access the R&D results through their competitive partners, with which they have greater technological proximity.

Key words: coopetition, proximity, absorptive capacity, environmental innovation

1. Introduction

Due to an increased focus on global warming, firms with emissions of greenhouse gases face increasingly stricter environmental regulation. To adapt production to new

regulations, firms are forced to develop environmental innovations that increase the use of resources or that reduce emissions. The development of new products or processes can encourage firms to cooperate with external partners, such as other firms and research organizations (Belderbos, Carree, & Lokshin, 2004). However, there are few in-depth studies of environmental innovations and the importance of relationships and of how such relationships actually work (De Marchi, 2012). The development of environmental innovations is complex and extends beyond firms' core competences, requiring information and skills that are new to the firm. This requirement makes cooperation key to gaining access to new environmental knowledge. R&D cooperation is more important in the development of environmental innovations than it is for other innovations due to its complex and systemic nature (De Marchi, 2012; Foxon & Andersen, 2009).

Innovation cooperation comes in many forms and is much debated in the literature (e.g., the open innovation perspective (Chesbrough, Vanhaverbeke, & West, 2006)). However, relationships in which competing firms cooperate with each other by sharing resources and capabilities to develop new innovations have been given less attention (Bengtsson & Kock, 2000; P. Ritala & Hurmelinna-Laukkanen, 2009). In this paper, we argue that firms can be involved in both cooperative and competitive relationships with each other simultaneously and can benefit from both. This is known in the literature as "coopetition." An important precondition of benefiting from coopetition is that the cooperative activities should be distanced from the customer (Bengtsson & Kock, 2000).

Environmental innovations meet this requirement, especially regulation-driven process innovations. Pollution problems are often perceived as a common challenge that needs to be addressed by an industry together, and it is expected that the actors within an industry will therefore share environmental knowledge more openly than they will share knowledge related to products and processes. However, with open communication within an industry, firms with

different backgrounds and experiences will accrue different benefits from cooptation. This diversity can be explained by firms' absorptive capacity, which can be increased by different types of proximity, which is generally seen as an important precondition for knowledge transfer, knowledge sharing and technological acquisition (Gertler, 1995). Cooperative partners need a certain level of similar technological knowledge to be able to learn and innovate together. Cognitive proximity facilitates common understanding and effective communication, whereas social proximity enhances trust through social relationships. Being located within geographical proximity influences collaboration effectively through face-to-face interactions (Boschma, 2005). In a cooptation alliance, these various types of proximity can be leveraged for the cooperative partners and can increase a firm's absorptive capacity and thereby build the industry's overall environmental knowledge.

This study aims to build a theory of how firms with different levels of absorptive capacity benefit from cooptation by considering the following research question: "*How can cooptation facilitate increased environmental knowledge for firms with different levels of absorptive capacity?*" In seeking answers to this question, we build on the theoretical insights on cooptation and proximity and develop propositions that address the dimension of proximity facilitated through a cooptation alliance.

We make several contributions to the knowledge of how firms with differing levels of absorptive capacity reap the benefits of participating in a cooptation alliance. In particular, we address the research gap regarding cooperation with external partners to increase firms' environmental knowledge by analyzing the role of cooptation. Using qualitative case studies from a Norwegian cooptation alliance, we build a theory of cooptation by proposing that cooptation is key to increasing environmental knowledge at firms with different absorptive capacities. We propose that larger firms with higher levels of absorptive capacity gain most from cooptation because they are able to directly implement the results of R&D during

coopetition. However, our findings show that firms with different levels of absorptive capacity all reap benefits from coopetition. Firms with lower levels of absorptive capacity gain increased environmental knowledge and closer relationships with both competing firms and research organizations, which would be difficult for firms with limited resources to achieve other than through coopetition.

This article proceeds as follows. The following section presents our theoretical framework, building on the literature on the development of coopetition, followed by information on absorptive capacity and the types of proximity that are important for effective cooperation. The third section presents the methodological approach, using a case study of a Norwegian coopetition alliance. In the fourth section, the empirical findings are presented in conjunction with our discussion of the scholarly literature, followed by our derived propositions. Finally, we present our conclusions and the implications of our findings.

2. Theoretical background

This section presents the theoretical framework of this paper, which includes the concepts of coopetition, absorptive capacity and different types of proximity. At the end of this section, a conceptual model of coopetition and its effects on absorptive capacity through the enhancement of social, cognitive and technological proximity is presented.

2.1. Coopetition

Research shows that more than 50% of cooperative relationships (strategic alliances) occur between firms within the same industry or between competitors (Gnyawali & Park, 2009). Most of these alliances are vertical relationships between buyers and sellers and

between competitors with indirect links through relationships with the same buyer. Less attention has been paid to horizontal relationships between direct competitors (Bengtsson & Kock, 2000).

Firms may have several reasons to cooperate with each other. First, many firms are unable to provide the necessary resources, both financial and knowledge-related, for large-scale innovation projects. Another challenge for single firms relates to the time between the identification of a problem and its arrival, which may not be sufficient for the firm to develop the internal knowledge and capabilities necessary for it to respond effectively (Dierickx & Cool, 1989). In such cases, competitors can form a strategic alliance to create economies of scale, mitigate risk and leverage resources together (Gnyawali & Park, 2009). Firm innovativeness may rely on coopetition because a common knowledge base with regard to markets and technologies increases the potential for value creation (P. Ritala & Hurmelinna-Laukkanen, 2009). Coopetition is relevant when the competitors face a common challenge: for instance, when firms within the same industry try to adapt their production to new environmental regulations. Lado et al. (1997, p. 118) claim that the syncretism between competition and cooperation will foster greater knowledge development, economic and market growth, and technological progress than either competition or cooperation alone. It seems that syncretic behavior, or coopetition, capitalizes on the efficiency-enhancing effects of competition and cooperation (Quintana-Garcia & Benavides-Velasco, 2004). However, the disadvantage of coopetition is the risk of opportunism (Levy, Loebbecke, & Powell, 2003), in which competing partners use knowledge created during coopetition for their own advantage (Bouncken & Kraus, 2013). Opportunism occurs mostly between firms that are too similar (Ritala and Hurmelinna-Laukkanen, 2009). Dissimilarities with regard to firm size are found to have positive impacts on coopetition, especially for SMEs that accumulate knowledge and discover new opportunities in collaboration with larger firms (Bengtsson & Johansson, 2012).

Firms engage in coopetition for several reasons. Most commonly, they want to increase the size of the market in which they operate, enter new markets, use resources effectively, mitigate risk, share costs, or increase their competitiveness (P. Ritala & Hurmelinna-Laukkanen, 2009). Coopetition is found to be more relevant for incremental innovations than for radical innovations. Because the competitors have a common technological knowledge base, they are more able to improve existing technologies than to make novel developments (Paavo Ritala & Hurmelinna-Laukkanen, 2013).

2.2. Coopetition and the role of absorptive capacity

Coopetition can lead to new knowledge and technological innovations, but the coopetition partners may accumulate this new knowledge at different rates (Quintana-Garcia and Benavides-Velasco, 2004). This diversity may be linked to each firm's absorptive capacity; that is, the firm's ability to recognize the value of new, external information, assimilate it, and apply it for commercial ends (Cohen and Levinthal, 1990a, p. 128). Firms in a coopetition alliance will often share the same specialized language, which will make communication between them more effective. However, they may not be able to accumulate external knowledge sources at the same rate. The differences in firms' absorptive capacities will be an important determinant of how much knowledge a firm can absorb from the alliance. Firms will need a certain level of absorptive capacity to learn from coopetition, and firms with lower levels of absorptive capacity will have few incentives to engage in such activities (Paavo Ritala & Hurmelinna-Laukkanen, 2013). The level of a firm's absorptive capacity can be discussed in terms of its most important determinants. First, firms absorb external knowledge better if they also perform some amount of R&D internally (Cohen & Levinthal, 1990). Another aspect of absorptive capacity is the potential to buy R&D performed by

external organizations. Although Cohen and Levinthal (1990) were uncertain about the effectiveness of bought R&D, other studies have shown that bought R&D increases the firm's internal R&D as long as the firm already possesses its own absorptive capacity (Veugelers, 1997). Cooperation with external partners also increases the potential to transfer knowledge between organizations, and studies have shown that firms with close relationships with both vertical actors and R&D partners perform significantly better with regard to innovation than do firms with only one close relationship (Murovec & Prodan, 2009). The advantage of cooperation within a co-opetition alliance is that competing firms have relatively strong absorptive capacity with respect to each other (Dussauge, Garrette, & Mitchell, 2000) and have a shared knowledge base on which to build existing and emerging technologies and concepts (Paavo Ritala & Hurmelinna-Laukkanen, 2013). As noted above, there are differences between firms in terms of how they accumulate knowledge and put it to use. Cohen and Levinthal (1994) claim that firms with higher levels of absorptive capacity are more proactive in exploring new opportunities than are firms with lower levels of absorptive capacity. Firms can compensate for their lack of absorptive capacity by participating in a co-opetition alliance in which all participants have access to the same results, regardless of their prior knowledge. There are, of course, challenges related to the utilization of new knowledge; however, a co-opetition alliance can strengthen the proximity between the firms in the alliance and can thereby strengthen their absorptive capacities (Knoben and Oerlemans, 2006).

2.3. Types of proximity that are relevant for collaboration

The literature on proximity contributes to our understanding of interaction and knowledge transfer as important conditions for innovation (Boschma, 2005; Gertler, 1995). If

we seek to understand the factors in the process of interaction and knowledge transfer, the concept of proximity is useful because proximity promotes trust and understanding when complex and high-risk innovation activities are conducted (Menzel, 2008). Different dimension of proximities are highlighted as relevant to collaboration and innovation (Boschma, 2005), and the dimensions of organizational, technological and geographical proximity are seen as particular relevant to inter-organizational collaboration (Knoben & Oerlemans, 2006).

Organizational proximity occurs through shared relationships within or between organizations that are advantageous for innovation networks (Boschma, 2005). This type of proximity includes social, cognitive, institutional and cultural proximity (Knoben & Oerlemans, 2006). *Social proximity* is generated through relationships between actors that are social in that they involve trust, friendship, kinship and experiences (Boschma, 2005). Social proximity is critical to both innovation and collaboration (Ben Letaifa & Rabeau, 2013) and facilitates effective communication (Maskell & Malmberg, 1999). Social proximity is often generated by past collaborations and repeated contact between partners, in which reputation and trust are created (Balland, 2011), and social proximity increases the probability of engaging in innovative networks (Boschma, 2005). To achieve extensive knowledge learning, organizations must attain social proximity when engaging in practices that rely on social interactions. Social interactions are a pre-condition for absorptive capacity because these interactions enable cooperative partners to participate in a common context (Hotho, Becker-Ritterspach, & Sake-Helmhout, 2011). *Cognitive proximity* refers to the similarities between the ways actors perceive, interpret, understand and evaluate the world (Wuyts, Colombo, Dutta, & Nooteboom, 2005) and facilitates effective communication and the absorption of new knowledge (Boschma, 2005). Actors need to have similar frames of reference to manage effective communication and transfer knowledge (Knoben & Oerlemans, 2006), which are

important determinants of R&D collaboration (Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007). Sharing a knowledge base and expertise may facilitate learning between actors (Nooteboom, 2000). *Institutional proximity* relates to the institutional framework on a macro level (e.g., laws and norms) and affects how organizations coordinate their actions (Knoben & Oerlemans, 2006). The last dimension of organizational proximity is *cultural proximity*. When organizational cultures are similar, organizations are expected to interact more easily with better results because common interpretations and routines allow organizations to interpret and give meaning to actions without making all of these difficult interpretations explicit (Knoben & Oerlemans, 2006).

Technological proximity is based on shared technological experiences and knowledge. Technological proximity refers to the knowledge that actors gain from technologies, not to the technologies themselves (Knoben & Oerlemans, 2006). Technological proximity is generally based on absorptive capacity (Cohen & Levinthal, 1990), which can be built through technological intermediaries via knowledge activities such as gate keeping, technology watch and road mapping (Spithoven, Clarysse, & Knockaert, 2010). Technological proximity can be seen on a general and a dyadic level. The new knowledge must be generally similar to a firm's prior knowledge but also must include new, specialized knowledge at a dyadic level (Knoben & Oerlemans, 2006).

Geographical proximity is related to territorial, spatial, local or physical proximity and is related to better performance on collaborations (Broekel & Boschma, 2012). Small geographical distances facilitate face-to-face interactions, which promote the transfer of knowledge and innovation (Knoben & Oerlemans, 2006). It is easier to interact when actors are co-located, even temporarily – for instance, during conferences and business meetings (Torre, 2008). In some cases, the dimension of geographical proximity can compensate for other types of distance such as organizational differences. Geographical proximity can also

positively influence mutual trust between cooperating partners by facilitating face-to-face interactions (Ponds, Van Oort, & Frenken, 2007).

2.4. Conceptual framework

Our conceptual framework suggests that the types of proximity that are relevant to cooperation can be divided into two groups: those that are relevant to the foundation of the cooperation and those that are relevant to the development of the cooperation. In the foundation of cooperation, institutional and cultural proximity are the most relevant. Institutional proximity is especially relevant when competing firms face a common challenge, such as new environmental regulations, and may act as the main driver for establishing cooperation because it concerns shared laws at a macro level. Cultural proximity is also important to the foundation of cooperation alliances because firms within the same industry have cultural similarities that are essential for them to reach a common understanding of the industry's challenges. Furthermore, when an alliance is founded, cooperation contributes to other types of proximity between participating actors. Participating in cooperation facilitates social interactions, which contribute to common understanding and effective communication about shared technological challenges. In turn, these types of proximity strengthens firms' absorptive capacity and, thus, their ability to accumulate and exploit new knowledge. This chain of events is illustrated in Figure 1, which is the basis for our analysis.

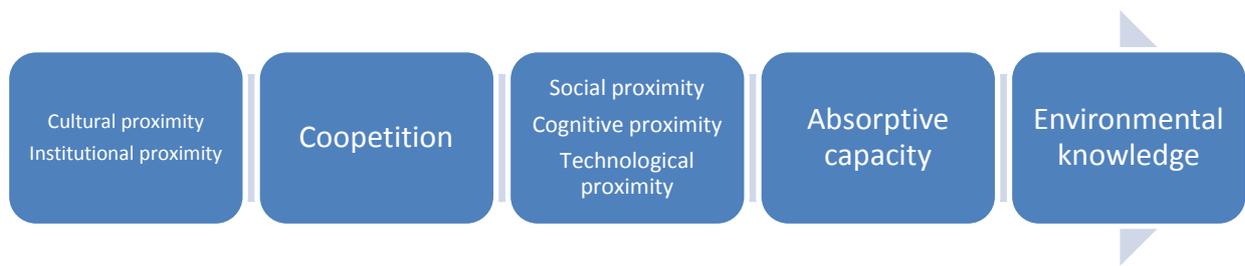


Fig. 1. Conceptual framework

3. Methodology

3.1. Research design

Due to limited research in the field of environmental innovation and coopetition, a qualitative approach was selected for this study (Stake, 1994). One particular strength of a qualitative approach is its ability to provide insight into complex relationships and processes through in-depth information. In this research, a case-study design was used to examine the process of establishing coopetition alliances that increase firms' environmental knowledge and to analyze how firms with different levels of absorptive capacity benefit from a coopetition alliance. We used a multiple–case study to enhance the existing framework and to thereby build the relevant theory (Yin, 2009). Propositions are developed to summarize the main findings that should be tested further in future quantitative research.

3.2. Case selection

The research question is examined using data collected from a cooperation alliance within the Norwegian manufacturing industry. This industry faces many environmental challenges because it is one of the most polluting industries in Norway. Given the increasing focus on environmental issues, this industry faces an ever-increasing number of regulations and needs to innovate to be competitive in the global market. The case selection is based on theoretical research (Eisenhardt, 1989) and on research suggesting that competitors within this industry formed an alliance to address common environmental challenges (Gnyawali & Park, 2009). The alliance consists of all firms within the business sector and their external R&D partners (mainly universities and public research organizations), who conduct joint research on products and processes. The aim of the alliance is to pursue environmental improvements and to increase the technological qualifications of the employees within the industry. The alliance is operated as a non-profit organization, with research activities funded by research grants from The Research Council of Norway (30-50%) and by participation fees from member companies. The alliance is currently collaborating on four environmental R&D projects. Each project is managed by an actor who represents the external R&D partners, and other firms and research institutions are included as partners. As the first step in selecting our cases, we conducted an initial interview with the manager of one of the projects and addressed subjects that became the core of the later interviews. Additionally, we contacted the board of directors and presented our research objective to secure the opportunity to collect information about the projects in the cooperation alliance and to establish an agreement regarding further research collaboration. For confidentiality reasons, at the request of the board, the cases were anonymized, which, in turn, helped us to obtain more honest statements from the informants. The descriptive characteristics of the firms that we selected are provided in Table 1.

Table 1

Characteristics of the case firms in the coopetition alliance.

Firm	Employees*	Number of production plants
Firm 1	80-100	Single plant
Firm 2	100-150	Single plant
Firm 3	100-150	Single plant
Firm 4	500-600	Part of a larger international corporation with three Norwegian production plants.
Firm 5	700-800	Part of a larger international corporation with four Norwegian production plants.

*To maintain anonymity, ranges are used.

3.3. Data collection

We used data triangulation by including several data sources in determining how firms with differing levels of absorptive capacity benefit from participation in a coopetition alliance. We started as observers at a seminar arranged by the coopetition alliance, during which each project was presented and discussed. We conducted this observation to learn about the projects, to become acquainted with the participants and to begin to observe their cooperative efforts.

We also interviewed 18 informants from the alliance: 13 representing the firms, with an average of two interviews at each firm, and five representing the R&D partners. All of the interviews involved participants in the four projects being conducted by the cooperation alliance. The interviews were recorded and transcribed by the authors as part of the data analysis process. We selected a narrative interview approach because this approach is a valuable way to gain deeper insight in organizations' underlying structures (Pentland, 1999) and to obtain an in-depth understanding of how firms benefit from cooperation alliances (Polkinhorne, 1988). In this approach, the informants are encouraged to describe the process from its beginning to the present with a minimum of interruptions by the interviewers. We did not use theoretical concepts explicitly in the interview setting to avoid bias. We also used this type of narrative interviewing to gain an in-depth understanding of the actual events that had occurred in the projects and to keep the data collection process from being influenced by personal factors or the relevant theory (Czarniawska, 1998). Table 2 shows the informants' roles and the number of interviews with each person.

Table 2

Persons interviewed (number of interviews in parentheses)

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Research partners
Informants	CEO1 (1)	CEO (1)	CEO (1)	CEO (2)	Researcher (2)	Research partner 1 (2)
	CEO2 (1)	Policy manager (1)	Researcher 1 (1)	Researcher (2)		Research partner 2 (1)
	Engineer (1)		Researcher 2 (1)			Research partner 3 (1)
						Representative for industry Federation (1)
Total no. of interviews*	3	2	3	3	2	5
Secondary	Firm presentation	Firm presentation	Firm presentation	Firm presentation	Firm presentation	R&D project presentation

*The total number of interviews is less than the sum of the persons interviewed because some interviews were conducted with more than one person.

The external research partners were a university, a public research organization and an industry federation.

3.4. Data analysis

The data analysis is based on cross-case comparisons, and the aim was to search for cross-case patterns (Yin, 2009). From the data, we identified critical characteristics and events that influence how firms with different levels of absorptive capacity gain environmental knowledge through a cooptation alliance. We read and reread the interview transcripts as the data were collected (Yin, 2009) so that we could become familiar with each case and develop the ability to identify general patterns across cases (Eisenhardt, 1989). To avoid false conclusions based on bias, we categorized the data based on theoretical dimensions, seeking to identify similarities and differences across the cases and the literature (Eisenhardt, 1989). The data analysis focused on the firms' level of involvement and the benefits achieved from the cooptation alliance, as well as the cooperative dynamics related to various types of proximity. To avoid bias, the interview transcripts were also read by colleagues who generated with alternative suggestions from the data (Yin, 2009).

4. Results and Discussion

The purpose of this study was to develop an understanding of how firms of different sizes and firms with different levels of R&D intensity all gain benefits from cooperation alliances. First, we present the overall findings from the cases, revealing the level of output from the alliance under study and indicating how involved the firms were. Then, we present the key findings from our study related to different types of proximity. The findings and discussion presented below integrate the data from our case study with information from the scholarly literature.

4.1. The involvement and outcome of the cooperation alliance

Table 3 summarizes each firm's absorptive capacity with reference to key theoretical determinants. We observed a distinction between firms with low levels of absorptive capacity and firms with high levels of absorptive capacity. The group of firms with low levels of absorptive capacity is characterized as less R&D intensive because they have no internal R&D, limited or no use of cooperation outside the cooperation process, and a reactive attitude towards change. On the other hand, the firms with high levels of absorptive capacity have internal R&D departments, report strong connections with external research organizations, and have a proactive attitude towards change.

Table 3

Determinants of absorptive capacity.

Firm	Internal R&D (Cohen & Levinthal, 1990)	Cooperation outside the cooperation (Murovec & Prodan, 2009)	Attitude toward change (Cohen & Levinthal, 1994)	Level of absorptive capacity
Firm 1	None	None	Reactive	Low

Firm 2	None	Limited use of research organizations	Proactive	Medium/low
Firm 3	Small R&D department	Limited use of research organizations	Reactive	Medium/low
Firm 4	Own R&D department	Strong connection with research organizations	Proactive	High
Firm 5	Own R&D department	Strong connection with research organizations	Proactive	High

Table 4 outlines how involved the case firms are in the alliance and indicates the level of output they experience. The table illustrates a division between the most involved and active firms, which have high levels of absorptive capacity and are able to implement the results of the R&D projects, and the less involved firms, which have lower levels of absorptive capacity and which report social ties and increased knowledge as the most important outcomes of the alliance. These findings are supported by the external R&D partners, as our informants describe the same differences as existing within the alliance. One representative of a R&D partner says that *“particularly those who have offices near the research partners are very involved. Some of the others, such as [the CEO in Firm 2] are very involved.”* Most of the firms with lower levels of absorptive capacity are more engaged in short-term activities and do not see the need to use resources in research activities. Their available financial R&D resources are spent on the fee for participating in the alliance. This fee may be the small firms’ most important contribution to the alliance. Firms with higher levels of absorptive capacity are used to thinking about research and are more involved in the competition alliance. These firms also attend board meetings and are active when projects are

initiated. All of the research partners highlight Firm 4 and Firm 5 as very involved in the cooperation alliance, but Firm 2 is also noted for its commitment: *“Those who have their own research departments like [Firm 4 and Firm 5] are normally very involved. [Firm 2] is also very involved, even if they do not have a R&D department, but you see a difference in the commitment”* (Research partner 2). The question, however, is how a firm can actually use the results of the R&D projects, and this area is the one in which the differences between the firms are the most visible. The firms gain access to the same R&D reports, but as one research partner says, *“The problem is how to do it. It is not enough with just a report; it is not enough to read the report. You have to be committed to improving.”* The commitment to improve is definitely greater at the R&D-intensive firms, whereas the smaller firms are mostly production oriented, and for them, according to one R&D partner, production *“will always win over research.”* The differences between the firms may actually be a key success factor for the alliance because previous research shows that firms that are too similar may wish to use the same R&D results to their own advantage in relatively similar ways, which could lead the competition among the participants to lessens their competitive edge collectively (P. Ritala & Hurmelinna-Laukkanen, 2009).

Table 4

Description of firm involvement in and outcomes of cooperation.

Firm	Involvement	Outcome
1	Firm 1 is not very involved in the cooperation and does not have the financial resources to use the R&D results that have accrued from the cooperation.	Firm 1 has experienced few direct technological outcomes but has experienced indirect outcomes, such as increased knowledge and better network relations.
	<i>“We are not as involved as we should be. However, we</i>	<i>”Oh yes, the [cooperation alliance] has provided us with a</i>

- participate in board meetings where we can influence which projects to carry through and so on. In that arena we have the same influence as everybody else” (Engineer)*
- network. If we experience environmental difficulties, we have someone to contact. If there are others with the same problems, we do not have to face them alone” (Engineer).*
- 2 Firm 2 is small and has no formalized internal R&D department. It is, nonetheless, one of the most engaged small firms within the alliance.
- Firm 2 has experienced an increase in knowledge due to the alliance.
- ”The cooperation within the alliance and between the alliance and [the external R&D partners]is very good and has resulted in many important projects... from which we have gained important knowledge” (Policy manager)*
- 3 Firm 3 is quite small and has a small R&D department.
- Firm 3 cannot report direct outcomes from the alliance, but the knowledge that the firm has gained is applied to their internal R&D.
- ”We are active in the sense that we read reports and participate in projects...we interpret the results of the projects” (Researcher 2)*
- ”We would not have the environmental knowledge that we have today without the alliance” (Researcher 2)*
- ”Some firms are more passive, but we and [another firm]are very open when it comes to results and observations” (Researcher 2)*
- ”Reporting the direct knowledge [that we have attained] from the alliance is almost impossible, but I am convinced that we would not have the knowledge we have today without the alliance” (Researcher 2)*
- ”We would have even better results if we had invested more resources” (Researcher 2)*
- 4 Firm 4 is part of a larger corporation and has an R&D department that is close to the university and educate Ph.D.s related to the cooperation alliance. Are among the most involved firms.
- Firm 4 educates Ph.D.s within the alliance and has implemented changes based on the outcomes of the alliance projects.
- ”You exchange knowledge and come up with new ideas which gain the project, but in the long run the firm gain benefits from the ideas” (Researcher)*
- ”If we have a problem, chances are that other firms face the same problem” (Researcher)*
- ”We get a lot of research for a small amount of money” (Researcher)*
- ”Yes, we have a great influence on the alliance” (Researcher)*

“We are opening up our production plant and will therefore gain more information” (Researcher)

- 5 Firm 5 is part of a larger corporation with its own R&D department situated in close proximity to the external R&D partners. The firm is involved in all aspects of the projects within the cooperation alliance; it initiates projects and works effectively within them.
- They are able to implement the results of the R&D.
- “ So if we are curious about the results of one of the R&D-projects, we assemble an industrial project where the aim is to implement the results” (Researcher)*
- “..a large part of the R&D results are impossible to implement. The importance of these results is that they build knowledge, which, again, can generate good ideas” (Researcher)*
-

4.2. Cooperation and absorptive capacity

To be able to use the results generated in a cooperation alliance, the firms must invest resources to further develop the results to an implementable level. The firms that are able to do this are those with the time, capacity and competences required to transform the R&D results into new processes, i.e., the firms with high levels of absorptive capacity. A research partner describes the research process as a self-reinforcing cycle in which the most involved firms experience benefits from their R&D investments, including increased knowledge, spin-off projects and more resources, which allows them to continue their research. Although the larger firms gain more from the cooperation, they share a common understanding with the smaller firms that the value created in the cooperation process could not be achieved by one firm without the alliance and that the alliance is an important source of external research financing. Both the firms and the research partners agree that all participants in the cooperation alliance reap benefits from the alliance. Although the less R&D-intensive firms have relatively low absorptive capacity relative to the other firms in the alliance, cooperation

increases value-creation for these firms because they possess some of the same knowledge concerning markets and technologies that the larger firms have (P. Ritala & Hurmelinna-Laukkanen, 2009). One of the research partners says that *"even if they are not so active, they will increase their knowledge, meaning that they will get a higher level of knowledge than if they had not participated in the alliance. They understand more of what they are doing and run their firms better in a way...without [the coopetition alliance], there would have been much knowledge they would not have had access to."* It is obvious that all firms gain something from the alliance and that the level of output from a coopetition alliance is linked to each firm's level of absorptive capacity.

4.3. Coopetition and the role of proximity

Our case study shows that coopetition relies on institutional and cultural proximity. In this case, the institutional proximity generated by new environmental regulations acted as the main driver for establishing this coopetition alliance. We also observe that the cultural proximity between the participating firms in the coopetition alliance has been a condition for effective cooperation since the beginning of the alliance. Because both institutional and cultural proximity are found to be inherently necessary to the coopetition alliance, these types of proximity are given less attention in this study. More attention is paid to the types of proximity that we observed as being facilitated by interactions among the members in the coopetition alliance and which, in turn, increase firms' absorptive capacity. These types of proximity are social, cognitive and technological proximity. We also observe that the existence of the alliance reduces the need for geographical proximity.

4.3.1. Social proximity

Social proximity is strong within the industry and enables effective network utilization because it fosters innovativeness (Broekel and Boschma, 2012). Through the coopetition alliance, representatives from all of the firms are invited to participate in meetings, seminars and conferences. These arenas build stronger social networks and increase the trust between firms. One researcher says that *“the policy within the coopetition alliance is that you should be open when it comes to environmental issues. We cooperate very well... and are confident that sensitive information is treated with care.”* Another informant describes the alliance as a *“family,”* which reflects the trust among the firms within the alliance. This remark confirms the findings of Hubers (2011) regarding social proximity, as Hubers showed that personal relationships and emotional closeness are important to cooperation. The social networks and trust within the alliance are highlighted by all of the firms and are essential to cooperation on environmental issues. To quote one of the informants, *“We know each other very well, and when we have environmental problems, we just pick up the phone and call one of the other firms. That is one of the big advantages of the alliance.”* The size of the industry might be a contributing factor to the strong social ties and good communication within the alliance. In Norway, a relatively small group of people work within the industry, and many of the people in the industry have studied or worked together at some level. As one of the research partners says *“At some point in time, we have all been either classmates or colleagues.”* The coopetition functions as a social arena characterized by trust and openness among the participants, which is important for effective collaboration. Thus, we propose that

Proposition 1: Coopetition can leverage the social proximity between firms by facilitating social interactions between the participants.

4.3.2. Cognitive proximity

Good cooperation between the firms within the alliance is facilitated by another important type of proximity, cognitive proximity. Being within the same industry provides firms with a common language and a common understanding of some of the challenges that the industry is facing. This common language and mode of working (Ponds et al., 2007) makes it easier to communicate; however, we observe that the less R&D-intensive firms experience difficulty communicating with the R&D partners, whereas the more R&D-intensive firms do not. What is interesting is that the less R&D-intensive firms rely on the more experienced R&D firms in their communication with and attempts to understand of the R&D partners. They trust that the leading firms will propose projects that are of importance to the entire industry and that they will learn from the experience. In addition, the smaller firms communicate with the R&D partners through the bigger firms, with which they have greater technological proximity than they do with the R&D partners. An informant from one of the less R&D-intensive firms describes the relationship between the firms as follows: “*we are all in the same industry, and we talk about the same things most of the time.*” On the other hand, he describes the communication with the R&D partners as difficult because “*they [the R&D-partners] have so much specialized equipment that we are unable to understand.*” This situation is typical for all of the small firms within the study. A research partner observes this and says that “*there are some firms that are not involved that much, but they see that other firms are. Like [Firm 1], for instance, which produces the same as [Firm 5] and feels that they do not need to get so involved because [Firm 5] is in the alliance.*” It appears that cognitive proximity increases for all firms in the cooperation because it facilitates interaction among the members. Another striking observation is that the firms with low levels of absorptive capacity share more cognitive and technological proximity with the firms with higher levels of absorptive capacity than with the R&D partners. Thus, we propose that

Proposition 2a: Coopetition can leverage cognitive proximity to participants by facilitating communication and social interactions that address shared technology challenges.

Proposition 2b: The firms with lower levels of absorptive capacity learn more from competing firms in the coopetition alliance than from the R&D partners because they have more cognitive and technological proximity to firms within the same industry.

4.3.3. *Technological proximity*

For firms to be able to accumulate knowledge effectively, technological proximity is required. Firms with higher levels of absorptive capacity have the technological knowledge that is necessary for them to further develop their environmental knowledge. These firms have the basic knowledge that they require to understand the results and the specialized knowledge that is necessary to implement the new environmental knowledge. To quote an informant from one of the high-absorptive- capacity firms: *“When we are working with [the industry] and talk about the [industry], we talk mostly about the same things.”* The firms with higher levels of absorptive capacity are also more aware of their own limitations and will therefore more readily identify knowledge gaps and address them by either strengthening their own R&D departments or using external R&D to fill the gaps. Firms with lower levels of absorptive capacity share some technological knowledge with the first group of firms and with the cooperative research partners at a general level. Several firms expressed in the interviews that they have technological knowledge that is similar to that of both the competing firms and the cooperative research partners in the coopetition alliance. However, as a result of their inability to transform the knowledge generated in the coopetition alliance to implementable information, we argue that this group of firms has less technological

knowledge than the group of firms with higher levels of absorptive capacity. This group of firms lacks the specialized technological knowledge that is necessary to implement its new understanding of the research topics as well as the consciousness to understand that they need specialized knowledge. We observe that these firms do not prioritize internal R&D departments and have little or no cooperation with external R&D beyond their participation in the coopetition alliance. Because of their lack of technological knowledge, like the other participants in the coopetition alliance, these firms do not have the information that would be necessary for them to participate in the overall dialogue about the development of environmental knowledge. Cassi and Plunket (2012) found that the impact of technological proximity depends on social proximity. During participation in a coopetition alliance, technological proximity is leveraged through social interactions, thereby increasing technological proximity to firms with lower levels of absorptive capacity. Thus, we propose the following:

Proposition 3: Coopetition can leverage technological proximity to participants by facilitating communication and social interactions focused on shared technology challenges.

4.3.4. Geographical proximity

The firms in the coopetition alliance are situated in different parts of Norway, and the geographical distance between them is quite large. However, some of the firms with high levels of absorptive capacity have internal R&D departments that are located near each other and near the alliance's research partners. Geographical proximity is found to drive the formation of networks (Broekel and Boschma, 2012) and has a positive influence on trust because it facilitates face-to face interaction (Ponds, et al., 2007). We observe that a

coopetition alliance eliminates the need for geographical proximity because it facilitates frequent meetings and member interactions. Broekel and Boschma (2012) found that for firms with low technological knowledge links, geographical proximity helps to overcome cognitive distance. Our findings show that establishing a coopetition alliance leverages cognitive proximity as well as social proximity and reduces the relevance of geographical proximity. Thus, we propose that

Proposition 4: Coopetition reduces the need for geographical proximity because it enhances social and cognitive proximity.

In summary, firms with high levels of absorptive capacity gain more from a coopetition alliance than firms with lower levels of absorptive capacity because they have cognitive and technological proximity to the cooperative R&D partners in the alliance. The firms with lower levels of absorptive capacity lack the technological proximity and cognitive proximity that would allow them to implement the environmental knowledge gained through the alliance, but in addition to increased environmental knowledge, they develop social relationships with and network links to other relevant firms and knowledge sources and thereby generate the previously missing links to firms with high levels of absorptive capacity and the cooperative research partners. Being in an alliance is also useful for this group of firms because they learn more from competing firms than R&D partners because of similar firm-related experiences.

5. Conclusion and implications

This paper contributes new evidence that refines our understanding of how coopetition can facilitate increased environmental knowledge for firms with different levels of absorptive capacity. By studying five firms in a coopetition alliance and their external R&D partners, we developed propositions that claimed that despite their differences with regard to absorptive capacity, all participating firms gain knowledge from the alliance that they would not be able to achieve alone. This finding contradicts other findings on coopetition alliances that conclude that firms should have relatively similar technological backgrounds to develop new knowledge from this type of alliance. The small firms learn much more from the larger firms than the large firms learn from the smaller firms. However, the smaller firms contribute financially to the joint R&D, from which the larger firms accumulate more knowledge than the smaller firms. We therefore propose that the level of output from the coopetition alliance is linked to the individual firms' levels of absorptive capacity. We also propose that participating in coopetition enhances social interaction and communication about shared technologies, which increases firms' social, cognitive and technological proximity, thereby improving their absorptive capacity. Thus, the need for geographical proximity is reduced through coopetition because coopetition enhances social and cognitive proximity. The firms with the highest levels of absorptive capacity gain new knowledge from the R&D partners, whereas the firms with lower levels of absorptive capacity increase their absorptive capacity by accumulating knowledge from their competitors, with which they have greater technological proximity. Hence, the knowledge from the R&D partners is transferred to firms with lower levels of absorptive capacity through firms with higher levels of absorptive capacity.

5.1. Limitations and directions for future research

One of the limitations of the current study is the focus on one industry and the lack of comparison with other cooperation alliances. Future research should test our propositions statistically to explore whether our results are transferable to other cooperation alliances. Another limitation of our research is the cross-sectional nature of our data. Additional longitudinal data collection could investigate the effects on firms' absorptive capacities of being in a cooperation alliance over time.

5.2. Implications

Our findings indicating that cooperation increases the environmental knowledge of an entire industry have important implications for the development of policy as well as for the industry and the firms in question. At the policy level, the most important implication is the need to secure firms' ability to cooperate on environmental issues. Cooperation can be difficult to establish due to antitrust laws, and governments that seek a more sustainable future should develop regulations that ensure that competing firms can cooperate on environmental issues. The next step should be to develop dedicated financial measures directed towards environmental R&D within cooperation alliances. Such measures could encourage more firms to cooperate on environmental issues and could ensure not only that firms with R&D experience increased their knowledge but also that smaller and less R&D-intensive firms gain access to important knowledge. The policies should be formulated to include firms of different sizes and those with different technological capabilities. The purpose of including the less R&D-intensive firms would be to encourage the environmental development of an entire industry rather than leaving this responsibility to the largest and most developed firms. The case firms in our study compete in a global market, and by participating in a national cooperation alliance, they may enhance overall industry knowledge at the national level and

thereby increase their competitiveness in the global market. On the firm level, the most important implication is related to firm-specific knowledge development. By pooling the industry's environmental R&D funds together, these firms will all gain more than any one firm could gain on its own. The largest firms invest the most and reap the greatest benefits; however, the smaller firms gain much more knowledge by interacting with the more R&D-experienced firms than they could ever do alone with their limited finances directed towards R&D. Smaller firms should therefore seek larger firms within the same industry with which they communicate well and try to form alliances with them.

References

- Balland, P.-A. (2011). Proximity and the Evolution of Collaboration Networks: Evidence from Research and Development Projects within the Global Navigation Satellite System (GNSS) Industry. *Regional Studies*, 46(6), 741-756.
- Belderbos, R., Carree, M., & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, 33(10), 1477-1492.
- Ben Letaifa, S., & Rabeau, Y. (2013). Too close to collaborate? How geographical proximity could impede entrepreneurship and innovation. *Journal of Business Research*, In press
- Bengtsson, M., & Johansson, M. (2012). Managing coepetition to create opportunities for small firms. *International Small Business Journal*, 1-17.
- Bengtsson, M., & Kock, S. (2000). "Coopetition" in business networks - to cooperate and compete simultaneously. *Industrial Marketing Management*, 29(5), 411-426.
- Boschma, R. (2005). Proximity and Innovation: A Critical Assessment. *Regional Studies*, 39(1), 61-74.
- Bouncken, R. B., & Kraus, S. (2013). Innovation in knowledge-intensive industries: The double-edged sword of coepetition. *Journal of Business Research*(0).
- Broekel, T., & Boschma, R. (2012). Knowledge networks in the Dutch aviation industry: the proximity paradox. *Journal of Economic Geography*, 12(2), 409-433.
- Cassi, L., & Plunket, A. (2012). Research Collaboration in Co-inventor Networks: Combining Closure, Bridging and Proximities. *Presented at 2012 Barcelona Workshop on Regional and Urban Economics*.
- Chesbrough, H., Vanhaverbeke, W., & West, J. (2006). *Open innovation : researching a new paradigm*. Oxford: Oxford University Press.
- Cohen, W. M., & Levinthal, D. A. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35(1), 128-152.

- Cohen, W. M., & Levinthal, D. A. (1994). Fortune favors the prepared firm. *Management Science*, 40(2), 227-251.
- Czarniawska, B. (1998). A narrative approach to organization studies
- De Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. *Research Policy*, 41(3), 614-623.
- Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, 35(12), 1504-1511.
- Dussauge, P., Garrette, B., & Mitchell, W. (2000). Learning from competing partners: Outcomes and durations of scale and link alliances in Europe, North America and Asia. *Strategic Management Journal*, 21(2), 99-126.
- Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532-550.
- Foxon, T., & Andersen, M. (2009). The greening of innovation systems for eco-innovation - towards an evolutionary climate mitigation policy. Paper presented at 2009 DRUID Conference, Copenhagen Business School, 17-19 June 2009.
- Gertler, M. S. (1995). "Being There": Proximity, Organization, and Culture in the Development and Adoption of Advanced Manufacturing Technologies. *Economic Geography*, 71(1), 1-26.
- Gnyawali, D. R., & Park, B. J. (2009). Co-opetition and Technological Innovation in Small and Medium-Sized Enterprises: A Multilevel Conceptual Model. *Journal of Small Business Management*, 47(3), 308-330.
- Hotho, J. J., Becker-Ritterspach, F., & Sake-Helmhout, A. (2011). Enriching Absorptive Capacity through Social Interaction *British Journal of Management*
- Huber, F. (2011). On the Role and Interrelationship of Spatial, Social and Cognitive Proximity: Personal Knowledge Relationships of R&D Workers in the Cambridge Information Technology Cluster. *Regional Studies*, 46(9), 1169-1182.
- Knoben, J., & Oerlemans, L. A. G. (2006). Proximity and inter-organizational collaboration: A literature review. *International Journal of Management Reviews*, 8(2), 71-89.
- Lado, A. A., Boyd, N. G., & Hanlon, S. C. (1997). Competition, cooperation, and the search for economic rents: A syncretic model. *Academy of Management Review*, 22(1), 110-141.
- Levy, M., Loebbecke, C., & Powell, P. (2003). SMEs, co-opetition and knowledge sharing: The role of information systems. *European Journal of Information Systems*, 12(1), 3-17.
- Maskell, P., & Malmberg, A. (1999). The Competitiveness of Firms and Regions. *European Urban and Regional Studies* 6(1), 0969-7764.
- Menzel, M. (2008). Dynamic Proximities: Changing relations by creating and Bridging Distances. *Papers on Evolutionary Economic Geography Number 08-16. Section of Economic Geography*(Utrecht University).
- Murovec, N., & Prodan, I. (2009). Absorptive capacity, its determinants, and influence on innovation output: Cross-cultural validation of the structural model. *Technovation*, 29(12), 859-872.
- Nooteboom, B. (2000). *Learning and innovation in organizations and economies*: Oxford University Press, USA.
- Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., & van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity. *Research Policy*, 36(7), 1016-1034.
- Pentland, B. T. (1999). Building Process Theory with Narrative: From Description to Explanation. *The Academy of Management Review*, 24(4), 711-724.

- Polkinhorne, D. E. (1988). Narrative knowing and the human sciences. *State University of New York Press*(Albany).
- Ponds, R., Van Oort, F., & Frenken, K. (2007). The geographical and institutional proximity of research collaboration*. *Papers in Regional Science*, 86(3), 423-443.
- Quintana-Garcia, C., & Benavides-Velasco, C. A. (2004). Cooperation, competition, and innovative capability: a panel data of European dedicated biotechnology firms. *Technovation*, 24(12), 927-938.
- Ritala, P., & Hurmelinna-Laukkanen, P. (2009). What's in it for me? Creating and appropriating value in innovation-related coopetition. *Technovation*, 29(12), 819-828.
- Ritala, P., & Hurmelinna-Laukkanen, P. (2013). Incremental and Radical Innovation in Coopetition—The Role of Absorptive Capacity and Appropriability. *Journal of Product Innovation Management*, 30(1), 154-169.
- Spithoven, A., Clarysse, B., & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation*, 30, 130-141.
- Stake, R. E. (1994). Case Studies. In N. K. L. Denzin, Y. S (Ed.), *Handbook of Qualitative Research*. Thousand Oaks SAGE Publications.
- Torre, A. (2008). On the Role Played by Temporary Geographical Proximity in Knowledge Transmission. *Regional Studies*, 42(6), 869-889.
- Veugelers, R. (1997). Internal R&D expenditures and external technology sourcing. *Research Policy*, 26(3), 303-315.
- Wuyts, S., Colombo, M. G., Dutta, S., & Nooteboom, B. (2005). Empirical tests of optimal cognitive distance. *Journal of Economic Behavior & Organization*, 58(2), 277-302.
- Yin, R. K. (2009). *Case Study Research - Design and Methods*: Sage Publications.