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Research paper

Managing tension in coopetition through mutual dependence and asymmetries: A longitudinal study of a Norwegian R&D alliance

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ABSTRACT

Strategic alliances between competitors (coopetition) is perceived to be full of tensions that needs to be managed. This study explore the evolution of a Norwegian coopetition alliance, through how firms handle tensions over time. The study finds that the firms experience a mutual dependence towards one another and that this dependence evolves over time. In the early phases of a coopetition alliance firms handle tension by relying on a structural dependence with their partners whereas firms move towards a more harmonious relationship with their partners by building a psychological dependence through trust and generosity. Further, the results indicate these dependencies might reduce the possible tensions related to asymmetries in size and knowledge between firms.

1. Introduction

In today's rapid changing world, manufacturing firms face increasing expectations to produce better, faster, cheaper and with less pollution than ever before. To enhance products or production processes, firms are often dependent on research and development (R&D), which can impose challenges through increasing technological development, shorter product life cycles and increasing costs (Sampson, 2007). To face these challenges, firms are to an increasingly extent engaged in *R&D cooperation* with external partners (Becker & Dietz, 2004; Cassiman & Veugelers, 2002). Strategic alliances, joint ventures, university-industry cooperation are some examples of cooperative relations where organizations can conduct joint R&D (Bruneel, d'Este, & Salter, 2010; Mowery, Oxley, & Silverman, 1996; Parkhe, 1993). Although such interorganizational cooperation has received a lot of attention in the literature (Schermerhorn Jr, 1975; Smith, Carroll, & Ashford, 1995), a form of interorganizational cooperation that has received less attention is *coopetition*, where competing firms that pursue similar (or partly similar) geographical and product markets, cooperate (Kraus, Meier, Niemand, Bouncken, & Ritala, 2018; Ritala & Hurmelinna-Laukkanen, 2009). Although coopetition research is still in its infancy (Gast, Filser, Gundolf, & Kraus, 2015), it is growing rapidly with several contributions related to the motives, likelihood, interaction, process and outcome of coopetition (Bengtsson & Kock, 2014). As coopetition is regarded as a paradox where two firms interact with contradictory logics related to cooperation and competition, tension is viewed as the consequence of this interaction (Raza-Ullah, Bengtsson, & Kock, 2014). It is concluded that coopetition is filled with tension (Bengtsson & Kock, 2014), and this tension can be discussed in relation to role conflicts, tension between cooperation and competition, or between the contradictions inherent in the nature of the coopetitive phenomenon, such as value creation versus value appropriation (Raza-Ullah et al., 2014).

This paper will focus on the possible tensions related to competing firms cooperating on joint R&D. In this situation, tensions can arise when firms are expected to share information with their competitors in order to do joint research. Knowledge sharing can provide the firm with new valuable knowledge from the coopetition partner, but there is also the risk that the firm can lose valuable firm-specific knowledge to a competitor (Das & Teng, 1999). Further, in the value appropriation process the firms compete over the knowledge created in the alliance, which can be the process filled with most tension as all partners want their piece of the pie. One approach to the tension view of coopetition is to study how firms handle these tensions. One strategy is to rely on formal contracts (Enberg, 2012) or a well-developed appropriability regime to protect firm-specific knowledge (Bouncken, Gast, Kraus, & Bogers, 2015; Ritala & Hurmelinna-Laukkanen, 2013). Another strategy is, whenever possible, to try cooperation to manage tensions, as trust and commitment developed through collaboration can reduce tension (Tidström, 2014) and be beneficial for innovation (Park, Srivastava, & Gnyawali, 2014a). Although the literature has uncovered several sources of tension and strategies to handle them, there is little

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knowledge on coopetitive processes (Bengtsson & Kock, 2014), particularly the process of how firms manage tensions (Raza-Ullah et al., 2014). Further, there is a significant gap in our knowledge on how and why coopetition persists in maturing market categories (Mathias, Huyghe, Frid, & Galloway, 2018).

This paper aims to narrow these gaps by exploring how firms manage the possible tension related power and dependence in a coopetition alliance. A theoretical perspective suitable to investigate these aspects, is the resource dependence theory. This perspective is chosen because it provides a framework for analyzing the evolution of a coopetition alliance from *why* organizations form interorganizational arrangements, the *evolution* of the relationship and why firms seek *long-term* relationships. The resource dependence theory explain these parts through power asymmetries and mutual dependence as constructs important for understanding resource dependence between firms (Casciaro & Piskorski, 2005; Gulati & Sytch, 2007; Hillman, Withers, & Collins, 2009). First, the concept of mutual dependence can explain the development of trust between cooperative partners (Gulati & Sytch, 2007), whereas power asymmetries is seen as the potential for one partner to impose one's will on another regardless of their interests (Czakon, 2009). This paper focus on how the mutual dependence between competitive firms develops over time and its effect on tensions in R&D coopetition. Second, the paper focus on asymmetries between firms related to size and knowledge, as there is a gap related to studying asymmetric alliances, especially the development of trust mechanisms between asymmetric firms (H. Yang, Zheng, & Zhao, 2014). The following research question is explored: *"How do firms handle the possible tensions related to power and dependence in R&D coopetition?"*

The paper addresses this question by employing longitudinal case studies of firms in a Norwegian coopetition alliance. This alliance consists of firms within the process industry of different sizes and different levels of resources and knowledge. By adding to the few studies on the evolution of coopetition relationships (Bengtsson & Kock, 2014), the limited knowledge on the capabilities that are necessary to coopete successfully (Bouncken et al., 2015), and the call for more research on how coopetition persists over time in a mature industry (Mathias et al., 2018), this paper makes several contributions to the literature. First, the paper contributes longitudinal insight into the evolution of a coopetition alliance through the evolution of mutual dependence between firms. Second, this paper contributes to the limited insight into how firms handle the possible tensions arising from cooperating with competitors (Raza-Ullah et al., 2014; Tidström, 2014), by showing that building structural and psychological dependencies reduces the possible tensions related to asymmetries in size and knowledge between firms, making the relationship more stable and robust. Third, this study provides data from an alliance with several competing partners. As most studies on coopetition focus on dyadic relationships (Park et al., 2014a), this study provide novel insight into how firms are able to handle the cooperation with several competitors.

The paper proceeds as follows. First, the theoretical perspective is presented, building on the literature on strategic alliances, resource dependence theory, coopetition and value creation and value appropriation. Next, the methodology is discussed and the case is presented. Following this, the empirical findings are presented in conjunction with the discussion of the scholarly literature, followed by three derived propositions. Finally, the conclusions are presented.

2. Literature review

A strategic alliance between firms is a mechanism to share skills and resources to reach some common goals for the involved firms (Cimon, 2004). Mowery et al. (1996) classifies different forms of alliances on a scale from simple unilateral contracts, through more complex contractual alliances, such as technology sharing and joint development agreements, collaborative R&D, to equity joint ventures where the partner firms share ownership in a separately incorporated entity. Alliances on joint R&D, where innovative activity or an exchange of technology is part of the alliance agreement (Gilsing, Lemmens, & Duysters, 2007; Hagedoorn & Duysters, 2002; Verspagen & Duysters, 2004), are important for many firms as it facilitates transfer of resources, exchange of knowledge and competencies, as well as the sharing of the risks involved in R&D projects and innovation (Cassiman, Di Guardo, & Valentini, 2009). Alliances between competing firms, *coopetition*, comes in many forms, although the more recent stream of literature on coopetition has focused more and more on collaborative R &D and joint innovation processes (Bouncken & Kraus, 2013; Enberg, 2012; Gnyawali & Park, 2011; Park et al., 2014a). Coopetition related to R&D and innovation means that firms collaborate in R&D-activities, whereas they compete in utilizing the knowledge derived from the collective R&D in their own firms' product or process development (Bengtsson & Kock, 2000). There is also a shift from early studies on coopetition that mainly focused on the dyadic relationship between two actors towards a more multifaceted view on coopetition, incorporating multiple partner alliances, as well as coopetition in horizontal and vertical relationships. This study will therefore consider coopetition in relation to Bengtsson and Kock's (2014, p. 182) definition that *"coopetition is a paradoxical relationship between two or more actors simultaneously involved in cooperative and competitive interactions, regardless of whether their relationship is horizontal or vertical"*.

2.1. Coopetition, paradox and tension

A paradox is defined as the simultaneously existence of two inconsistent states, such as new and old, innovation and efficiency (Eisenhardt, 2000), or in relation to coopetition, the two contradictory, yet interrelated, elements of competition and cooperation that are juxtaposed in one phenomenon (Bengtsson & Kock, 2014; Raza-Ullah et al., 2014). This paradox is considered to be an antecedent of tension (Raza-Ullah et al., 2014), which is much discussed in the strategic alliance literature (Autio, 2005; Parkhe, 1993), and are of considerable interest in the coopetition literature. Bengtsson and Kock (2014) conclude that coopetition is filled with tension, and this tension can be viewed as either inherent in the relationship between cooperation and competition (Wilhelm, 2011) or as a result of coopetition (Bengtsson, Eriksson, & Wincent, 2010; Raza-Ullah et al., 2014). Hence, there are several studies on the coopetition paradox, potential types of tensions within this paradox, and how firms manage paradox/tension within an alliance. There are numerous tensions that can emerge in cooperative relationships, and the most common tensions in coopetition are related to *roles, knowledge, power and dependence* as well as *opportunism* (Tidström, 2014). Much effort has been devoted to resolving or understanding paradoxes (Poole & Van de Ven, 1989), which is evident within the coopetition literature with several articles on different types of management (Fernandez, Le Roy, & Gnyawali, 2014; Tidström, 2014), and relational issues related to tension and the resolving of tension (Raza-Ullah et al., 2014). However, managing a paradox, such as cooperation and competition, may not imply resolving or eliminating the paradox, but rather tapping into its energizing potential (Andriopoulos & Lewis, 2009). Lewis (2000) suggests that paradox management means exploring, rather than suppressing, tensions. This paper will explore the possible tensions related to power and dependence, and how they are related to the coopetition paradox over time.

Cooperation on R&D within a coopetition alliance is a collective process that should generate common benefits that are shared by all partners within the alliance. When these common benefits are created, power and dependence mechanisms may determine the distribution of knowledge among the different partners. Cassiman et al. (2009) found in their study of coopetitive R&D-projects that cooperation prevailed in knowledge creation activities, whereas the competitive forces emerged in the distribution of this knowledge. Ritala and Hurmelinna-Laukkanen (2009) propose that knowledge-creation has a higher potential in coopetition compared to cooperation between non-

competitors because firms share a large common knowledge base concerning both markets and technologies. However, this potential is more likely to be eroded because of opportunism concerns compared to cooperation between non-competitors. The literature also points to the duration of a relationship as a possible risk, as the longer the relationship, the higher the possibility that a competitor can use the resources and capabilities accessed during the relationship to reinforce its own market advantage (Pellegrin-Boucher, Le Roy, & Gurău, 2013). Competitive partners with a high absorptive capacity may act opportunistically and recognize and appropriate key technologies and know-how from their partners (Quintana-García & Benavides-Velasco, 2004). Hence, the possible tensions related to power and dependence relationships in joint R&D, are interesting dimensions to study in order to understand the coopetition paradox better.

2.2. Mutual dependence and asymmetry

This paper will take on a new approach to the discussion of paradox and tension in coopetition and build on Das and Kumar's (2009) argument that the tension-based view on alliances cloud the consideration that firms' quest for harmony is a significant factor in alliance dynamics. They argue that through joint commitment and forbearance, harmony is a natural outcome of an alliance, even as tension persist as inevitable challenges. However, it may be too simple to say that trust, commitment and strong cooperation will lead to weak tensions in coopetition (Tidström, 2014), and there is a need for more research on this process in particular and the coopetition process in general (Bengtsson & Kock, 2014). The resource dependence theory is suitable to study the development of coopetitive relationships, as the resource dependence theory postulates that the need for resources creates interdependencies between partners, and that these interdependencies explain why organizations engage in different kinds of interorganizational arrangements such as board interlocks, alliances, joint ventures, in-sourcing, and mergers and acquisition (Drees & Heugens, 2013; Pfeffer & Salancik, 1978). The original theory of resource dependence viewed interdependence between organizations as a combination between power imbalance and mutual dependence (Pfeffer & Salancik, 2003). This view has later been criticized as it is argued that these dimensions should be studied separately as they can influence resource dependence in opposite ways. While mutual dependence helps us to understand why firms seek long-term relationships (Casciaro & Piskorski, 2005), power theories are useful in predicting the dynamics of cooperative relationships over time (Smith et al., 1995). These two dimensions will be discussed more in detail, as they can be suitable to describe how firms handle tension in coopetition.

Mutual dependence between firms are important in alliances because an alliance where the mutual dependence erodes or vanishes, is likely to terminate (Parkhe, 1993). Das and Kumar (2009) differentiate between structural and psychological dependence when explaining dependence between partners. This distinction is useful when discussing different aspects of mutual dependence and the relation between them. Structural dependence is in Das and Kumar's (2009, p. 35) definition a dependence where *"both partners are dependent on the alliance specific investments that they have made"*. When firms are confronted with similar resource constraints, which may often be the case with competing firms that operate in the same markets, this common resource dependency motivate firms to cooperate on accessing crucial resources (Peng, Pike, Yang, & Roos, 2012). This will very often require a financial investments towards the alliance, which can be both a substantial and irreversible commitment (Drees & Heugens, 2013). Luo (2008) suggests that economic integration within an alliance can increase the value of other variables such as joint governance, interparty trust and alliance performance. Further, Gulati and Sytch (2007) find that joint dependence is important for firm's performance and that this is mediated through joint action and the quality of information exchange. They view joint action as "*the degree of dyadic cooperation and coordination across a wide array of organizational activities, such as design, cost control, and quality improvement*". Related to coopetition the joint action can be most successful, or at least experience less tension, if it concerns activities far from the customer, such as R&D. This is to decrease the risk of transferring knowledge important for a firm's competitive advantage (Bengtsson & Kock, 2000), which is especially risky in collaborative relationships with competitors. Hence, joint R&D might be "easier" to handle over time compared to e.g. joint marketing or joint product development. Another aspect of strategic dependence between firms is that it does not necessarily imply that the partners are satisfied with the relationship. An alliance member may be highly dependent on the value creation within an alliance, but may not be particularly satisfied with it (Das & Kumar, 2009).

In addition to the structural dependence related to specific actions like finance, joint action and information exchange, there is also a psychological aspect of a relationship involving mutual dependence. Dyer and Singh (1998) argue that an alliance will not generate a competitive advantage if it does not invest in relation-specific assets. Investing in such assets is important because no matter how mutually beneficial and logical the structural parts of the alliance may seem at its start, without trust and commitment, the alliance will fail entirely or at least it will fail to reach its strategic potential (Cullen, Johnson, & Sakano, 2000). Building a psychological dependence implies that the partners are reluctant to dissolve the relationship (Das & Kumar, 2009), as they experience a commitment towards their partners. Building and sustaining mutual commitment through partner dependencies is important as it enables all partners in a relationship to engage in value-creating activities (Holm, Eriksson, & Johanson, 1999). Important for building a psychological dependence is the notion of trust between partners. Trust is "*a type of expectation that alleviates the fear that one's exchange partner will act opportunistically*" (Bradach & Eccles, 1989). As risk of opportunism is considerable in competitive alliances and/or where partners are highly interdependent, Krishnan, Martin, and Noorderhaven (2006) shows that trust is important for reducing the effects of uncertainties related to opportunistic behavior from partners. Trust facilitates openness in knowledge sharing by allowing partners to give each other the benefit of the doubt rather than interpret each other's actions in a negative way (Krishnan et al., 2006). Another aspect related to the relationship between partners that has not gained much attention in neither the strategic alliance literature nor the coopetition literature is the role of generosity in building trustful relationships. Drawing on the psychology literature, Klapwijk and Van Lange (2009) study of the psychological consequences of various interpersonal strategies in social dilemmas related to the conflict between self-interest and collective interests found that in a noisy environment (i.e. when the other party every now and then behaves less cooperatively), a generous strategy caused an increase in cooperation. They conclude that when noise is present, a generous strategy is perceived more moral and trustworthy. If this is transferred to an alliance context, one can assume that acts of generosity in an alliance where tension (noise) is present will increase cooperation and trust, which again can strengthen the psychological dependence. In an alliance without this psychological dependence based on trust and generosity, the communication and knowledge sharing will be restricted and the partners must rely on impersonal and standardized mechanisms to communicate and share knowledge (Enberg, 2012).

The structural and psychological aspects will be interrelated in the process of creating mutual dependence, as high levels of structural dependence will also lead to higher levels of psychological dependence (Das & Kumar, 2009). Hence, for partners to experience a high degree of dependence in each other, they need to have both a structural and psychological dependence towards their partners. As Cullen et al. (2000) argue; in evolving or long-term alliances it is difficult to rely on merely contracts and agreements, as new issues or situations will require rewriting of these contracts. In such long-term alliances, trust can fill the gaps in the formal contracts and help to keep the relationship

running. However, these processes will take far longer to develop than much traditional economic theory acknowledge (Ring & Van de Ven, 1994), and hence, we can assume that the structural dependence will be developed first, and the psychological dependence will follow.

The second aspect important within the resource dependence theory is the notion of a power imbalance or asymmetries between partners. From the resource dependence theory, asymmetry exist when the exchange is not equally important for both firms in the relationship (Pfeffer & Salancik, 2003). The existence of asymmetries in a relationship can lead to the stronger part taking advantage of the weaker part. For this to occur, the net resource balance between firms must be asymmetrical, meaning that the most powerful firm should have advantages related to several resources compared to their weaker counterpart, and not just one aspect that can be counterbalanced by superior resources in the partner firm (Pfeffer & Salancik, 2003). Although asymmetries related to power mean that the most powerful partner can take advantage of their weaker counterparts, Gulati and Sytch (2007) argue that firms that exert power in order to get the biggest piece of the value creation-pie, might destroy value rather than creating value. This can be illustrated by the case study of technological collaborations by Davis and Eisenhardt (2011), where managers in dominating organizations believed that they could access complementary resources from their partners without relinquishing control to them. This turned out to be difficult as the non-leading firms were less motivated to assist the leading firms without having any decision control. They found that marshalling complementary capabilities from both partners was best achieved through alternating control, where both partners made unilateral decisions through the various stages of the collaboration.

In relation to coopetition, Gnyawali, He, and Madhavan (2007) also use a pie-metaphor to explain the different stages of coopetition, where the cooperation is evident in baking the pie, whereas the competition surfaces in bargaining over the biggest slice. However, to take the pie-metaphor even further, when there are asymmetries between firms, you may have a situation where the cooperation firms might not want the same piece of the pie. An example is a study on asymmetrical coopetition alliances where small and medium-sized innovative firms cooperate with large competitors. Here the small and medium-sized firms reap benefits in terms of increased technological diversity, whereas the larger and more diversified firms gain access to very specialized technologies from smaller and more flexible firms (Quintana-García & Benavides-Velasco, 2004). Hence, they are not interested in the same piece of the pie. Further, within an asymmetrical alliance, there can be a common understanding that the firms who bring most resources into the relationship, can also appropriate the highest proportion of the benefits (Pfeffer & Salancik, 2003). The role of the smaller firms might, however, be affected by more powerful firms who make the crucial decisions in their own favor (Bouncken & Kraus, 2013). The less resourceful firms might be stuck on the sidelines, whereas the more resourceful firms might not wish to stay in an alliance with partners that cannot contribute as much (Ahuja, 2000). However, from the harmony-view of interpartner cooperation, the concept of forbearance suggest that patience and tolerance, both in relation to other partners' behavior and to the alliance outcome (Das & Kumar, 2009), can help overcoming possible tensions related to differences between partner firms. Forbearance between firms is developed over time, and one can therefore assume that tensions related to asymmetries will be higher in relationships without trust and patience, compared to relationships where such attributes are developed.

In summary, there is an understanding in the literature that coopetition is a paradoxical relationship (Wilhelm & Sydow, 2018), which is filled with tension (Bengtsson & Kock, 2014). Part of a coopetition alliance's success is related to how firms manage this paradox and it's tensions. However, there is little knowledge on the coopetition process (Bengtsson & Kock, 2014), especially on the interplay between the paradox of cooperation and competition over time, (Park, Srivastava, & Gnyawali, 2014b), how a coopetition alliance persists in a maturing industry (Mathias et al., 2018), and how firms manage tensions in coopetition (Tidström, 2014). This paper will address these issues by analyzing the evolution of a coopetition alliance through how partners handle possible tensions in joint R&D. This is analyzed through the evolution of firms' structural and psychological dependence, as well as an analysis of the effects of asymmetries between firms. The following methods-section describes how a longitudinal case study is suitable to explore this.

3. Methodology

3.1. Design and sample

In this research, a longitudinal case-study design was used to examine how firms handle the possible tensions in R&D-coopetition. The paper employs a single-case study of a coopetition alliance to enhance the existing framework and to build the relevant theory (Yin, 2013). Using a single-case study is appropriate in this study because my case is both *critical* and *longitudinal*. It is *critical* because it has a strategic importance in relation to the general problem in study (Flyvbjerg, 2006), and its *longitudinal* nature makes me able to specify how certain conditions presented in the theoretical framework can change over time (Yin, 2013). Related to the research question, there were set some specific criteria for case-selection. First, as the aim of the research was to contribute to the coopetition literature, an important criteria was to select an alliance that included competing firms. The alliance chosen fits the criteria because it consists of firms within the same industry that compete (to different degrees) within the same markets. Further, as there is a lack of knowledge on the evolvement of coopetition relationships over time (Bengtsson & Kock, 2014; Park et al., 2014b) and the capabilities that are necessary to coopete successfully (Bouncken et al., 2015), a selection criteria was that the alliance should have survived over some time in terms of several subsequent joint R&D-projects. The selected case have conducted joint R&D since 1989 and the longevity of the alliance could be reckoned as a success. Most of the earlier studies on coopetition is done on dyadic relationships between two firms, whereas there is an increasing focus on coopetition as part of a firm's alliance portfolio (Bengtsson & Johansson, 2012; Park et al., 2014a). To provide new insights on multi-partner coopetition, a criterion was that the alliance had to consist of more than two competing firms. This alliance consists of firms from six industrial groups within one particular industry in Norway, and our data collection was conducted in firms from five of these industrial groups. All Norwegian firms within this industry are represented in the alliance. To the best of my knowledge, there has been very little research of alliances where several competing firms cooperate simultaneously. Thus, a study of such an alliance is likely to extend the literature on coopetition, which is the goal of performing case studies (Eisenhardt, 1989). The alliance in study cooperates with external R&D partners (mainly universities and public research organizations), who are included in most of their projects. The aim of the alliance is to pursue environmental improvements, conduct basic research and 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 participant firms can choose to exit the alliance with one year's notice.

3.2. Data collection

The level of analysis in this study is the firms engaged in the coopetition alliance. The data collection includes interviews of 28 informants from the alliance: 21 representing the firms, with an average of four interviews at each firm, and seven representing the R&D partners. The interviews were conducted in two time periods: the first 18 interviews were collected during autumn 2011, with 10 additional

interviews collected in January 2014. All interviewees were participants in one or several of the four research projects being conducted by the coopetition alliance. The data collection used a semi-structured interview guide, where the questions were divided into themes related to i.e., the partners' motivation, expectations and involvement in the alliances, the interaction between the alliance partners and the research and innovation activities. The interview guide was meant to serve as a checklist to ensure that all relevant topics are covered, but the aim of the interviews were to establish a conversational style where the interviewees talked as freely as possible around the topics (Patton, 2015). Two collaborating researchers conducted the entire data collection, both in 2011 and 2014. Having multiple investigators in case studies is advantageous because it increases the creative potential of the study and enhances the confidence in the findings (Eisenhardt, 1989). Although this article is written by one author, it draws on the benefits of receiving comments from a college that knows the data as good as the author. The interviews were recorded and transcribed by the data collectors as part of the data analysis process. I also included insights from observational data and project descriptions as part of the data collection. These data sources were collected prior to the interviews in order to give input to the interview protocol. The data gave us increased knowledge on the alliance and its projects and made us more able to generate relevant questions that could be pursued further in the interviews (Patton, 2015). As an example, our observations of the interaction between the different firm representatives during breaks, conference-dinner and after-party, gave us a clue into how important trust and the social relationships were within this alliance. Hence, this was given more attention than we first anticipated in the interviews.

I used a retrospective interviewing approach to gain deeper insight into the firms' underlying structures and to obtain accurate information on the cooperation history and the evolution of mutual dependence over time (Miller, Cardinal, & Glick, 1997). With this approach I tried to get the informant to reconstruct past experiences (Fraenkel, Wallen, & Hyun, 1993), as well as reflecting over present situations. Using a retrospective approach has it's pitfalls as the informants will view the past through the lens of the present (Silverman, 2013), however, people seldom forget about significant events (Denzin & Lincoln, 2011). The informants were thus encouraged to describe their involvement in the coopetition alliance from its beginning to the present with a minimum of interruptions by the interviewers. I also used this type of interviewing to gain an in-depth understanding of the events that had occurred in the alliance and to keep the data collection process from being influenced by personal factors or the relevant theory (Czarniawska, 1998). The follow-up interviews two years after the first round of interviews were aimed at both uncovering any changes within the alliance, as well as giving additional information of topics that were found to be of interest in the analysis of the interviews from the first round. Of the ten persons interviewed in the second round, six were interviewed in the first round, with four new informants. Interviews ranged from 40 to 127 min, with an average of 69 min (total 32 h and 16 min). To avoid bias, I did not use theoretical concepts explicitly in the interview setting. Table 1 shows the informants' roles and the number of interviews with each person.

3.3. Data analysis

The data analysis was based on cross-case comparisons, and the aim was to identify cross-case patterns within the alliance (Yin, 2013) related to the mutual dependence as well as asymmetries between firms and how they can contribute to less tension in R&D coopetition. I read and reread the interview transcripts as the data were collected (Yin, 2013) to become familiar with each case and develop the ability to identify general patterns across cases (Eisenhardt, 1989). In the coding of the data, I integrated theory-driven deductive codes (e.g. structural dependence through joint action, common challenges and financial dependence) with data-driven inductive codes (Langley, 1999), which I apply on two levels. First, there were codes emerging during the data collection (such as the notion of generosity that was not uncovered in the initial theoretical review), that were relevant to explain how firms cooperate. Further, I also included inductively sub-codes, which were assigned after the initial coding to add relevant detail to the code (e.g., time horizon). After the initial coding procedure, where both deductive and inductive codes were used, I grouped the data into a smaller number of categories, *pattern codes,* which can identify an emergent explanation (Miles, Huberman, & Saldaña, 2014). This pattern-matching strategy is found to be one of the most desirable techniques within case study analysis (Yin, 2013). Compared to the initial coding procedure, the pattern codes can be compared to theory in order to create more conceptual codes that can be used to build *constructs* and further *theories* (Miles et al., 2014). To illustrate how the data from my case could provide evidence on the development of cooperative relationships, I relied on tables that summarized findings related to the constructs explaining the development of the coopetition alliance over time (Miles et al., 2014). Such tables are helpful in theory-building research because they illustrate the fit between the data and the constructs, which is necessary for building strong theories (Eisenhardt, 1989). Table 2 shows different firms' structural dependence towards the alliance and Table 3 highlights firms' perceptions of the psychological dependence between alliance firms. Table 4 shows the level of symmetry and asymmetry between the firms in the study. To build reliable propositions, I went back and forth between the theory and data in order to create theoretical propositions that have a close fit with the data (Eisenhardt, 1989).

3.4. Quality of research

The quality of the research is discussed according to four tests; construct validity, internal validity, external validity and reliability (Yin, 2013). I used three tactics to ensure that the research actually reflects the aim of the research and represents the phenomena in study

Table 1
Sources of primary and secondary data (number of persons interviewed in parentheses).

	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Research partners
Informants round 1 (2011)	CEO1 (1)	CEO (1)	Production manager (1)	CEO (1)	Researcher (2)	Research partner 1 (2)
	CEO2 (1) Engineer (1)	Policy manager (1)	Researcher 1 (1) Researcher 2 (1)	Researcher (2)		Research partner 2 (1) Research partner 3 (1) Representative for industry federation (1)
Informants round 2 (2014)	CEO3 (1) Researcher (1)	CEO (1)	CEO1 (1) Researcher 1 (1)	Researcher (1)	CEO (1) Researcher (1)	Research partner 1 (1) Research partner 2 (1)
Total no. of interviews	5	3	5	4	4	7
Secondary sources	Firm presentation Press articles	Firm presentation Press articles	Firm presentation Press articles	Firm presentation Press articles	Firm presentation Press articles	R&D project presentation

Table 2
Firms' structural dependence.

Structural dependence		
Common challenges (Ritala & Hurmelinna-Laukkanen, 2009)	Financial dependence (Drees & Heugens, 2013)	Joint action (Gulati & Sytch, 2007)
We ask at an alliance meeting: "we have this problem, do any of you have the same problem?" (Researcher, Firm 4)	We get a lot done for a small amount of money (Researcher, Firm 4)	They cooperate on things all are interested in, such as environmental standards. (Research partner 1)
We have the same products so even when the data collection is at another plant, we get access to the results which are relevant for our own problems (Engineer, Firm 1).	The R&D we conduct is through the alliance (CEO, Firm 1)	They join together in communicating with politicians and environmental governments in order to set the right levels of emission for the industry (Research partner 1)
The projects emerge because we have a problem we must fix (Researcher, firm 5)	If you are four, five, six firms, then the costs are shared by all. Then we are able to do much more R&D for the same amount of money. (CEO, Firm 5)	The environmental governments wanted new data from the firms. This would have meant a lot of work for all firms, but we discussed this within the alliance and addressed the government and argued that they would get an even better result if they looked at the industry as a whole… so instead of all of us inventing the wheel by ourselves, we did it together. (Engineer, Firm 1)
We have an extra challenge compared to other countries. We need to be competitive related to production and costs, but on top of that we have more environmental demands (Researcher, Firm 5)		There has to be a will to acknowledge that there is a common effort in conducting the kind of research that we do (CEO, Firm 5)
The background for forming the alliance was to pool resources across several firms in order to work on development that would benefit all (CEO, Firm 5)		It is easy to pick up the phone or send an e-mail and agree that we will get organized and get to it!

(*construct validity*). First, I used multiple sources of evidence, where I triangulated secondary data (observational data, written documents (project reports) and information collected online (the alliance web page, firm's web pages and press articles)) with the interview data. The secondary data was used to confirm or disconfirm the data from the interviews. Second, the longitudinal nature of my data increases the construct validity as investing more time in the field increases my knowledge on the context and increases the likelihood of focusing on the most relevant data, ignoring the less relevant information (Johannessen, Tufte, & Christoffersen, 2010; Merriam, 2014). Third, I let a key informant read a draft of the paper to check if my interpretation resembled his experiences. When this informant felt that I had described the case in accordance with his experience, it reduced the risk of focusing on "wrong" constructs.

Further, to increase the *internal validity* of my research I tried to look for data that support alternative explanations (Patton, 2015), and when I did not find data that contradicted the explanations, the confidence in the original explanations increases. Second, by using the pattern matching analytic technique, I compared my findings with a predicted pattern uncovered in the literature review. When the empirical and predicted patterns appear to be similar, this increases the internal validity of the study (Yin, 2013).

Third, in qualitative research the *external validity* concerns whether the findings are transferable beyond the case in this study. To ensure that my findings can be transferable to other similar contexts, I collected longitudinal data until the findings felt saturated, meaning that we heard the same things over again and no more new information surfaced (Merriam, 2014). Further, I developed propositions that may be applicable in other contexts. Hence, the transferability of my findings are best tested through the propositions that are meant to propose how my findings might exist beyond the context of this particular study. Last, the *reliability* of the research is ensured by providing details about how data was collected, how it was analyzed and how I reached my conclusions.

4. Results and discussion

The purpose of this study is to develop an understanding of how firms manage the possible tensions related to R&D coopetition by analyzing the development of mutual dependence and asymmetries

Table 3
Perceptions of psychological dependence.

Psychological dependence	
Trust	Generosity
I experience a high degree of trust (Researcher, Firm 4)	During measurements [data collection in the projects] at the specific production plants, everyone knows that the firm where the data collection was conducted reaps greater benefits than the other firms do. It is like an unwritten law (Researcher, Firm 4)
We have visited each other [about competitors] to look at how we deal with environmental issues, but we do not enter each other's control room and look at other process equipment (Engineer, Firm 1).	You do not experience the competition that much related to knowledge; no one is afraid that some but not all will access the knowledge. (Research partner 1)
On processes, we do not share anything. That is quite important, because if it leaks [process knowledge] people get skeptical and then the other aspects of cooperation get destroyed (Engineer, Firm 1).	All the Norwegian firms desire that all the other firms shall remain in the country. They do not want them to be moved, even if they are owned by their competitors (Research partner 2)
Since the cooperation areas are clearly defined and based on the notion that everyone bring something to the table, I believe that we have created a trust to facilitate such a cooperative arena (Researcher, Firm 4).	In our world we experience that we reap benefits of drawing others' expertise where we lack knowledge. Then we have to be generous enough to share our expertise when they need it (Production manager, Firm 3)
What issues you can and cannot discuss is a big and important part of the research projects (Research partner 2)	The people on the board are very pragmatic people who acknowledge other's needs. In that way we have avoided conflicts around which areas to do research (CEO, Firm 2)
We understand each other, what we can say and bring into the cooperation (CEO, Firm 2)	Even if not all results are relevant for our firm, we still get a lot for our investments (CEO, Firm 5)
	Over time the resources used are balanced across the different process areas [research areas] (CEO, Firm 2)

Table 4
Case firm characteristics.

Firm	Size		Maturity	Knowledge		Level of coopetition
	Employees[a]	Production plants	Age	Internal R&D involved in the alliance	PhD-candidates[b]	Market symmetry
Firm 1	80–100	1	2003	Little	0	Same market as firm 5
Firm 2	100–150	1	1983	Little	0	Market overlap with firm 3 and 4
Firm 3	100–150	1	1989	Small R&D-department	1	Market overlap with firm 2 and 4
Firm 4	700–800	3	1969	R&D-department	12	Market overlap with firm 2 and 3
Firm 5	500–600	3	2001	R&D-department	3	Same market as firm 1

[a] Ranges are used to maintain anonymity
[b] Accumulated since the start in 1989.

between firms.

4.1. Mutual dependence

Mutual dependence between firms is important for the longevity of an alliance (Casciaro & Piskorski, 2005), and understanding the mutual dependence may therefore be a key to explain how firm handle tensions in coopetition and are able to continue to cooperate over time. The coopetition alliance in this study has survived for two decades and the findings from the case study give insight into the development of mutual dependence between firms. To illustrate the evolution over time, the mutual dependence is analyzed in relation to the structural and psychological dependence (Das & Kumar, 2009). First, the structural dependence is analyzed through firms' common challenges (Ritala & Hurmelinna-Laukkanen, 2009), financial dependence (Drees & Heugens, 2013) and their joint action (Gulati & Sytch, 2007) (see Table 2). The findings from the case firms show that the motivation behind the formation of the alliance was that the industry had some challenges they would rather address together than as separate firms. These challenges are mainly related to increasing industry knowledge through basic research as well as conducting joint R&D to address the increasing amount of environmental regulations the industry faces. These common challenges enhances the value-creation potential of the coopetition alliance because the firms share a common industry knowledge concerning both markets and technologies (Ritala & Hurmelinna-Laukkanen, 2009). The firms acknowledge that by co-operating they can achieve much more than if one firm should do it alone. This view is illustrated by quoting a representative from Firm 4 who says that *"when everyone pools their finances together and the Research Council contributes with additional resources, you get the possibility to gain much more compared to your input. If you should do this alone it would cost you much, much more"*. A representative from one of the smaller firms support this: *"if we should spend 100.000 NOK to do just about nothing [about research], it gets so much better, thorough and much more when we cooperate"* (Engineer, Firm 1). These quotes show that there is a financial dependence between the alliance firms, and that this financial dependence is motivated by the need to address common challenges related to R&D. These findings are in line with previous research on mutual dependence and point to the structural dependence between firms (Das & Kumar, 2009; Peng et al., 2012). Table 2 shows the structural dependence between firms:

When analyzing the evolution of the coopetition alliance over time, it is observed that the structural dependence was crucial for the formation of the alliance, and for the early evolution of the alliance. In the early phase of the alliance, there was little knowledge exchange between the firms and the suspicion was rather high. The alliance's R&D was conducted by the research partners and the firms paid their participation fees and got access to the results from the research partners. Using a third party, such as researchers, is common in alliances in order to get access to complementary resources (Gebrekidan & Awuah, 2002). However, in this case, the third party acted as a moderator between the competing firms in the early stages of the alliance. One of the research partners who has been involved in the alliance since the beginning describes the situation in the early phase of the alliance: *"Previously there has been a strong confidentiality focus where they were not interested in discussing with each other. Probably because they were afraid of leaking firm specific knowledge"*. This suspicion was most visible in the larger firms as they had most to lose compared to their weaker partners. They were more than willing to contribute financially to the alliance, but kept their mouths shut when it came to their own knowledge. At this stage the tension and suspicion between the firms was rather high and the knowledge sharing low, as the knowledge sharing went through the research partners. In such an early phase of an alliance between competing firms, the firms are uncertain about the other firms' intentions and they will therefore rely on impersonal and standardized mechanisms to communicate and share knowledge (Enberg, 2012). To secure that none of the firms had more influence on what topics the alliances' money were spent, they relied on the research partners to act as a neutral third party who coordinated the alliance. Hence, this coopetition alliance was formed because the firms faced common industry challenges that the single firms were unable to take on alone. This early phase was characterized by tension related to uncertainty and suspicion towards their partners, and the communication and knowledge sharing between the firms were low. Based on this I propose:

Proposition 1. In the early phases of a coopetition alliance firms handle tension by relying on a structural dependence with their partners.

However, as the alliance evolved the level of interaction and communication between the firms increased, illustrated by a quote from a researcher in Firm 4: "*You often get ideas when you learn about how others have solved things… it is not a problem for me to call [name on researcher in partner firm] and ask if I can come and see how they have solved things"*. The firms still rely heavily on the structural dependence in relation to the alliance's joint R&D, but there has also emerged a psychological dependence between the firms. According to Das and Kumar (2009) a psychological dependence is present between firms in alliances when they are reluctant to resolve the relationship because they experience a commitment towards their partners. In line with Das and Kumar (2009) this study use informants' perceptions of dependence to determine psychological dependence, rather than "objective" measures of this aspect of mutual dependence. The perceptions important for psychological dependence used in this study are trust (Krishnan et al., 2006) and generosity (Klapwijk & Van Lange, 2009) as illustrated in Table 3.

Where the knowledge sharing was next to nothing in the early phases of the alliance, as the alliance evolved there has been established a common understanding of what to share and what not to share. Although trust between partners is important for a well-running alliance (Cullen et al., 2000; J. Yang, Wang, Wong, & Lai, 2008), I argue that trust alone is not enough to explain the psychological dependence between firms. Trust in the alliance is characterized by the absence of opportunism or violation of their written agreements, as illustrated by a quote from one of the firm representatives: *"we trust that no one sneaks around* [when visiting partner firms] *and looks at things they are not*

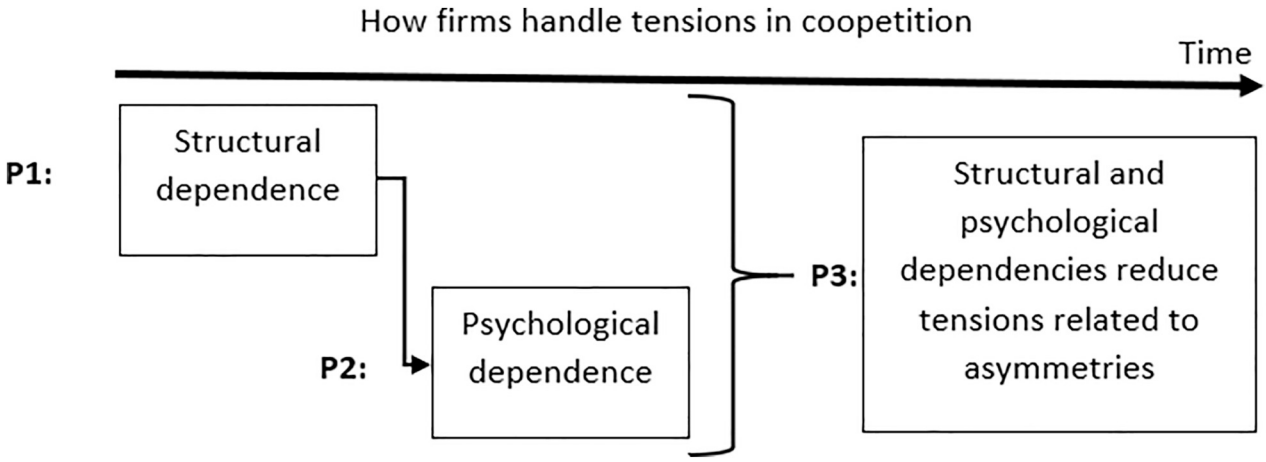

Fig. 1. Graphical illustration of how firms handle possible tensions related to power and dependence in a coopetition alliance over time.

supposed to look at, and vice versa". However, as coopetition is a paradoxical relationship where tension is an inherent aspect, building a psychological dependence between firms can be more challenging compared to relationships with less tension. I therefore add the notion of generosity to explain the level of psychological dependence between firms. Acts of generosity are when you act in a way that will benefit others, rather than pursuing self-interest (Klapwijk & Van Lange, 2009). The CEO from Firm 2 describes the generosity within the alliance with these words:

> *"You must be willing to give, and not just try to satisfy your own needs. It is often the case in research that even if the areas of research lies within your cooperation partner's areas, there will still emerge some basic knowledge that you can utilize yourself. So you ought to be a bit generous. That is important; very important to try to acknowledge other's needs as well."*

The firms experience that if they are generous towards their partner in one area, they will receive the same generosity the next time around. Overall, there has evolved a notion within the alliance that you have to wait your turn. If the current research project is not of interest for your firm, the generous nature of the alliance implies that the next one will. Hence, as the firms perceive their coopetition partners as both trustworthy and generous, the alliance avoids tensions and opportunistic behavior. Because there were less interaction and more tension in the early phases of the alliance, I propose that the psychological dependence between firms is built over time and reduce tension through trust and generosity.

Proposition 2. Building a psychological dependence over time, through trust and generosity, reduces tension in a coopetition alliance.

4.2. Asymmetries

According to Pfeffer and Salancik (2003) for asymmetry to occur, the net resource balance between firms must be asymmetrical, meaning that the most powerful firm should have advantages related to several resources compared to their weaker counterpart, and not just one aspect that can be counterbalanced by superior resources in the partner firm. As the alliance in study is a multi-partner alliance, the level of symmetry between the firms will vary as illustrated in Table 4.

Firms 4 and 5, stand out with superior resources related to size and knowledge, compared to the three other firms in the sample. Table 4 also indicate some areas of symmetry, as all firms can be considered to be well-established in a mature industry. Related to coopetition there are market symmetries between the firms. Firms 1 and 5 experience a large market overlap and are direct competitors in the market, whereas the three other firms have less market overlap and the level of competition is lower. Overall, Firms 4 and 5 stand out as more powerful compared to the Firms 1–3, related to both size and knowledge. According to the literature on resource dependence, the most powerful firms can take advantage of their weaker counterparts in an asymmetric relationship (Pfeffer & Salancik, 2003), although others argue that this can destroy rather than create value (Gulati & Sytch, 2007). Evidence from the case firms show that the most powerful firms exert some level of power over the smaller firms as the large firms are more active in setting the agenda for which areas the alliance should do research. However, since the alliance firms are within the same industry they experience similar challenges and the smaller firms are confident that the larger firms set an agenda that will also be relevant for them. Hence, since they experience both a structural and psychological dependence towards one another, the possible tensions related to asymmetries are reduced. This is illustrated by one of the research partners who observe that *"when the largest firms get involved, the smaller firms will also gain substantial benefits".* This is supported by the production manager from Firm 3, who states: *"we are too 'light-weighted' to generate enough research ideas… so having such a network is extremely positive for us".*

Proposition 3. When a structural and/or psychological dependence is present within a coopetition alliance, the possible tensions related to asymmetries between firms are reduced.

5. Conclusion and implications

This study is a novel attempt to address the call for more studies on the evolution of coopetition alliances over time (Bengtsson & Kock, 2014). Through a longitudinal case study of firms in a Norwegian coopetition alliance, this paper makes three distinct contributions to the coopetition literature, which are illustrated in Fig. 1.

First, I extend the literature on how firms handle the possible tensions arising from cooperating with competitors (Tidström, 2014) by showing that in the early phases of a coopetition alliance, firms handle tension by relying on a structural dependence with their partners (P1 in the Fig. 1). This structural dependence is motivated by common industry challenges that create resource dependencies, which motivate competing firms to pool some of their resources and address these challenges together. This phase is characterized by suspicion and arms-length interaction where the value creation is mainly through their external resource partners. Second, my findings contribute with evidence on what capabilities that are necessary to coopete successfully (Bouncken et al., 2015) with insight into how repeated cooperation adds a psychological dependence between the coopetition partners (P2 in Fig. 1). Building trust and generosity within the alliance reduces

tension and facilitates success through more interaction between the coopetition firms. Third, my findings provide insight how coopetition persists beyond a market category's emergent phase (Mathias et al., 2018), by showing that strong dependencies can reduce other tensions, such as tensions related to asymmetries (P3 in Fig. 1).

5.1. Limitations and direction for future research

This study has its limitations that can provide potential avenues for further research on coopetition alliances. One of the limitations of the current study is its focus on a single industry in Norway and the lack of comparison with other coopetition alliances in other countries. Future studies could transfer the propositions developed in this paper into other coopetition alliances to see if they are valid in a cross-industry and/or cross-national context or if they are specific for the industry in study. Another limitation is related to the qualitative nature of this research. As the study addresses gaps in the coopetition literature regarding the evolution of coopetition alliances and how firms handle tension in coopetition, it is argued that in-depth, longitudinal, qualitative studies are best able to understand these complex processes. Although the findings might be transferable to other coopetition alliances, one cannot argue that they are universally valid. However, future research could test the propositions statistically to explore whether the results are transferable to other coopetition alliances. This study is one of few studies on multi-partner coopetition and lack comparison with other empirical examples. Future studies should therefore consider multi-partner coopetition alliances, especially in terms of how they develop over time and handle the possible tensions between several partners.

5.2. Implications

The findings from this study indicate that firms of different sizes and level of resources can join together in joint R&D without much tension. These findings have implications for the coopetition literature, policy makers, firms and managers. First, to the coopetition literature, the results of this study inquire into the question about how coopetition persists in a mature industry over time (Mathias et al., 2018; Park et al., 2014b), with the added insight that the development of dependencies reduces tension in the paradoxical cooperation between competitors. Second, the findings also have some implications for policy. Coopetition alliances can be difficult to establish due to antitrust laws, but as this paper shows that such alliances can contribute to value creation in the form of new industry knowledge and innovation, policy makers interested in industrial development should facilitate and encourage such alliances. Further, as the coopetition paradox is considered to be filled with tension, firms need to build trustful relationships over time. Hence, policy makers can support long-term R&D projects where cooperating firms are given time to build trustful relationships.

Further, the results from the analysis also have some important implications for firms and managers. As firms are increasingly involved in alliances with external partners in order to gain new knowledge, they should also consider their competitors as potential partners because they share a large common knowledge base. However, to reduce the possible tension in this relationship, firms should have a long-term commitment towards the alliance as the psychological dependence based on trust and generosity between firms is built over time. Being patient, generous and trustworthy with your collaborating competitor is important as they will act similar towards you and together you can achieve an increased value creation. However, as building trust and generosity takes time, firms should not be naïve and can rely on contracts regulating the cooperation, especially in new partnerships. Firms should also acknowledge that when collaborating with competitors, the ideal partner might be a firm with somewhat different characteristics from yourself, as this might reduce possible tensions in cooperation.

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