Beyond the dyad: Role of Non-Competitive Partners in Coopetitive R&D Projects

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Abstract: R&D projects between multiple partners have been examined by various disciplines at the macro-, micro- and meso-level. Even though scholars have acknowledged the possibility that both competitive and non-competitive partners participate in such projects, we still lack a holistic perspective on their complex interactions. This paper builds on open innovation and coopetition literature to explore the influence of research partners and clusters on the relationships between competing companies in different project phases of R&D projects. The study is based on insights from five coopetitive R&D projects in mature industries. Findings revealed the need for simultaneous involvement of research partners and clusters when establishing the collaboration in the pre-project phase, while research partners have dominant roles in balancing coopetition in both the pre- project and project implementation phases. Propositions are offered to inform future studies and managerial implications are discussed.

Keywords: Coopetition; R&D Projects; University–Industry Collaboration, Role of Research Partners; Role of Clusters; Mature Industries

1 Introduction

R&D collaboration with multiple partners is of interest for several research disciplines, including economics, economic geography, organisation studies, strategy and management (Corsaro, Cantù and Tunisini, 2012). Scholars have examined collaborative

actors, their characteristics and interactions, the management of their relationships and possible outcomes at the macro-, meso- or micro-level (Corsaro, Cantù and Tunisini, 2012; Ritala *et al.*, 2017). While previous studies have revealed appreciable insights regarding multiple-partners interactions, competitive and non-competitive partnerships have been often analysed separately.

Collaboration between competing companies for innovation is receiving increasing research interest in open innovation (OI; Mention, 2011) and coopetition research streams (Tidström, Ritala and Lainema, 2018). The OI stream has thoroughly examined R&D collaborative practices from the perspective of participating firms, alliances or innovation networks, with scholars seeking further insights on OI projects (Bogers et al., 2017). Meanwhile, the coopetition literature has been mainly focused on the coopetitive dyad and scholars have, to a limited degree, evaluated the effects that other partners may have on the focal coopetitive relationship. Tidström (2014) acknowledged this gap and called for more research about tensions related to actors outside of main coopetitive relationship. To date, this aspect has not received sufficient research attention. Czakon and Czernek (2016), for instance, revealed, in one of limited number of studies, the importance of third-party legitimisation and reputation when competing companies in the tourist sector decide to enter into network coopetition.

To explore how non-competitive partners might influence competitor-to-competitor relationships, this qualitative study focuses on five R&D projects in mature industries that involve competing companies, research partners (RPs; universities and research centres), business clusters and at least one other partner: customer or supplier. The presence of RPs and business clusters as non-competitive partners, in all sampled projects, enables the merging of coopetitive and OI perspectives. New insights beneficial to both streams will be discovered by answering the following research question: How do RPs and clusters influence relationships between competing companies in the pre-project and the project implementation phases of coopetitive R&D projects in mature industries? Most of the attention in OI and coopetition research streams so far has been drawn to the context of high-tech emergent industries (Pellegrin-Boucher, Le Roy and Gurău', 2018). Examinations of emergent industries, as early adopters of OI practices, have enriched our knowledge about various types of those practices. However, scholars have acknowledged differences in innovation processes and practices as well as collaborations between companies in emergent compared to those in mature phases of the industry lifecycle (McGahan and Silverman, 2001; Bodas Freitas, Argou Marques and de Paula Silva, 2013). Following on that, the context of mature industries in this study should provide new and valuable insights.

The paper is structured in the following manner: Literature is reviewed in Section 2, while Section 3 explains the research method. The empirical results are presented in Section 4. Section 5 discusses the results and concludes.

2 Literature review

R&D projects

R&D collaboration with external partners, as a form of OI practices, aims for knowledge transfer, integration and new knowledge creation (Chesbrough and Bogers, 2014). While technology sourcing meets current needs, R&D collaboration addresses future needs (Cassiman, Di Guardo and Valentini, 2010). This type of collaboration can be established in the form of networks, alliances or projects. While previous OI research explored the first two forms extensively, less is known about collaborative projects (Bogers et al.,

2017). As defined by Du, Leten and Vanhaverbeke (2014), 'R&D projects can be considered as temporary entities that conduct a series of complex and interrelated activities with predefined goals' (p. 829). Exploring short-term, goal-oriented collaboration between loosely connected partners in projects (Culpan, 2014) can produce new and valuable insights about R&D collaborative practices.

Research–industry R&D collaboration

Scholars associate different partners with different level of risk and different type of co-created knowledge in R&D projects (Hamadi, Leker and Meerholz, 2018). RPs are recognised as valuable sources of knowledge and resources that, under reduced costs and risks, may enhance firms' technological competitiveness, and innovation performance (Belderbos, Gilsing and Suzuki, 2016). Collaboration with RPs results in broader scientific knowledge (Tether, 2002), and may even support moving towards open innovation practices (Guan and Zhao, 2013).

Several researchers have argued that public research can hold different importance for different industries. Cohen, Nelson, and Walsh (2002) claimed crucial importance of university research for a mature manufacturing sector in two aspects: as a source of project ideas and as a source of knowledge for project completion. Established contact networks in mature industries encourage frequent collaboration with university partners, allowing for the integration of new and old technologies as well as problem solving, while emergent industries typically collaborate with universities for new knowledge development (Bodas Freitas, Marques, and de Paula Silva, 2013). Similarly, Perkmann and Walsh (2007) indicated that the orientation of some industrial sectors towards incremental versus radical improvements had influenced the level, types and mechanisms of research–industry collaboration deployed. More breakthrough-oriented industries use both research partnerships and services to generate cutting-edge output, while industries aiming for incremental improvement, rely more on contract research and paid consulting for a specific industrial client.

Collaboration between the public and private sectors implies alignments of different norms, policies and strategies (Ankrah *et al.*, 2013; Al-Tabbaa and Ankrah, 2016). On the one hand, scientists aim for knowledge creation that can be shared and acknowledged among the scientific community; on the other hand, companies aim for secrecy and appropriation of created knowledge for private gain (Bruneel, D'Este and Salter, 2010; Alexander *et al*., 2020). Following that, relational drivers (such as trust, commitment, effective communication and flexible project management) are highly ranked as factors that support industry and research partners satisfaction in R&D collaborations (Barnes, Pashby and Gibbons, 2002). Regular, timely and accurate communication empowers the development of trust between dissimilar and institutionally different research and industry partners (Bstieler, Hemmert and Barczak, 2017; Rybnicek and Königsgruber, 2019). Communication and coordination are also deemed of particular importance for knowledge sharing and innovation outcomes (Olander *et al.*, 2010) of multi-partner R&D projects (Hamadi, Leker and Meerholz, 2018) which may involve several industry partners, universities and public research organisations (Bogers, 2011).

The increasing complexity of research–industry collaboration and its arising management challenges have brought into the focus the dynamics and changeable nature of collaboration. However, no consensus has been reached regarding success factors for collaboration lifecycle phases. When it comes to relational factors, Plewa *et al*. (2013) found that communication affects collaborative success during all phases (Boehm and Hogan, 2013) and that trust plays a particularly important role in the initiation phase while understanding between partners becomes more important in later phases. Ruangpermpool, Igel, and Siengthai (2020) argued that informal communication

combined with formal governance mechanisms may support trust development during the initiation phase of R&D alliances. This leads to commercialisation phases characterised by higher levels of trust with lower need for coordination and control. That being said, according to Estrada *et al*. (2016), inter-partner dissimilarities do not necessarily hamper collaboration in the start-up phase of research–industry alliances, while lack of goals and expectations alignment may putt desirable outcomes at risk during the post-formation stage. Al-Tabbaa and Ankrah (2016) followed the same vein, emphasising the importance of ties and connections between partners for mitigating the obstacles during the post-formation stage. Ongoing debates and various opinions therefore indicate the need for further research of collaboration lifecycle phases.

R&D collaboration has also been examined from a Triple Helix model perspective (Leydesdorff and Etzkowitz, 1998). Such articles focus on interactions between research institutions, industry and government aiming to ensure certain innovation output and improve regional and national innovation systems (Jiao *et al.*, 2016) by way of selected policies and instruments (Lee and Kim, 2016). The Triple Helix model highlights the importance of universities and other R&D institutions for enhancing innovation (Gaofeng, 2019). This research stream examines policies and measures that support research–industry collaboration and research institutions engagements in innovation development (Faria, Mixon and Upadhyaya, 2019).

While acknowledging highly relevant research–industry collaboration for both policy makers and company innovation strategies (Estrada *et al.*, 2016) scholars have also agreed that there is no single best way to manage increasingly complex research–industry interactions (Mascarenhas, Ferreira and Marques, 2018). To unpack those relationships, scholars have sought insights about day-to-day management of collaborative relations in varying contexts and different phases of collaborative projects (Plewa *et al.*, 2013; Rybnicek and Königsgruber, 2019; Alexander *et al.*, 2020).

R&D collaboration in clusters

Universities are recognised as important source of knowledge in clusters (Østergaard, 2009; Nishimura and Okamuro, 2011). Cluster literature indicates that knowledge and information flow better in R&D collaboration within the cluster than in such collaboration across cluster borders (Østergaard, 2009). Companies in clusters have more information about their potential partners and may be approached more for collaboration, leading to higher numbers of collaborative R&D projects (Broekel, Fornahl and Morrison, 2015). However, some scholars (e.g., Nishimura and Okamuro,2011) have indicated that while collaboration with RPs within a region leads to higher R&D productivity, collaboration with industrial partners within a region lowers productivity. Thus, to overcome cognitive lock-ins and over-embeddedness in a cluster, companies may need to complement cluster collaboration with cross-regional collaboration (Molina-Morales and Expósito-Langa, 2012).

Scholars also identified that companies within a cluster may be reluctant to share firm-specific knowledge, and yet be more willing to share general insights (Huber 2012). When geographical proximity between collaborative partners is low, knowledge diffusion may be influenced by various factors, for instance institutional, cognitive or social distance between partners (Molina-Morales and Expósito-Langa, 2012), trust as well as interaction between various partners and stakeholders (Huber, 2012). Therefore, knowledge sharing and R&D collaboration in clusters requires particular guidance and facilitation (Connell and Voola, 2013).

Coopetition in collaborative relationships

R&D collaboration may involve both competitive and non-competitive partners (Chen, Dai and Li, 2019), allowing for the exploration of coopetition, which was defined by Bengtsson and Kock (2000) as simultaneous cooperation and competition between competitors. Coopetition is recognised as one of the main destabilisation factors affecting trust, harmony and coordination in R&D innovation networks (Ritala and Hurmelinna-Laukkanen, 2009; Rampersad, Quester and Troshani, 2010). Scholars agree that involving competitors in R&D collaborations brings a higher risk of knowledge leaks and opportunistic behaviour (Perks and Jeffery, 2006), can cause information tensions and requires development of specific knowledge sharing and integration mechanisms (Ritala *et al.*, 2017; Yang *et al.*, 2020). Enberg (2012) suggested that, in such settings, problem solving needs to remain an individual activity for each partner, while decision making has to remain a collective action.

When exploring R&D collaboration, scholars were mainly focused on management and orchestration, partner positioning and power, or tensions related to knowledge sharing or integration (Ritala et al., 2017). Few studies went further to explore interactions between competitive and non-competitive partners. Czakon and Czernek (2016) identified that reputation and legitimisation of the third party are crucially important for competing companies in touristic sector to determine if they would enter network coopetition. Chen, Dai and Li (2019), for instance, notified that involvement of market competitors together with other partners (e.g., suppliers, universities and customers) forms curvilinear relationships with interactions in consortia and U-shaped relationships with joint R&D results. To the best of author's knowledge, beyond that, complex interactions between competitive and non-competitive partners in R&D collaboration haven't received much attention.

Regarding collaboration in clusters, scholars have claimed that close geographical concentrations of competing companies within a cluster reduces the possibility of technology and information monopolisation and may lead to stronger competition (Chung and Cheng, 2019). As clusters mature, companies within them become more conscious of opportunistic risks. To protect competitive advantage, they tend to collaborate mainly in the areas which don't affect their competitive edge, such as for instance cost reduction (Felzensztein, Gimmon and Deans, 2018). Balancing between competition and collaboration has found to be particularly important in tourism clusters, due to high interdependence and complementarity of companies in this sector (Chim-Miki and Batista-Canino, 2017). Besides within the cluster, coopetition may also appear between the clusters located in same area and operating within similar fields (Cusin and Loubaresse, 2018).

Building on the existing literature, this paper aims for specific, micro-level insights regarding the influence that RPs and clusters, as non-competitive partners, have on competitor-to-competitor relationships. To capture indicated peculiarities of different phases in research–industry collaboration (Rybnicek and Königsgruber, 2019; Alexander *et al.*, 2020), this paper focuses on two project phases: the initiation and planning phase or "pre-project phase" (Hill *et al.*, 1988); and the project implementation phase that starts after a kick-off meeting, as suggested in PMBOK Guide (2013).

3 Research Design

Adopted case research methodology (Yin, 2003; Zomerdijk and Voss, 2011) is appropriate for the explorative nature of this research and theory building (Eisenhardt and Graebner, 2007). The unit of analysis is a project, and the sample consists of strategically selected coopetitive R&D projects involving competing companies and RPs and clusters, as non-competitive partners. In line with the chosen unit of analysis, this paper focuses on micro-level, project participants. To identify projects that enable the learning process, the starting point in sampling was a dialogue with two managers in a business cluster of firms in the mature oil and maritime industries of Norway. This cluster has been awarded and labelled as highly innovation- and collaboration-oriented. Based on the dialogue and publicly available information, five coopetitive R&D projects were identified and selected as cases for this study. Participants in all sampled projects were RPs, business clusters, two or more competitors, and at least one customer or supplier.

All projects were innovation-oriented and involved competing companies producing equipement for the oil, gas and maritime industries. Project Alpha was established with the aim of developing new technology and the aim of Project Beta was developing and implementing a new test laboratory. Project Gamma aimed to develop a new analysis model to comply with new environmental regulations while business model innovation (Aas *et al.*, 2018) was the aim of Projects Delta and Epsilon. Of the five projects in the sample, four reached the implementation phase, while one was finalised at the time of the investigation.

Data were collected through semi-structured, in-depth interviews with key informants from each project. An interview guide was developed to ensure common understanding of the phenomenon and purpose of the questions (see Appendix A). There were 45 in-depth semi-structured interviews conducted, including nine follow-up interviews, with decision-makers from high- and middle-level management of competing companies, project managers, cluster managers and employees from RPs involved in the projects. Most of the interviews were conducted in person, and eight of the follow-ups were conducted over Skype. Interviews varied in length between 60 and 90 minutes. All interviews were recorded and transcribed. Characteristics of the selected projects and information about the informants are presented in Table 1.

Table 1. The sample

Project	*Participants*	*Description and Status*	*Funding*	*Informants*	
Alpha	Initiated by the university and the business cluster. Participants: Four universities, two research institutes, one business cluster, four competing	The aim of the project was technology development. The interviews were conducted during the project implementation phase.	Funded partially by the Research Council of Norway and companies.	CM RCe Ue HLM MLM	16

	companies and a few non-competing companies.				
Beta	Initiated by the university and the business cluster. Participants: One university, one business cluster, four competing companies, and a few other non-competing companies.	The aim of the project was to develop and implement a new test laboratory. The interviews were conducted after the project's finalisation.	The university funded the establishment, but the laboratory needs to work according to market principles.	CM Ue HLM MLM	6
Gama	Initiated by the business cluster and companies. Participants: One university, one business cluster, four competing companies and several non-competing companies.	The aim of the project was to develop analysis model in line with new environmental regulations. The interviews were conducted during the project implementation phase.	Funded partially by Innovation Norway and companies.	CM Ue MLM HLM	4
Delta	Initiated by the university and the business cluster. Participants: One university, one business cluster, one research centre, two competing	The aim of the project was to develop new service-oriented business models. Interviews were conducted during the pre-project and project implementation phases.	Funded partially by the Research Council of Norway and companies.	CM RCe HLM	5

	companies and a few non-competing companies.				
Epsilon	Initiated by the university and company. Participants: Two universities, one research centre, two business clusters, two competing companies and a few non-competing companies.	The aim of the project was to develop new service-oriented business models. The interviews were conducted during the pre-project and project implementation phases.	Funded partially by the Research Council of Norway and companies.	CM Ue RCe HLM MLM	5

Legend
CM: Cluster manager
RCe: Research Centre employee
Ue: University employee
HLM: High-level manager (CEO, vice president, R&D director)
MLM: Mid-level manager

Data analysis was performed in an inductive manner and followed three steps: coding, within-case analysis and cross-case analysis. Nvivo 12 software was used as a tool in a two-step coding process (Miles, Huberman and Saldaña, 2014) where all information about the role and influence of RPs and clusters was descriptively summarised in respect to the two specific project phases. Descriptive codes were then grouped into explanatory categories thorough an iterative process. Presentations from the companies and projects, as well as annual reports and publicly available information, were used to ensure better understanding of the interview data.

4 Findings

Data revealed that the roles of RPs and clusters differed during the pre-project and the project implementation phases. Their roles and influence on coopetitive relationship are presented in accordance with the project phases.

Roles and influences of RPs and clusters in the pre-project phase

Table 2 illustrates the roles and influences of RPs and clusters on coopetitive relationship in the pre-project phase.

Table 2 Roles of RPs and clusters in the pre-project phase

Role/Partner	*RPs*	*Clusters*
Establishing cooperation		Platform mechanism to accelerate innovation
	Idea generation	
	Research capabilities as a selling point offered to the companies	
	Writing the application	Lobbying for the project at Government level
	Leading the project—consortium agreement, organising the structure, defining the scope of work and establishing the rules	Leading the project—administrative lead, organising the structure in some cases
Balancing coopetition	A neutral partner between competing companies—Establishing data sharing vs. data protection mechanisms	No role

As presented, two roles became apparent in the pre-project phase:

1. Establishing cooperation; and
2. Balancing coopetition.

Data indicated RPs involvement in both roles, while clusters focused only on establishing cooperation. The following subsections elaborate on the effects both types of partners had on relationships between competing companies.

Establishing cooperation

Project ideas were generated in synergies between both partners in Projects Beta, Delta and Epsilon. In Project Alpha, the RPs produced the idea and the cluster created it in Project Gamma. According to the data, most contacts with competing companies were established throughout the cluster while cooperation was established. RPs, alone, had a lower number of direct relations with companies in all sampled projects, as indicated by one of the RP informants (University in Project Gamma):

> "Starting the cooperation with businesses, that's not what we are good at. He [manager from the cluster] has the competence on how to talk with the industry on managerial level ... and I think we should realise that we need a lubricant for getting the CEOs and CTOs to want to talk to us."

Another informant, a cluster manager and Project manager from Project Delta, illustrated the role of clusters in connecting RPs and companies: ‘Linking business practice with academic theoretic knowledge and resources, kind of building a bridge between the researchers and key personnel in the companies.’ Some of the RP informants, from university involved in Projects Alpha and Beta, indicated that direct communication with companies, required trust built over a long period prior to project initiatives. This was illustrated by the project manager in Project Alpha:

> “You have to build up the trust. When, and how do we approach them? That was long before the projects. We just wanted to build up relationships with the CEOs; you need to have them on your side. And, of course, you have to have the next layer, the heads of the technical development…We started to discuss with them what could this type of Professor do that they need. So we're not asking for money, we're just asking: ‘Tell us what you need?’…That is what they like. So, they told us…you don't go to the industry always to ask for money, but you ask them for strategic advice.”

The main selling point when establishing cooperation with companies was the research capabilities available in concrete projects. This was explained by a cluster manager, who acted as project manager for Project Delta:

> “I knew that with this research team, we can have a true impact for the companies. The task for me then was to convince the managers to be a part of the project, where they will get access to the best capabilities. That was a selling point.”

Project Alpha’s project manager (a university informant) supported this: ‘We need to impress them with the type of content that we have. And to convince them that the type of knowledge that we can bring to the table can help them solve their problem.’ A middle-level manager from a company involved in Project Beta also provided confirmation: ‘When you have a drive from the university that wants to be outstanding in these technologies, it fits very well…that is a great drive...and it has been a very, very good project for cooperation and development.’

Due to the importance of research capabilities when establishing cooperation, a lack of direct communication between competing companies and RPs caused lower success rates maintaining company interest in project participation. For instance, limited understanding and a lack of direct communication may be factors that contributed to one competing company leaving Project Delta later on. Its project manager explained that all communication was done by the cluster and that the lack of direct communication with RPs in the pre-project phase was certainly a drawback:

> “But that is the mistake. I think if I should do that again, besides cluster representative on board, I'm going to bring the university with me…I think it's very important to bring the university early on board for companies to understand, see and talk to the person or the team.”

Some tasks were clearly distinguished in all projects. RPs were in charge of writing the application while the clusters lobbied for higher governmental funding. Project leadership was dependent on the funding pre-requirements, some of the projects were led by RPs (University, for instance, in Projects Alpha, Beta and Epsilon) and some other by cluster (Projects Gamma and Delta). Nuances in the leadership role are presented in Table 2. Project Delta’s project manager revealed a way to influence the relationship between competing companies in the early pre-project phase:

> "We should have one point where we are bringing all the managers from all companies together to discuss objectives, to understand the risks, to understand each other and to build a relationship. Just to have a place where we all can meet and get to know before they have to say 'yes' to cooperation."

Balancing coopetition

As indicated in the Table 2, RPs had a dominant role in balancing coopetition during the pre-project phase. The main coopetitive issue in that phase was establishing appropriate data protection and data sharing mechanisms, which was illustrated by a high-level manager from a competing company involved in Project Alpha: 'This is not so simple, let's sit around the campfire and share our good ideas, and the rest will just pop up … there was a bit of tension between the industrial partners.' To resolve this issue, RPs were recognised as neutral partners that can ensure better cooperation between competing companies while simultaneously protecting their information. A high-level manager from a competing company involved in Project Delta confirmed this:

> "The researchers that come here and interview us will make sure that we can be open with them but will only share what is relevant for the project. They will not share that our company is here, and the competing company is there, or what we are doing internally."

Another high-level competing company manager involved in Project Alpha offered further explanation:

> "In the early beginning, RP was a neutral part, safety factor…probably like a best friend, that you can trust a hundred percent and you can tell that friend secrets that you don't want to reveal to anybody else. You could have a fruitful discussion with that person, and then, in the end, you could decide how much information would be revealed to the outside world…The cluster connected companies with university but cluster would not insure you secrecy if you are willing to share something. It is just like networking. They provided the network, but they were not able to provide the necessary trust and the necessary feeling of being able to protect the secrets."

Roles and influences of RPs and clusters in the project implementation phase

Table 3 illustrates the roles and influences of RPs and clusters on coopetitive relationship in the project implementation phase.

Table 3 Roles of research partners and clusters in the project implementation phase

Role/Partner	*RPs*	*Clusters*
Enabling cooperation	Participation in project governance (e.g., position in steering board)	Participation in project governance (e.g., steering board)
	Leading the project—full managerial role (decisions	Leading the project—administrative managerial role

	about organisational structure, contribution, rules, tensions)	
Knowledge creation and dissemination	Enabling technology	Communication with companies to identify potential spin-offs
	Creating scientific knowledge	Results dissemination
	Creating problem-solving, practical knowledge	
Balancing coopetition	Neutral partner in between competing companies—ensuring information sharing necessary for project continuity	No role
	Actor causing tensions regarding an increased need for information	
	Establishing new modalities for collaboration between competing companies	

Table 3 indicates three apparent roles in the project implementation phase:

1. Enabling cooperation;
2. Knowledge creation and dissemination; and
3. Balancing coopetition.

Data indicated the involvement of RPs in all roles, while clusters were focused on enabling cooperation with very limited roles in knowledge dissemination. The following subsections elaborate on the effect that both types of partners had on relationships between competing companies.

Enabling cooperation

Clusters and RPs were both involved in project governance, holding positions in several managerial bodies. An RP (university) informant in Project Alpha explained the role of a steering board in terms of steering the project, resources and budget:

> "I'm sitting on the board, part of the board for negotiation. And we steer how we would like the project to run, make the decisions and so on. We have budgets, we have resources we're going to use, we have to look at the feedback …checking if the project is following the plan, on the one side but also making new decisions on the changes."

Regarding leadership roles, RPs were assigned to tasks related to organisational structures, roles, contributions and resolving tensions, even in cases where a cluster was leading the project. That being said, even when a cluster led a project, it was placed in charge mainly for project administration. This was indicated by an RP (research centre) informant with Project Delta:

> "He's [cluster manager leading the project] the one organising and being sort of the administrator of the project, and that is so helpful because it can take so much time for organising; you know, just for you to get an interview with me now it takes time to organise everything. We have him doing it all, which

> means that we can really focus on what we need to do here with that company instead of using our time with administration."

Knowledge creation and dissemination

This role emerged in the project implementation phase and revealed a clear distinction between RPs (responsible for knowledge creation) and clusters (responsible for knowledge dissemination). Our informants indicated that RPs were responsible for enabling technologies, creating scientific knowledge and creating problem-solving, practical knowledge. To illustrate, a high-level manager from a company in Project Beta explained:

> "The university would bring all the scientific knowledge into it. The users would be the companies, they would have the problem they need to verify and test. The university will provide the scientific people to do the verification, getting the result documented."

Another high-level manager from a company involved in Project Alpha confirmed this: 'They were not developing products. They were developing technology or knowledge.' A high-level manager from the company involved in Project Epsilon offered additional clarification: 'Their role is to describe what is happening within digitisation and what kind of business models have been used and what's happening in other businesses, and can we learn something from that.'

The role of cluster in Project Epsilon was solely dissemination of the results, as indicated by the cluster manager: 'We have a very small role now just to be informed about the main findings in the project and disseminate them…that could be an open seminar, or just a web-article or news article in our newsletter.'

A more important role of clusters was evident in Project Alpha. The cluster was leading a work package aiming for identification of potential spin-offs throughout communication with competing companies. As elaborated by the work package leader and cluster manager:

> "We are aiming at having at least one one-to-one meeting with each company every year. We spend one to two hours discussing the progress, quality, what they don't like what they want to see more in the future, how we can help to bring the results into the companies and make new spin-off projects."

Due to the specific role of RPs in knowledge creation in the project implementation phase, competing companies established good direct communication with RPs. In this project phase, they communicate without the mediation of the cluster, as was the case in the pre-project phase. As summarised by a middle-level manager from a company involved in Project Alpha, 'If we want to know more about the project and get more involved since that is interesting for business or knowledge development...we will approach the scientific personnel directly.'

Balancing coopetition

The same as in the pre-project phase, data indicated the dominant role of RPs in balancing coopetition in the project implementation phase. Two roles of RPs in relation to information sharing became apparent. The majority of the companies in the sample projects recognised RPs as neutral partners with a significant role in enabling data sharing that is necessary for the continuity of the project. A high-level manager from a competing company in Project Alpha explained as follows:

> "If the discussion had only been between the companies, the companies would have been very afraid that competitor would steal their trade secrets and they wouldn't trust each other in such a sense that they could reveal important information. But the role of the university made it possible to have all the vital information entered into the project and still the companies would be safe and nobody would know their trade secrets. They were like safety wale."

However, when RPs would increase the requirements for information sharing, some companies may perceive them as a source of tensions. One middle-level manager from another competing company in Project Alpha clarified this perception as follows:

> "It could be a challenge for the university that they know that there are some activities in the companies that they will not see because of our competitors …they can't get all the information they want from the companies because we want to be even more generic…in some cases, unfortunately, we have to be more restrictive on that, and we have got some feedback from the university that that is a problem."

In Project Epsilon, RPs had to establish new modalities and ways to work with competing companies while balancing coopetition, as emphasized by an RP (research centre) informant :

> "Now we can't have workshops with both of them together… The only thing we have to do is to ensure that they are not in the same room in the same workshops because they then don't want to talk. So, we will have one workshop with one company, and then one workshop with the other…that is what we need to do to handle these challenges since it is crossing the line; it's close to their competitive edge."

5 Discussion and implications

This study examined the influence of RPs and clusters on relationships between competing companies in two distinct project phases (pre-project and project implementation phases) of five coopetitive R&D projects. The competing companies in the selected projects were producers of equipment for oil and gas and maritime industries. All the projects were embedded in the same industrial setting—mature industries in Norway—and had mixed public-private sources of funding.

Similarly to findings from phase-oriented research–industry literature (e.g., Estrada *et al.,* 2016), the findings of this study indicate that the influence of RPs and clusters vary between the pre-project and project implementation phases. The findings revealed that business clusters are very important for negotiations in the pre-project phase, as they have many direct relations with competing companies. This is in line with the expected role of clusters in facilitating collaboration between the industry and RPs towards improvement of regional innovation performance (Nishimura and Okamuro, 2011). RPs, on the other hand, have a lower number of direct relationships with companies and rely more on indirect relationships through clusters. As research capacity and potential are major selling points for R&D projects, a lack of direct communication between RPs and companies or a lack of simultaneous communication between clusters, RPs and competitors resulted in lower success rates in keeping the companies interested in participating in projects. Therefore, the findings confirmed that efficient communication directly influences the establishment of projects (Plewa *et al.*, 2013) and, consequently,

the relational success of research–industry collaboration (Boehm and Hogan, 2013), as indicated in the first proposition of this study:

> P1: Simultaneous communication between competing companies, RPs and clusters during the pre-project phase increases the likelihood of the establishment of coopetitive R&D projects in mature industries.

The findings also indicated that RPs are crucial for building trust and convincing companies in project's relevance (from the knowledge creation side) and information safety (from coopetitive side). Thus, RPs have a dominant role in balancing coopetition in the pre-project phase. These findings are in line with, for instance, those of Czakon and Czernek (2016), who indicated the importance of the reputation and legitimacy of third-party when competing companies are deciding to enter coopetitive networks. As a distinction from Plewa *et al.* (2013), who stress the importance of trust in the initiation phase and understanding in the later engagement phase of research–industry collaboration, our findings revealed that both trust, based on the credibility and expertise of RPs, and understanding are of crucial importance for the establishment of collaborations. These differences in findings could be attributed to the coopetitive nature of the projects. Therefore, even if companies in mature industries may be more willing to collaborate with RPs compared to those in emergent industries (Freitas, Marques and Silva, 2013), effective communication, understanding and trust are necessary for the decision to engage in R&D collaboration with competitive partners. This leads to the second proposition:

> P2: Information support provided to competing companies by RPs and trust in RPs during the pre-project phase increase the likelihood of the establishment of coopetitive R&D projects in mature industries.

In the project implementation phase, cluster has the same role in enabling collaboration, a limited role in knowledge dissemination and no role in balancing coopetition. Therefore, RPs maintain a dominant role in balancing coopetition in this phase of coopetitive R&D projects in mature industries. At this point, they are 'in the middle' between competing companies and have plenty of contacts with all of them to enable knowledge creation and knowledge flows. The role of RPs in balancing coopetition is realised throughout the establishment of new modes of collaboration, such as separate relations with competing companies, when RPs act as a mechanism for data sharing and protection. In this way, information tensions are mitigated, and the continuity of the project is ensured. Coopetition literature has discussed mechanisms and practices for solving information tensions (Fernandez and Chiambaretto, 2016; Tidström, Ritala and Lainema, 2018), but the role of non-coopetitive partners in establishing those mechanisms hasn't been considered yet. Communication and coordination have been found to be particularly important in multi-partner R&D projects (Hamadi, Leker and Meerholz, 2018). When it comes to R&D networks, Ritala *et al.* (2017) noted that coordination efforts performed by a third party may support goal alignment and mitigate interdependence risks. As indicated in phase-oriented research–industry literature, routine-based dissimilarities

between partners may remain hidden in the early stage of collaboration and start hampering collaboration and its outcomes in the later stages (Estrada *et al.*, 2016). Following that, involvement of RPs in managing tensions between competing companies in the implementation phase can be explained as a coordination effort that fosters adjustments in collaborative routines between competitive partners with aim of ensuring desirable outcomes of the projects. This finding contradicts the statements of Ruangpermpool, Igel and Siengthai (2020) about a higher level of trust and a lower level of coordination and control in the project implementation phase of non-competitive R&D alliances. Knowledge sharing and protection mechanisms appear to be dependent on the relational factors and coopetitive nature of collaboration (Bogers, 2011), as indicated in the third proposition:

> P3: The involvement of RPs in the management of information tensions between competing companies during the project implementation phase increases the likelihood that those tensions will be successfully resolved in coopetitive R&D projects in mature industries.

Successful R&D collaboration relies on effective knowledge and technology transfer (Rybnicek and Königsgruber, 2019). However, our findings indicated that, when increasing requirements for data sharing in the project implementation phase, RPs might be considered a source of tensions by competing companies. Ritala *et al.* (2017) pointed out that companies within R&D networks may have different expectations for reciprocal knowledge sharing or different perceptions regarding risks of knowledge leaking, which might influence variations in their information-sharing attitudes. Our findings may also resonate with the attitudinal misalignment of RPs and companies discussed in research–industry literature (Hamadi, Leker and Meerholz, 2018) Academics aim to publish their research before it become obsolete, whereas industry is afraid of knowledge leaking that might erode their competitive advantage (Ankrah *et al.*, 2013). Another aspect that needs to be considered is the context of mature industries. Challenges in balancing between open and traditionally more closed innovation practices of companies in mature industries (Boscherini *et al.*, 2012; Caiazza, 2015) may impede their openness to sharing information in research–industry collaboration (Fontana, Geuna and Matt, 2006). Lastly, while a lower level of coordination is evident in the later stages of non-coopetitive R&D projects (Ruangpermpool, Igel and Siengthai, 2020), reciprocal communication (Bstieler, Hemmert and Barczak, 2015) and adaptation of collaborative routines between RPs and industry becomes very important in the implementation phase of coopetitive R&D projects in mature industries. On the basis of the above findings, the final proposition is as follows:

> P4: In the case that RPs increase requirements for data sharing during the project implementation phase in coopetitive R&D projects in mature industries, some competing companies may consider the RPs to be a source of tension.

Theoretical implications

The findings offer several theoretical insights. On the one hand, the adopted case study contributes to a richer theoretical understanding of multi-partner R&D projects in mature industries. Building on research about phase-specific management of increasingly complex research-industry collaboration (Estrada *et al.*, 2016; Alexander *et al.*, 2020),

this paper provides a more integrative view of relational aspects in R&D projects that involve both competitive and non-competitive partners. Disentangling their joint effect on collaborative processes in different project phases reveals the specific communication, knowledge creation and coordination mechanisms needed to ensure desirable outcomes in this context. Furthermore, insights about the importance of non-competitive partners for the establishment, collaboration and knowledge flow in coopetitive R&D projects contribute to debates about the peculiarities of innovation processes and knowledge in mature industries (Bodas Freitas, Marques and Silva, 2013). On the other hand, this paper contributes to existing coopetition research by explaining the evolution of the roles and effects that non-competitive partners, RPs and clusters, may have on focal coopetitive relationships during different project phases. The findings revealed the need for the simultaneous involvement of both RPs and clusters for the establishment of collaboration in the pre-project phase, while RPs have a dominant role in balancing coopetition in both the pre-project and project implementation phases. Therefore, while shaping collaborative processes and mitigating coopetitive difficulties over collaboration lifetime, non-competitive partners certainly influence the relational success and outcomes of the projects. Lastly, the paper shows how two research streams can complement each other. An important contribution of this study is also a set of propositions that will hopefully inform future studies in both fields.

Practical implications

This study increases the awareness of project managers, competing companies, RPs and business clusters regarding the possible consequences of the complex interactions during competitive R&D projects in mature industries and helps all partners act knowledgeably. The understanding of the influence that non-competitive partners, in particular RPs and clusters, have on competitor-to-competitor relationships may improve collaboration, knowledge creation and consequently, the outcome of coopetitive R&D projects in mature industries. Since research-industry collaboration is one of the priorities on policy agendas (Alexander *et al.*, 2020), unpacking the relationships in coopetitive R&D projects also generates valuable insights for the definition and optimisation of innovation policies.

The limitations of this study may provide potential avenues for further research. While this investigation solely focuses on the context of mature industries, future research may provide comparative insights from coopetitive R&D projects in both mature and emergent industries. Most of the sampled projects have reached the implementation phase, and further investigation may also include the finalisation phase of the collaboration lifecycle and reflect on the collaborative outcomes. Furthermore, the policy perspective was beyond the scope of this study, and future studies could explore the influence that policy makers have on the relationships between competitive and non-competitive partners, as well as which type of policies and strategies can stimulate R&D collaborations in this context.

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Appendix A - Interview guide

The pre-project phase

- What did the pre-project phase look like?
- Who were the competitive and non-competitive partners involved in this phase?
- What were their aims and interests?
- What was the role of the clusters?
- What was the role of the RPs?
- What type of knowledge do competing companies try to obtain in this type of project?
- What were the coopetitive challenges in this phase?
- What was the role of the cluster and the RPs regarding those challenges?
- How were those challenges solved?
- What is the most important thing for relationships between competing companies in this phase?
- How did the clusters and RPs influence the relationship between competing companies in this phase?
- Which collaborative aspects need to be improved in this project phase?

The project implementation phase

- What did the project implementation phase look like?
- Who were the competitive and non-competitive partners involved in this phase?
- What were their aims and interests?
- What was the role of the cluster?
- What was the role of the RPs?
- How did the roles of clusters and RPs differ compared to the pre-project phase?
- What were coopetitive challenges in this phase?
- What was the role of cluster and RPs regarding those challenges in this phase?
- How were those challenges solved?
- What is the most important thing for relationships between competing companies in this phase?
- How did the clusters and RPs influence the relationship between competing companies in this phase?
- Which collaborative aspects need to be improved in this project phase?