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Abstract

Based on a longitudinal study of two university-industry research centres, this paper examines how proximity along the dimensions of social and cognitive proximity and mutual commitment enables partners to comply with the research centres' goals of developing academic publications and innovations. We propose that social and cognitive proximity are equally important for complying with the goals, and we identify how these proximities co-evolve with actors' activities and interactions over time. Our main contributions are linked to the relationships among these proximities where repeated contact (social proximity) and mutual commitment are found to be key enablers for developing mutual understanding (cognitive proximity) between firms and university partners.

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ARTICLE

The role of proximity dimensions and mutual commitment in shaping the performance of university-industry research centres

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ABSTRACT

Based on a longitudinal study of two university-industry research centres, this paper examines how proximity along the dimensions of social and cognitive proximity and mutual commitment enables partners to comply with the research centres' goals of developing academic publications and innovations. We propose that social and cognitive proximity are equally important for complying with the goals, and we identify how these proximities co-evolve with actors' activities and interactions over time. Our main contributions are linked to the relationships among these proximities where repeated contact (social proximity) and mutual commitment are found to be key enablers for developing mutual understanding (cognitive proximity) between firms and university partners.

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1. Introduction

It is well established that university-industry collaboration (UIC) can generate important and central contributions for firms and universities through the development of innovations, patents, licences and academic publications (Cohen, Nelson, & Walsh, 2002; D'Este & Perkmann, 2011; Mueller, 2006). However, in practice, these potential benefits are not always realised (Barnes, Pashby, & Gibbons, 2002; Estrada, Faems, Martin Cruz, & Perez Santa, 2016; Geisler, 2003), as firms (Bruneel, D'Este, & Salter, 2010; Galán-Muros & Plewa, 2016; Howells, Ramlogan, & Cheng, 2012) and university partners (Adler, Elmquist, & Norrgren, 2009; Boardman, 2012) often find it challenging to collaborate effectively in UICs. Such challenges often relate to the divergent goals of industrial innovations and academic publications, which are difficult to leverage conjointly (Bjerregaard, 2010; Steinmo, 2015). These differences are often ascribed to a dichotomy between the opposing logics involving the academic publishing system and industrial commercialisation (Perkmann, 2017; Perkmann & Walsh, 2007).

This study responds to the call to examine how university and industry partners with different institutional logics (Bjerregaard, 2010; Bozeman, Fay, & Slade, 2013; Estrada et al., 2016) realise the specific goals of academic publications and innovations through the development of proximity dimensions. Proximity dimensions focus on the

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interaction, common norms, and physical closeness between collaborative partners (Boschma, 2005; Hansen, 2015; Knoben & Oerlemans, 2006) and provide a nuanced framework for understanding collaborative processes in greater depth (Steinmo & Rasmussen, 2016). While prior research on proximity has largely analysed short time periods (Balland, Boschma, & Frenken, 2015) and focused mainly on one dimension of proximity and collaborative outcomes (Heringa, Horlings, van der Zouwen, van den Besselaar, & van Vierssen, 2014), recent research has studied successful UICs and shown that social proximity (interaction) develops cognitive proximity (mutual understanding) (Steinmo & Rasmussen, 2016; Villani, Rasmussen, & Grimaldi, 2017). However, there is limited evidence concerning *how* these proximity dimensions evolve and the activities and preceding events.

This paper seeks to address these gaps through a longitudinal study of two university-industry research centres in Norway. Such research centres represent the predominant, policy-focused means to increase UIC in the EU and the US by which both academic publications and industrial innovations are expected to be produced (Chai & Shih, 2016; Gulbrandsen, Thune, Borlaug, & Hanson, 2015; Ponomariov & Boardman, 2010). The study addresses the following research questions: (1) '*How do social and cognitive proximity contribute to the achievement of the goals of publication and innovation in university-industry research centres?*' and (2) '*How do these proximities develop over time?*'

This paper adds to the few studies conducted on the organisational dynamics underlying UIC in general (Bozeman et al., 2013; Lind, Styhre, & Aaboen, 2013; Perkmann & Walsh, 2007) and to the few studies comparing productive and unproductive collaborations in particular (Bozeman et al., 2013; Rajalo & Vadi, 2017), and it makes three distinctive contributions to the literature on UIC and proximity. First, this paper shows that proximity along the dimensions of social and cognitive proximity together with mutual commitment contribute to comply with the centres' goals of developing academic research and innovations (Gulbrandsen et al., 2015; Lind et al., 2013). Second, we contribute new knowledge on collaborative processes over time (Bjerregaard, 2010; Thune & Gulbrandsen, 2011) by showing key activities that build social and cognitive proximity.

Third, the present study explores how different dimensions of proximities co-evolve with actors' activities and interactions over time (Balland et al., 2015; Heringa, Hessels, & van der Zouwen, 2016; Mattes, 2012), thus contributing by developing a multidimensional framework of proximity in the context of UIC (Hansen, 2014). We find that repeated contact (social proximity) in combination with mutual commitment (inductively derived) between university and industry partners, which refers to a mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners, are key enablers for the development of cognitive proximity.

This paper is structured as follows. The next section presents the theoretical framework of UIC and proximity. Section 3 presents the methodology used. The study's empirical findings are outlined in Section 4. In Section 5, we discuss our empirical findings in relation to the scholarly literature and develop two propositions. Finally, Section 6 provides conclusions and implications.

2. Theoretical framework

2.1 University-industry collaboration in research centres

University-industry research centres represent the main policy strategy used to increase UIC in most developed countries (Chai & Shih, 2016; Kaiser & Kuhn, 2012; Ponomariov & Boardman, 2010). Research centres are created to resolve inherently conflicting goals between university and industry partners that have not been satisfactorily fulfiled by other institutions, such as academic departments, firms and research institutes (Gulbrandsen et al., 2015; Ponomariov & Boardman, 2010; Styhre & Lind, 2010). Research centres are intended to create long-term interaction (Thune & Gulbrandsen, 2011) and have two main goals: producing academic research and contributing to innovation (Gulbrandsen et al., 2015; Ponomariov & Boardman, 2010; Styhre & Lind, 2010). Research centres are therefore referred to as intermediary (Spithoven & Knockaert, 2012; Villani et al., 2017; Wright, Clarysse, Lockett, & Knockaert, 2008), boundary (Boardman, 2012; Gray, Lindblad, & Rudolph, 2001; Perkmann, 2017) and hybrid organisations (Chai & Shih, 2016; Gulbrandsen et al., 2015).

The conflicting goals and desired R&D activities that research centres are supposed to bridge can be explained through the partners' different institutional logics, a concept that originates from institutional theory. *Institutional logics* can be defined as 'the basic organizing principles through which actors interpret organizational reality, evaluate alternatives, and define their identities and actions' (Perkmann, 2017, p. 155). A fundamental assumption of the institutional logics' perspective concern differences, and an important research area therefore concerns theorising about and empirically illustrating such overarching differences (Greenwood, Hinings, & Whetten, 2014).

Consequently, a growing body of literature has explored this issue and has shown that industry and academia are characterised by conflicting institutional logics (Perkmann & Walsh, 2007; Sauermann & Stephan, 2013; Steinmo, 2015). University researchers are considered to be oriented towards the publication system, while industry has the commercial imperative to secure exploitable results through short-term applied research (Hewitt-Dundas, Gkypali, & Roper, 2019; Meyer-Krahmer & Schmoch, 1998; Perkmann & Walsh, 2007). Hence, individuals and organisations participating in research centres often face institutional complexities by confronting multiple logics that may or may not be mutually incompatible (Greenwood, Raynard, Kodeih, Micelotta, & Lounsbury, 2011).

However, the question of how the institutional logics of university and industry partners influence the collaboration *process* has received limited attention (Bjerregaard, 2010; Estrada et al., 2016). Prior research has indicated that research centres, despite having formalised structures, are dependent on informal collaboration processes such as developing commitment thorough repeated interactions (Okamuro & Nishimura, 2017; Thune & Gulbrandsen, 2011); however, there is limited knowledge concerning how such commitment can be set into action (Thune & Gulbrandsen, 2011). In an effort to correct these important shortcomings, this study builds on earlier proximity studies showing that more proximate actors collaborate and interact more easily (Balland et al., 2015; Knoben & Oerlemans, 2006), to examine whether and how proximity dimensions help to achieve the goals of producing both publications and innovations in research centres.

2.2 The proximity perspective

The proximity concept refers to 'being close to something measured on a certain dimension' (Knoben & Oerlemans, 2006, p. 71–72), and it has gained a prominent position in the inter-organisational collaboration literature over the last 20 years (Balland et al., 2015; Knoben & Oerlemans, 2006). The proximity concept proposes a framework that is widely applied by scholars seeking to understand the formation and effects of linkages between actors. The central premise of this framework is that different dimensions of proximity can reduce coordination costs through interactive knowledge creation (Hansen, 2015), thus mitigating uncertainty and enabling interactive learning and innovation (Boschma, 2005).

Although the proximity concept is often related to geographical proximity (e.g., De Fuentes & Dutrenit, 2016; Herrmann, Taks, & Moors, 2012), other important forms of proximity that may influence collaboration and innovation are also present (Filippetti & Savona, 2017; Mattes, 2012), such as institutional proximity, under which the actors in norms and incentives operate (Balland et al., 2015), and organisational proximity, which refers to shared relations within or between organisations, and it is advantageous for innovation networks (Boschma, 2005). Further, social and cognitive proximity are two of the most important proximities for knowledge transfer and innovation in collaborations (Leszczyńska & Khachlouf, 2018; Omobhude & Chen, 2019), and our data indicate that these proximities are key for complying with the goals to produce innovations and publications in research centres.

Social proximity stems from the embeddedness literature (Granovetter, 1985) and specifies how interactions are embedded within social interactions and that relationships affect the outcomes of these interactions. Hence, social proximity is embedded in agents' relationships at the micro-level in reference to personal relationships among social actors when they involve trust, friendship and common experiences (Boschma, 2005). Social proximity is generally associated with past collaborations and repeated contact between partners (Balland, 2011; Davids & Frenken, 2017; Huber, 2012), and it is found to be particularly central to the success of UIC innovation projects (Belderbos, Carree, Lokshin, & Sastre, 2015; Mora-Valentin, Montoro-Sanchez, & Guerras-Martin, 2004; Steinmo & Rasmussen, 2016). The capacity of organisations to learn and innovate may be related to social proximity, as trust-based relationships facilitate knowledge integration between actors (Boschma, 2005; Mattes, 2012). Hence, social proximity also reduces, but does not eliminate, the risk of opportunistic behaviour (Boschma, 2005).

Cognitive proximity refers to the degree of overlap between actors' knowledge bases (Broekel & Boschma, 2012) and, thus, to actors' degree of shared expertise (Nooteboom, 2000). Cognitive proximity is especially important for innovations, and it is based on and related to absorptive capacity (Cohen & Levinthal, 1990). As knowledge is dispersed among individuals and organisations, it is often necessary to connect diverse and complementary knowledge bases for knowledge creation and innovation (Berggren, Bergek, Bengtsson, & Söderlund, 2011; Boschma, 2005; Mattes, 2012). However, there must be a minimum level of similarity in actors' knowledge bases to identify, interpret, and exploit others' knowledge (Cohen & Levinthal, 1990).

Accordingly, Nooteboom, Van Haverbeke, Duysters, Gilsing, and Van den Oord (2007) find an inverted U-shaped effect of cognitive distance on firms' innovation

performance, and Hansen (2014) states that firms seeking to obtain knowledge prefer partners with an intermediate level of cognitive proximity. Hence, Broekel and Boschma (2012) find that high levels of cognitive proximity limit innovative performance. In practice, this means that collaborators' knowledge bases must be sufficiently similar to communicate, understand, and process knowledge successfully (Boschma & Lambooy, 1999), which may result in the learning and expanding of actors' knowledge bases (Franco, Marzucchi, & Montresor, 2014; Nooteboom, 2000).

Authors have recently begun to explore the interplay and co-evolutionary processes among different proximity dimensions (e.g., Fitjar, Huber, & Rodríguez-Pose, 2016; Hansen, 2015; Heringa et al., 2016), where social proximity is found to reduce cognitive distance (Villani et al., 2017) or develop cognitive proximity over time (Steinmo & Rasmussen, 2016). However, the studies of Steinmo and Rasmussen (2016) and Villani et al. (2017), which focused on successful UICs, provide limited evidence of *how* social proximity builds cognitive proximity and the preceding activities and events. Moreover, Villani et al. (2017) state that dedicated events are important for enhancing social and cognitive proximity, limited insights are provided for particular events, and whether and how these dimensions can make the university and industry partners able to produce results that are relevant for both parties over time, representing one of the main reasons for establishing UICs (Cohen et al., 2002; Galán-Muros & Plewa, 2016). We extend research on social and cognitive proximity by exploring them in the context of two university-industry research centres, where we search to identify the activities and events that contribute in building these proximities.

3. Methodology

3.1 Research design and cases

We conducted a longitudinal comparative study of two university-industry research centres to answer 'how' questions about the complex contemporary processes of UICs (Eisenhardt, 1989; Gephart, 2004; Langley, 1999). Research centres perform research with the explicit mission of promoting cross-sector collaboration, knowledge, and technology transfer and, ultimately, innovation (Boardman & Gray, 2010), often in particular industries (Gulbrandsen et al., 2015). The centres in this study operated from 2009 to 2015 under the auspices of the Norwegian public programme 'Centres for Environment-friendly Energy Research'. Accordingly, the studied research centres were established as one of the Norwegian government's main avenues by which to improve research on renewable energy and to position Norway as a leading clean energy nation (Research Council of Norway, 2008). The centres were funded with a yearly budget of approximately 3.5 million EUR by the Research Council of Norway (50%), university partners (25%), and industry partners (25%), to execute cutting-edge research and to develop industrial innovations (Research Council of Norway, 2008).

Based on a study conducted by the authors of a large data set of six research centres that function as a broad knowledge base in the context of university-industry research centres, two research centres (Alpha and Beta) were chosen as cases for this study (Eisenhardt, 1989). Alpha and Beta were chosen because they represent "polar cases' in terms of collaborative outcomes (ability versus inability to comply with the goals of

innovating and publishing) while sharing the same institutional background and structures (e.g., research and innovation objectives and partners with past collaborations (social proximity) and shared expertise (cognitive proximity)). Hence, a systematic comparison is possible, thus minimising extraneous variations (Eisenhardt, 1989).

3.2 Data collection

Secondary data, such as the initial project description, evaluation reports, and annual reports for both research centres, were collected at the beginning of the data collection process (see Table 1). These data were used to prepare for the data collection process and to improve the authors' understanding of the context of this study (Alvesson & Sköldberg, 2009). We further interviewed, on average, six key persons involved in each research centre (see Table 1). To increase the possibility of identifying how each research centre managed to achieve the publications and innovation goals, we selected a sample of the most involved firms in each research centre by studying the annual reports and suggestions from informants in each research centre. Moreover, the centre director and one-to-two work-package leaders were selected as informants at each research centre. By interviewing these key university informants who have interacted with all the industry partners and the most involved industry partners, we obtained multiple accounts of the same collaborative process (Pentland, 1999).

In total, we conducted 21 semi-structured interviews that lasted 66 minutes on average, of which 18 were conducted face-to-face and three were conducted over the phone in Alpha and Beta. The interviews were always conducted with two or more researchers involved to minimise interviewer bias. To observe whether and how the research centres were able to comply with the goals of publications and innovations over time, we conducted the interviews within a two-year interval: 2013 and 2015.

The interview questions were developed to explore the collaborative dynamics present in the research centres and were based on secondary data such as evaluation reports before the interviews commenced (Yin, 2013). Based on the evaluation reports, we were able to ask informants who were involved at each research centre specific

Table 1. Sources of primary and secondary data.

Research centre	Alpha (A)	Beta (B)
Informant round 1 (2013)	Firm A1	Firm B1
	Firm A2	Firm B2
	Firm A3	Firm B3*
	Centre Director	Centre Director
	WP leader A1**	WP leader B
	WP leader A2	
Informant round 2 (2015)	Firm A1	Firm B1
	Firm A2	Firm B2
	Firm A3	Centre Director
	Centre Director	WP leader B
	WP leader A1	
	WP leader A2	
Total no. of interviews	12	9
Secondary sources (2009–2015)	Initial project description, annual reports, mid-term evaluation report, newsletters, press articles, and websites	

* Firm B3 withdrew from Beta in 2014 due to a strategic reorientation.
** WP leader is an abbreviation for work-package leader.

questions. Considering the different perspectives of our informants, we designed and relied upon two separate interview protocols; one for industrial partners and one for university partners.

The interviews were designed to cover the interviewees' backgrounds, working relationships, and their expectations of and involvement in collaborative activities from the initial stages to the time of the interviews, ending with their thoughts on future collaborations. To obtain information in further detail concerning critical events of the collaboration, we used open-ended follow-up questions such as 'Why did you do that?', 'Who was involved?', 'Can you explain more in detail?' In this manner, we obtained the interviewees' narrative view of reality (Gephart, 2004). This type of narrative interviewing was used to obtain a better understanding of the collaborative process and to prevent personal bias and theoretical concepts from influencing the data collection. The narrative interviewing in combination with secondary documents was essential in reducing the problems of retrospective data collection bias (Eisenhardt, 1989; Yin, 2013) and limiting the risks of impression management (Eisenhardt & Graebner, 2007).

3.3 Data analysis

The interviews were recorded and transcribed verbatim throughout the data analysis process (Yin, 2013). Reading the interview transcripts multiple times enabled us to search for broader patterns and insights into how the two research centres developed (Eisenhardt, Graebner, & Sonenshein, 2016; Pentland, 1999; Yin, 2013). Applying a temporal bracketing strategy (Langley, 1999), the mid-term evaluation was singled out as the triggering event for the alterations in the research centres' research agendas. Hence, two distinct 'periods' – before the mid-term evaluation (2009–2012) and after (2013–2015) – created a temporal structure for the analyses.

A qualitative analysis software (NVivo 10) was used to code the data following an abductive approach (Alvesson & Sköldberg, 2009). We began with deductive coding, identifying relevant quotes from the interview data regarding the research centres' prevailing ability to comply with the research centre's goals of innovations and publications for the two periods. These empirics were combined in a matrix for the two periods (Miles, Huberman, & Saldaña, 2014) and are condensed in Table 2. During this process, the proximity framework was deemed relevant to explain how the centres' ability to comply with the goals changed over time, where social and cognitive proximity were found to be the dimensions that could elaborate on whether and how the research centres managed to comply with the goals of publications and innovations.

Next, the data were deductively coded based on theoretical definitions of social and cognitive proximity and combined in a matrix for the two periods (Miles et al., 2014); these data are condensed in Table 3 (Eisenhardt & Graebner, 2007; Pentland, 1999). As we were particularly interested in the *key activities* that facilitated proximity development in the two research partners, we looked for events in our data that we observed to have an influence of proximity development (e.g., industry visits were identified as a key activity for the development of social proximity). Based on illustrative examples and quotes, each research centre was characterised with low to high levels of proximity in each period.

However, a deductive analysis of proximity along the dimensions of social and cognitive proximity could not independently explain whether or how the centres were able to attend to the goals of publications and innovations over time. Thus, another round of analysis was warranted, whereby we read the interview transcripts and searched for insights into how the two research centres developed differently (Eisenhardt et al., 2016; Pentland, 1999; Yin, 2013). In this inductive analysis process, mutual commitment (mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners) was mapped as key for proximity development that contributed to the achievement of the goals of publications and innovations in the research centres; these data are condensed in Table 3 for the two periods. Next, we went back and forth between the theories and empirical data to develop reliable theoretical propositions that closely fit the data (Eisenhardt, 1989). The two propositions presented in the Discussion section of this paper are intended to support initial theory development and to guide future research.

4. Findings

First, our overall findings are presented in terms of whether the research centres of Alpha and Beta complied with the goals of producing innovations and publications. Then, the key findings regarding how social proximity, mutual commitment, and cognitive proximity between firms and university partners develops over time are presented.

4.1 Complying with the goals of university-industry research centres

Table 2 outlines and summarises the university and industry partners' ability to comply with university and industry partners' goals of innovations and publications in the research centres over the two periods. The findings are based on the university and industry partners' subjective perceptions regarding whether their goals are attended to in the research centre[1], which are found to be of utmost importance for actors' commitment to, and retention in, research centres (Fonti, Maoret, & Whitbred, 2017; Gray et al., 2001).

A clear distinction is observed between the two examined research centres. As the activities were directed mostly towards the university partners' goals to publish academic articles, Alpha was not successful in adhering to the goals of both the university and industry partners in Period 1. The pressure felt by university researchers to comply with the publication goals of the research centre can explain the strong emphasis found on research that supports academic merit: *'We experience pressure to publish, but the industry doesn't care about publications'* (WP leader A1). The centre director acknowledged the industry partners' frustrations with the centre's lack of concern for industry demands: *'The industry partners call for more innovations'* and *'many of the industry partners are not very interested in concepts that the researchers use. They are interested in products they can sell and maybe earn some money on'*.

Over time, the working projects at Alpha became more oriented towards the industry partners' goals once some of the industry partners became more involved: *'We are now taking more initiative'* (Firm A2). As a result, the work plan changed: *'We*

Table 2. The ability of the research centres to comply with the goals of innovations and publications.

	Period 1 (2009–2012)	Period 2 (2013–2015)
Alpha	The research is mostly oriented towards the university partners' goals of publications, but the industry partners expect more short-term applied research results that can lead to innovation: *'The conducted research in the research centre is not relevant for our industry … [Topic X] is a hot research topic in Europe, but it is not relevant in Norway'* (Firm A2) *'The industry in general, or much of it, has an expectation to turn research into commercialised products in a short time horizon'* (WP leader A1) *'The firms' [research] expectations are short-term rather than more strategic, long-term'* (Centre director) *'We need to publish articles, which requires long-term work and very high quality. At the same time, industry partners demand innovation'* (WP leader A2)	The university partners increasingly considered the industry partners' goals; however, this occurred at the expense of the university researchers, which resulted in fewer opportunities to conduct high-impact publications: *'I feel that [the research centre] has moved more in our [the firm's] direction'* (Firm A2) *'It is very little research, or what we call research; it is mostly consultancy by conducting minor analyses'* (WP Leader A1) *'It has started to produce relevant research results [from the research centre]'* (Firm A1) *'We do very little research [in the research centre]. It is mostly small 'development work' … it is not relevant for publications'* (WP leader A1)
Beta	The research is mostly oriented towards the university partners' goals, while the industry partners want more applied research. By the end of Period 1, the university partners are starting to consider more of the industry partners' interests: *'I have some, but not many, examples of concrete and relevant results from the collaboration'* (Firm B1) *'We have used some of the results from the research centre'* (Firm B1) *'We experience a lot of learning and knowledge development'* (Centre director) *'I experience that the firms are largely satisfied with the research centre … but they also want more research questions that are highly relevant to them'* (Centre director)	The university partners gradually directed their attention to the interests of the industry partners. The research plans were adjusted to address research questions that were valued by the industry partners in a way that complied with both parties' goals: *'We see that the research projects have resulted in some definite deliveries'* (Firm B2) *'The research we do is still of relevance for publications … and a lot of publications are produced … and the industry seems 'happy''* (Centre director) *'The research partners have acquired insight into the industry and see the relevance of that'* (Firm B1) *'I often get publications based on the collaboration, but it is the [industrial] results that matter'* [WP leader B]

have changed the way we plan our work in the [research centre] and try to balance between long- and short-term activities' (WP leader A1). These changes caused the industry partners to be more satisfied, as expressed by Firm A1: *'The researchers are now much closer to the 'real' process than they were two to three years ago'*, and they strengthened the focus of the industry's goals during Period 2. However, the increased orientation of the industry's goals at Alpha seemed to limit the research centre's focus on high-quality research and publications, as expressed by WP leader A1: *'We are now solving a lot of small things for the industry partners that cannot be called research'*. This lack of a research focus is also acknowledged by an industry partner who notes that *'the centre does conduct less research now'* (Firm A2). In summary, Alpha became more oriented towards the industrial goals of the research centre and was less able to conduct high-quality research that could lead to academic publications. Hence, Alpha was not able to comply with the university and industry partners' goals of both innovations and publications in Period 2.

Like the Alpha centre, the Beta centre was not able to comply with both the university and industry partners' goals at the beginning of Period 1. The projects were oriented mostly towards the university's goals, and the university partners set the agenda, as expressed by Firm B3: *'The first years of research have mostly been based on the premises of the university partners'* and Firm B1: *'It is a challenge to get the*

universities to work in another way than what they are used to. They want to benefit themselves and do what they want'. However, in this period, the university partners highlight that the centre plans to satisfy both partners' interests: *'We will now focus more on relevant research questions for the industry partners'* (Centre Director B). Prospects for further research that complies with both partners' goals were well received by the industry partners: *'We have taken part in defining the new themes, and I experience the university partners as quite sensitive to our [research] needs'* (Firm B2).

During Period 2, the Beta research centre increased its ability to adhere to both partners' goals by conducting research that was of relevance to both industrial and academic applications. The centre director highlighted the value of industrial data and research questions posed by the industry partners: *'The research we now conduct is not very different [from the research conducted during Period 1], but we use data from the industry partners and solve research questions that are more relevant to them'*. The industry partners expressed being very satisfied and noted that Beta has managed to maintain a balance in terms of the partners' different interests: '*I think the [research centre] has to be applied but also some basic research conducted; not everything can be applied. That balance is difficult to find, but in that regard, I think the [research centre] has succeeded*' (Firm B2). Another industry partner expressed how Beta partners had managed to work towards the same goals: *'We and the university partners have the same goals; we discuss how to get there and how to solve it. That [collaboration] is based on trust'* (Firm B1).

In summary, a clear distinction between the examined research centres is observed, in which Beta to a greater extent than Alpha managed to comply with the research centre's goals of conducting research relevant for both innovation and academic publications. By investigating how social proximity, mutual commitment, and cognitive proximity develop, this paper shows how Beta, unlike Alpha, was able to successfully comply with the different goals of university and industry partners.

4.2 The role and development of proximity dimensions and mutual commitment

Based on our data, we find that social proximity, mutual commitment (inductively derived), and cognitive proximity are key enablers to comply with the goals of producing innovation and academic publications in both the Alpha and Beta research centres but that the centres have developed them in various levels (see Table 3). Table 3 also summarises these findings in two periods of time and identifies key activities that contributed to developing social and cognitive proximity, which is discussed below.

4.2.1 The development of social proximity

When examining social proximity through the measures of past collaboration and repeated contact (Balland, 2011), we find that both the Alpha and Beta research centres had the same levels of social proximity based on *past collaboration* before the establishment of the research centres. In response to a call for applications from the Research Council of Norway, the universities gathered and submitted an extensive application to establish the research centres as well as recruit industry partners. Hence, for both research centres, most decisions on potential industry partners stemmed from past collaborations, as stated by the centre director of the Alpha research centre: *'We*

Table 3. Development of proximity dimensions and key activities in the research centres.

	Social proximity	Mutual commitment*	Cognitive proximity
Definition	Past collaboration, repeated contact (Balland, 2011)	Mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners	Shared expertise and mutual understanding (Nooteboom, 2000)
Alpha Period 1 (2009–2012)	**Low/moderate**: Some prior collaboration between the partners but limited contact: *'We have worked with many of the industry partners before, some for ages, but some are relatively new partners'* (Centre director) *'At the start-up, we participated in some meetings where we discussed possible themes, developed the work-packages and looked at their content … but we have been less involved after the start-up'* (Firm A2) *'They [the industry partners] are invited to [research] meetings and so on … but they often don't show up'* (Centre director)	**Low/moderate**: Limited willingness to focus on both partners' goals: *'We are very dependent on the industry's willingness to be open about their processes, but it has been somewhat difficult to get access to their data'* (Centre director A) *'Industry partners think that it is okay that we publish, but they want us to focus on short-term benefits for them at the same time'* (WP leader A2) *'If the industry contacts us, it is typically because they have a problem [in their production process] … but these problems are of less relevance for us to use as problem statements for our research'* (WP leader A2) *'It's our own fault as well [talking about the collaboration], all our people have worked towards our business expansion, so we have just passively received the [research] updates, but we haven't been involved in the collaboration'* (Firm A1)	**Low/moderate**: Some shared expertise (Ph. D. competence in some of the firms), but poor mutual understanding: *'I have a Ph.D. in the subject'* (Firm A3) *'Poor communication has been the challenge between us and the universities'* (Firm A2) *'[The research results] are presented in a way that is too advanced, too many formulas. When they are presented, there needs to be a focus on risks, challenges and results, not on how formulas are built'* (Firm A1)

(*Continued*)

Table 3. (Continued).

	Social proximity	Mutual commitment*	Cognitive proximity
Alpha Period 2 (2013–2015)	**Moderate**: Some of the industry partners participated in formal meetings, but informal contact was still limited: *'We have tried to make the [formal] meetings more accessible for the industry partners'* (Centre director) *'We have become somewhat better at following up on activities in the research centre'* (Firm A2) *'It's challenging to have an ongoing dialogue with the industry partners … they are so busy'* (WP Leader A1) **Key activities** Industry visits: University researchers visited the industry partners to discuss research opportunities: *'Instead of sending 50 pages of emails that frustrated the industry partners, we started to visit all of them, without sending any written correspondence before the meetings'* (WP leader A1) *'We are 'on tour' these days, every year now, we do visit them [industry partners]. We explain the procedure again regarding the next year work-plan, they provide their suggestions, and then we discuss'* (WP leader A2)	**Low/moderate**: Still limited willingness to focus on both partners' goals: *'There is a stronger connection and communication between the industry and the university partners than there was before … They now focus more on our needs'* (Firm A1) *' … [We] try to balance between long- and short-term activities … but it is difficult … I think they [the firms] look at research as less important, so it is hard to get them to understand or believe that what we do is directly relevant to them'* (WP leader A1) *'Yesterday we [company] had a meeting with the researchers here [at the industry location]. Unfortunately, only I could attend … It's so busy. I wasn't able to prepare well before the meeting'* (Firm A3) *'Firm wants us to do something that is only close to them, but its less relevant for other industrial and university partners'* (Centre director)	**Moderate**: Slightly better mutual understanding between the partners, but the industry partners still found it challenging to innovate based on academic publications: *'Understanding has become better during the collaboration'* (Firm A1) *' … collaboration between university and industry partners is are very different, very challenging'* (Centre director) *'They still don't read the research articles. The threshold is so high that they don't even try'* (WP leader A2) **Key activities** Summaries of articles: Due to the complex nature of the academic articles, some university researchers wrote short summaries: *'Some of the advanced articles were very challenging to read … They [industry partners] say that they do not have time to look at reports and such. So, we are now providing more presentations and generating short articles'* (WP Leader A1) Co-authorship: Some university researchers engaged industry partners as co-authors on academic articles to develop closer relationships and mutual understanding: *'I think that is important, and some of them [industry partners] appreciate that type of publicity'* (WP Leader A2) Categorised innovations: Established definitions for innovations to create common ground and expectations: *'Some industry partners believed the term innovation was too broad, so we classified different types of innovation'* (Centre director)

(*Continued*)

Table 3. (Continued).

	Social proximity	Mutual commitment*	Cognitive proximity
Beta Period 1 (2009–2012)	**Moderate**: Acquainted industry partners were recruited by the university partners to the centre. Some interaction between the partners at both formal and informal meeting areas: *'We know most partners from prior collaborations'* (Centre director) *'When invited to seminars or meetings about new projects, we experience quite low interest from the industry'* (WP leader B) *'There have been some discussions [about research possibilities and projects], and we have provided information to them after requests'* (Firm B1)	**Moderate**: Some willingness to engage in a two-way collaborative process that complies with both partners' goals: *'Then [in the beginning], it was mostly the university researchers who defined the 'headlines' … We are now searching for how to make the research more relevant for the industry partners'* (Centre director) *'I think there is an understanding among the firms that the universities have to be in their 'bubble' to a certain degree. However, the challenge is to develop insights that can help us'* (Firm B2)	**Moderate**: Some degree of shared expertise (Ph. D. competence in some of the firms) and mutual understanding between the partners: *'I have a Ph.D. in this subject … and I always want to develop more knowledge, to learn more'* (Firm B1) *'To a large degree, I suppose I agree with what they [the university researchers] have done … but we have talked past each other so many times, and that can go on for months, and in the end, you get a [research] delivery that does not answer the objectives at all'* (Firm B2) *'The [university] research is very narrow and specific, but we can't implement someone's Ph.D. results directly, we need to acquire that knowledge in relation to our business'* (Firm B1)

(*Continued*)

Table 3. (Continued).

	Social proximity	Mutual commitment*	Cognitive proximity
Beta Period 2 (2013–2015)	**High**: Increased two-way interaction between the partners (particularly informal contact), and valued accessibility of the university partners by the industry partners: *'We have increased the formal interactions, for instance through the centre board and workshops … and the informal interactions are also increased'* (Centre director) *'They [the industry partners] have become much more active the last two years'* (WP leader B) *'The research partners are very available; it is easy to contact them'* (Firm B1) **Key activities** Increased informal contact: The university partners took more initiatives in contacting the industry partners: *'We have engaged in many informal contacts with the industry partners to involve them'* (centre director) ICT for increased contact: Centre management established an ICT project to increase partner interactions: *'We have started a project that uses ICT to more closely connect the research groups'* (Centre director)	**High**: Increased willingness to engage in a two-way collaborative process that complies with both partners' goals: *'The midterm evaluation two years ago highlighted a need for more interactions and the industry indicated a need for more applied research, as did the university partners … We have focused more on 'real' research questions, and the real issued that the industry partners are facing … without turning to consultancy'* (Centre director) *"The research is now more 'focused' [on industrial issues]* (Firm B1) *'We and the university partners have the same goals; we discuss how to get there and how to solve it. That [collaboration] is based on trust'* (Firm B1) *'I am in general very pleased, and I think that we are 'marching in the same direction''* (Firm B2)	**High**: Increased mutual understanding between the partners were developed over time: *'Over time, we have achieved a better dialogue [with the industry partners] and a common understanding'* (Centre director) *'Many of the Ph.D. candidates' presentations were very specialised, which was perhaps not that interesting for the industry partners. So, we are now focusing more on general results'* (WP leader B) *A lot of the [recent] results are relevant to our needs … However, if the focus is only on innovation, research will gradually become very marginal" (Firm B1)* **Key activities**: Joint research project: Established a project that encompassed the whole industry, the main goal of which was to increase interactions and create mutual understanding: *'We are now studying the value chain as the industry partners sees it … and we have good discussions [on this project]'* (Centre director) Data access: The industry partners granted the university researchers access to relevant data: *'The university partners have acquired more detailed insights into [industrial] datasets than they have before. So, it is mutual interests, usefulness and learning'* (Firm B2) Categorised innovations: Established definitions for innovations to create common ground and expectations: *'There have been focusing on categorising and systematising innovations in the research centre … so that firms know better what results that they can continue working on [internally]'* (Firm B1) Summaries of articles: Findings were summarised and popularised in newsletters and in an ICT system: *'Here [in the system], we provide access to all publications, but they are also presented as 'popular science' through monthly newsletters that highlight the findings'* (Centre director)

* As mutual commitment regarding a firm's willingness to engage in the collaboration, key activities are not identified for this term.

contacted the ones with whom we had a relationship first'. Moreover, friendship and common experiences (Boschma, 2005) were present in both research centres in the early phases; as one industry partner at the Alpha research centre told us, *'I have worked there [at the university], so I know all the researchers very well'*.

When mapping *repeated contact* between the university and industry partners for Period 1, we found low levels of interaction at Alpha, especially after the centre was up and running, as stated by the centre director *'About half of the industry partners were involved in the meetings the first years to get the centre up and running, but at year two, we [centre management] started to get reports that few industry partners participated'*. With respect to repeated contact in Period 1, the two research centres differ most in that the industry partners at Beta prioritise the formal meetings: *'I have some contact with the centre, especially through seminars and meetings'* (Firm B3). Although informal interactions at Beta were found to be quite limited, the industry partners valued the availability of the university partners: *'It is very easy to email or call. [The research centre] is very responsive'* (Firm B2). For the Alpha research centre, we found closeness to be lacking: *'Communication is something that we have promised to become better at'* (WP leader A2).

Over time, the Alpha research centre gained somewhat higher levels of social proximity through more frequent formal contact, as noted by Firm A1: *'We have participated more actively in the research planning'*. The centre management acknowledged the need for more interaction, arranged visits to the industry partners, and facilitated more formal meetings to discuss the research agenda as quoted by Firm A2: *'We are now working with the workplan for 2014, where the university partners are much more eager to involve the industry than before'*.

Consequently, some industry partners became more involved with the collaboration: *'We are more engaged, and that in sum has created a good development'* (Firm A2). Nevertheless, not all of the firms were involved in this process: *'Yesterday, we visited a partner who was not prepared to discuss possible research projects'* (WP leader A1), and Firm A3 stated that *'To be honest, I don't know what is going on in the research centre; it is such a small part of my workday'*. As a result, some of the industry partners became more engaged in formal meetings facilitated by the centre's management team, while informal and ad hoc contact between university researchers and industry partners remained low.

The Beta research centre developed higher levels of social proximity over time through repeated contact between the university and industry partners: *'We have increased the formal contact, for example through contact with the board [of the research centre], and we have arranged workshops with the industry partners'*. The centre's management team facilitated key activities that improved levels of social proximity between the partners: An ICT project that aimed to connect the university partners to industry partners was established, and the meeting agendas became more heavily influenced by industry partners, which they valued: *'We shaped the meeting agenda, and that worked out very well for us; the professional discussions were very good'* (Firm B1).

4.2.2 The development of mutual commitment

Based on our data, we suggest that the term 'mutual commitment' between university and industry partners is a key enabler for complying with the goals of innovations and

publications. The term of mutual commitment is based on the general construct of 'commitment', which relates to a mutual willingness to develop relationships (Anderson & Weitz, 1992; Mora-Valentin et al., 2004; Núñez-Sánchez, Barge-Gil, & Modrego-Rico, 2012). We define mutual commitment as a 'mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners', which in the context of UIC involves working towards publications and innovations (D'Este & Perkmann, 2011).

In the Alpha research centre, we find low levels of willingness to engage in a two-way collaborative process in Period 1 and thus to comply with both partners' goals. This can be exemplified by limited willingness by the industry partners to prioritise the collaboration as stated by the centre director of Alpha: *'They don't prioritise dedicating a whole day to come and discuss with the other partners and determine what we should focus on'*. The same centre director is also frustrated regarding the industry partners unwillingness to dedicate resources in providing university researchers access to their processes: *'We are very dependent on the industry's willingness to be open about their processes, but it has been somewhat difficult'*.

The mutual commitment was somehow improved in Period 2, as the industry partners became more engaged in the collaboration to achieve more applied research and results as quoted by Firm A1: *'We have become more involved … getting them to focus on our interests'*. However, this engagement was at the expense of the university researchers, where the university researchers conducted mainly small-scale projects by applying existing knowledge, and they did not gain access to enough industrial data for academic publications. As such, the industry partners did not have the willingness to engage in a two-way collaborative process: *'We do very little research [in the research centre]. It is mostly small 'development work' [for the industry partners]'* (WP leader A1).

The partners in the Beta research centre were to some extent willing to engage in a two-way collaborative process in Period 1, which in particular is observed for the university partners: *'It is important to work on the [industrial] relevance of our research'* (WP leader B). In Period 2, the partners increased their willingness to engage in a two-way collaborative process that complies with both partners' goals even more: *'Everybody [industry and university partners] is very involved and committed to [the collaboration]'* (WP leader B). The industry partners increased their attendance at meetings and workshops facilitated by the centre management through active engagement, which illustrates their willingness to engage in the collaboration: *'Through discussions in workshops with the industry partners, we agreed on some very specific delivery targets, of which the industry partners were very engaged. [At the workshop] we wanted the firms to be specific about their expectations and engage in setting the goals together with us'* (centre director B). The Beta centre also encouraged more informal contact, and the industry partners in turn invited university partners to discuss research activities. These invitations by the industry reflect the occurrence of industrial commitment and the perceived value of collaboration. As Firm B2 noted, *'I am very pleased with the interaction between us and the centre management'*.

4.2.3 The development of cognitive proximity

The two examined research centres were found to exhibit different levels of cognitive proximity, as measured by shared expertise and mutual understanding between

university and industry partners (Nooteboom, 2000). *Shared expertise* was found for both research centres. Several of the university researchers have industrial work experience, and several of the industry partners have a Ph.D. and have worked at the universities: *'I know how the university world 'works''* (Firm A2).

The main differences between the two research centres in terms of cognitive proximity relates to the levels of *mutual understanding* between the parties. Lower levels of mutual understanding were found in Period 1 in Alpha: *'Some [of the industry partners] understand innovation as it is supposed to be commercial; it is not'* (Centre Director A). While mutual understanding grew over time, challenges were still experienced, as noted by Firm A: *'We acknowledge that it is a [communication] challenge. Maybe we have not managed to explain it [research needs of the industry] well enough, but at the same time, we almost experience a professional arrogance'*.

However, over time, the centre's management team accommodated, based on suggestions from the industry partners, some key activities that increased the mutual understanding in the Alpha centre, which eased the communication between the different partners. To reconcile the differing understanding between university researchers and industry partners of what is considered an innovation, the centre categorised innovations to create a common ground: *'Because, to what degree are the reported 'innovations', really innovations?'* (Firm A2). Relatedly, the centre director followed up: *' … In effort to create a common understanding of innovation, we have therefore defined and characterised what we mean by innovation'*. Further, as many industry partners found it challenging to understand the academic papers, the researchers in Alpha began to create summaries: *'The publications are often very technical … many formulas … So short summaries of the research results are well received'* (Firm A1) (see Table 3). As the mutual understanding increased, most of the university researchers in Alpha became more knowledgeable of how they could communicate to the industry partners: '*Over time, I have understood how I should talk with the industry partners and how I can fulfil their needs'* (WP leader A1).

While some level of mutual understanding was present between university and industry partners of the Beta centre in Period 1, the industry partners acknowledged that the communication could have been better: *'The communication is good, and we trust each other, but the technical communication and the mutual understanding could be improved'* (Firm B2). The university partners also reported being aware of the importance of developing mutual understanding, as illustrated by the quote by WP leader B: *'We have to try to find a mutual understanding of what we can do and how we can solve 'things' together'*, and *"there are many different subjects in the collaboration [research centre], and, of course, it is not easy to read the [research] results from a different subject* (WP leader B).

Over time, the mutual understanding between the partners improved, where the university partners facilitated key activities, such as summaries of academic articles based on industry partners requests; *'One small, but important aspect we have focused on … is the establishment [by the centre management] of a 'news flash', which presents the research we [the research centre] have achieved'* (Firm B1). Hence, over time, the research results were communicated in a more understandable way, where the partners experienced high levels of mutual understanding: *'I think we have a very similar understanding'* (Firm B2).

5. Discussion

University-industry research centres consist of university and industry partners who have notable complementarities but adhere to different institutional logics and thus different interests and goals (Perkmann, 2017). Research centres are established to facilitate collaborations that are less likely to occur without governmental interference, and they are therefore designed to address research gaps in specific industries not currently pursued by any party (Gulbrandsen et al., 2015; Ponomariov & Boardman, 2010). Hence, our research question addresses how social and cognitive proximity develop over time and contribute to compliance with university and industry partners' different goals. We discuss the extent to which the research centres comply with the goals of producing academic research and contribute to innovation (Gulbrandsen et al., 2015; Lind et al., 2013; Ponomariov & Boardman, 2010).

Our findings indicate that it is challenging for university and industry partners to adhere to both research centre goals in the initial years of collaboration (Bjerregaard, 2010). Both parties have a tendency to focus on their own interests and goals without attending to the other partners' goals or each party's dependence on one another to achieve industrial and academic goals, which can be attributed to considerable institutional differences between university and industry partners (Bjerregaard, 2010; Perkmann, 2017).

5.1 The first period of collaboration: low levels of social and cognitive proximity and mutual commitment in the research centres

Lower levels of social and cognitive proximity and mutual commitment between university and industry partners were found for both research centres during Period 1. Regarding levels of social proximity, most of the partners were, as previously found (Broström, 2012; Steinmo & Rasmussen, 2016; Thune & Gulbrandsen, 2011), acquainted prior to the collaboration; however, they did not interact much during the first period (Balland, 2011). The mutual commitment, defined as the mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners, were also quite low in Period 1, where university partners set the research agenda, and the industry partners exhibited limited engagement. The partners also exhibited lower levels of cognitive proximity, where mutual understanding of the objectives of the collaboration was limited and communication was challenging. At this time, industry partners experienced difficulties understanding the university partners' 'research language', and it was challenging for the university partners to adjust their communication (Galán-Muros & Plewa, 2016; Mittion, Adair, McKenzie, Patten, & Perry, 2007).

The Beta research centre developed some levels of social and cognitive proximity and mutual commitment during Period 1, making it easier for the partners to comply with the research centres' goals. Hence, we find a relationship between the social and cognitive proximity dimensions (Steinmo & Rasmussen, 2016; Villani et al., 2017) and mutual commitment, which together indicated that the Beta research centre somewhat managed to produce innovations and academic publications.

In summary, we argue that the development of social and cognitive proximity and mutual commitment partially contributed to the generation of some research results of relevance to both the industry partners and academic publications at the Beta research centre (see Table 2). However, the proximities and the mutual commitment did not reach the levels needed to adhere to the different goals in Period 1 (Gulbrandsen et al.,

2015; Lind et al., 2013). In contrast, the Alpha research centre did not develop the proximity dimensions and the mutual commitment needed to attend to both partners' goals, as university partners influenced the collaboration; although publications were produced, they were of limited relevance to the industry partners.

5.2 The second period of collaboration: mutual commitment as key for developing social and cognitive proximity

Our findings show that the Alpha research centre did not successfully adhere to the partners' different goals over time in the collaboration, where the research became more short term and commercially oriented based on the industry partners' interests (Bjerregaard, 2010; Perkmann & Walsh, 2007), which fulfiled the university partners' interests only to a very limited extent. Consequently, while the industry partners became more satisfied with the outcomes of the collaboration as they generated applicable results, the research conducted did not contribute to the research centre's goals of contributing to both industrial innovation and academic research (Gulbrandsen et al., 2015; Lind et al., 2013; Ponomariov & Boardman, 2010).

Partners of the Alpha research centre somewhat increased the levels of social and cognitive proximity in Period 2, as some industry partners became more involved in the collaboration, and the university researchers learned how to better communicate with the industry partners (Galán-Muros & Plewa, 2016; Mittion et al., 2007), which again confirms the relationship between social and cognitive proximity (Steinmo & Rasmussen, 2016; Villani et al., 2017). The centre's management team initiated several key activities (e.g., industry visits and co-authorship with industrial partners) (see Table 3). Such interactions co-evolved with- and boosted the levels of social proximity, while levels of cognitive proximity (mutual understanding), somewhat paradoxically, only slightly increased.

We argue that low levels of *mutual commitment*, regarding the mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners, is the main reason for only a slightly increased level of cognitive proximity in the Alpha centre. The lack of mutual commitment in Alpha is illustrated through the key activities of social and cognitive proximity (Table 3) that were only partially utilised. An example is the 'industry visits' performed by the university researchers, during which some of the industry partners were not even prepared to discuss potential research activities. The cases of 'co-authorship' serve as another example, as this involved little overlap in work practices; industry partners delivered the requested data, while university partners analysed the data independently. Although the levels of social proximity and mutual commitment somewhat increased over time in the Alpha centre, these two key activities (industry visits and co-authorship) illustrate opportunities to increase the shared expertise and mutual understanding (cognitive proximity) that did not reach their full potential at the research centre due to low mutual commitment.

Hence, we reveal important relationships between the proximity literature and the prior findings of the UIC literature, wherein repeated interaction (Thune & Gulbrandsen, 2011) and commitment are found to be central to UIC success (Mora-Valentin et al., 2004; Núñez-Sánchez et al., 2012; Okamuro & Nishimura, 2017). However, prior research has provided limited evidence regarding the extent to which actors should be committed or how such commitment should be put into action. Relatedly, the recent research on proximity has indicated important theoretical connections, specifically that social proximity may reduce

cognitive distance (Villani et al., 2017) or develop cognitive proximity over time (Steinmo & Rasmussen, 2016). However, limited evidence is provided concerning how social proximity builds cognitive proximity and the preceding activities and events and how these proximity dimensions enable university and industry partners to produce results that are relevant to both parties over time, which is one of the main reasons for establishing UICs (Cohen et al., 2002; Galán-Muros & Plewa, 2016).

Hence, we extend prior research by providing a more nuanced account of the development of cognitive proximity: We find that social proximity does not automatically develop cognitive proximity. Rather, social proximity in combination with *mutual commitment* is prerequisite to facilitate mutual understanding (cognitive proximity), of which mutual understanding is needed to comply with both partners' goals. Accordingly, we confirm and extend the findings of Ben Letaifa and Rabeau (2013), who studied the development of an unsuccessful cluster and showed that a lack of engagement between partners partly explains why proximities are at times not developed to sufficient levels.

Based on our findings and analysis, which are summarised in Tables 2 and 3, we observe that the Beta research centre managed to adhere to the partners' interests and goals over time. In Period 2, the university partners conducted research on issues that were discussed and found relevant for both parties based on datasets collected from industry partners, which allowed Beta's collaborative partners to produce academic research while contributing to innovation (Gulbrandsen et al., 2015; Lind et al., 2013). We explain the successful bridging of the partners' interest and goals through the strengthening of social proximity, mutual commitment, and cognitive proximity.

Over time, through repeated interactions, the Beta partners developed higher levels of social proximity (compared to those of Period 1) (Balland, 2011; Thune & Gulbrandsen, 2011). The industry partners increased their involvement, which is stated to be important for firms benefits of UICs (Jarvenpaa & Valikangas, 2016; Knockaert, Spithoven, & Clarysse, 2014), and the university partners engaged the industry partners more in collaborations through informal contact and by establishing new projects.

The Beta research centre facilitated comparable key activities to the Alpha centre; however, Beta strengthened the levels of social and cognitive proximity to a greater extent than Alpha. We attribute this outcome to strong levels of mutual commitment (mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners) between the university and industry partners, which, in combination with repeated contact (social proximity), is needed to develop mutual understanding (cognitive proximity) between collaborative partners. Moreover, through a co-evolutionary process of key activities such as increased informal contact, joint research projects, and summaries of articles (Table 3), the partners achieved a better mutual understanding of the scope of research activities that complied with the research needs of both partners.

Hence, through increased interaction and higher mutual commitment and understanding, university and industry partners at the Beta centre strengthened their ability to produce research results that are relevant to both parties. From this finding, we argue that cognitive proximity can be developed through the development of social proximity and mutual commitment between collaborative partners over time, which in turn helps collaborative partners produce both innovations and academic publications. Hence, we find a relationship between social and cognitive proximity and mutual commitment, which together contribute to complying with the research centres goals over time.

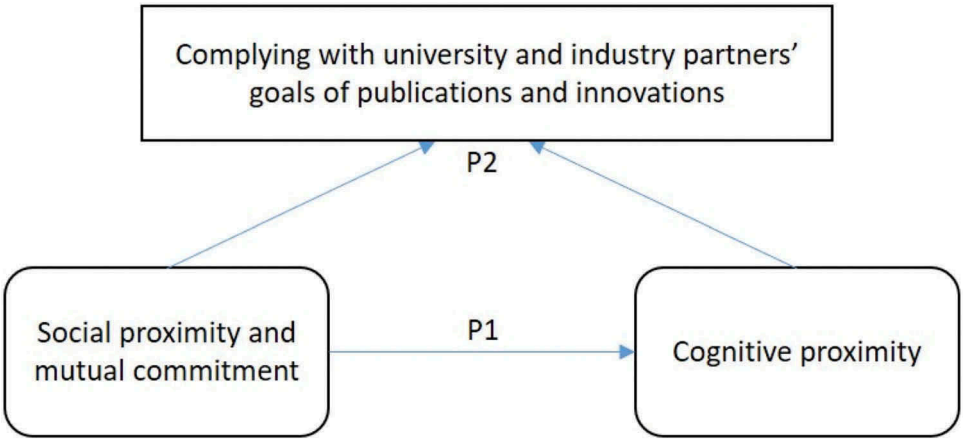

Figure 1. Complying with university and industry partners' goals of publications and innovations.

In summary, Figure 1 illustrates the relationships among social and cognitive proximity and mutual commitment and how they contribute to compliance with the goals of publications and innovations in university-industry research centres, with reference to the following propositions:

Proposition 1: Social proximity and mutual commitment between university and industry partners leverages cognitive proximity to a greater extent than when university and industry partners exhibit lower levels of mutual commitment.

Proposition 2: Compared to lower levels of social and cognitive proximity and mutual commitment between university and industry partners, higher levels comply to a greater extent with the goals of producing publications and innovations.

6. Conclusion

By studying two university-industry research centres over time, this paper refines our understanding of how proximity dimensions contribute to the achievement of the goals of publications and innovations at university-industry research centres and their development over time.

Due to the inherently challenging nature of compliance with collaborative partners' different goals in UICs, we propose that social and cognitive proximity are equally important for compliance with the centres' goals of producing academic research and contributing to industrial innovation at research centres (Gulbrandsen et al., 2015; Lind et al., 2013; Ponomariov & Boardman, 2010). Further, by illustrating *key activities* for the development of social and cognitive proximity, we show how these proximities co-evolve with actors' activities and interactions over time (Balland et al., 2015). Repeated contact (social proximity) strengthens personal relationships and thus facilitates exposure to

partners' different goals, which can be achieved through engagement in activities such as ad hoc informal contact and industry visits. Mutual understanding (cognitive proximity) contributes to greater consideration of each other's goals and can be achieved through key activities such as joint research projects and summarising of articles.

Finally, our key contributions are linked to the manner in which the dimensions of social and cognitive proximity interact and develop over time (Balland et al., 2015; Heringa et al., 2016; Mattes, 2012). We confirm that social proximity may develop cognitive proximity (Steinmo & Rasmussen, 2016) or reduce cognitive distance (Villani et al., 2017). However, we extend and nuance these findings by showing that repeated contact (social proximity) together with mutual commitment, which refers to a mutual willingness to engage in a two-way collaborative process that complies with the goals of both partners, acts as a key enabler of the development of cognitive proximity. As such, we identify important relationships to the proximity framework by connecting to and extending prior research that has shown that commitment is important for successful UIC but provided limited evidence regarding how such commitment should be put into action (e.g., Mora-Valentin et al., 2004; Núñez-Sánchez et al., 2012; Okamuro & Nishimura, 2017).

6.1 Implications

Our findings have important implications for university and industry partners involved in UIC aiming to develop academic research and industrial innovation, and for policy makers who provide funding for such collaborations. We find that social and cognitive proximity are essential for the achievement of the goals of a research centres and that it takes time to develop these proximities in research centres. Moreover, we find that proximity development requires mutual commitment from both parties and that both industry and university partners should participate actively. Consequently, these findings imply that formalising UIC through a research centre does not in itself automatically lead to increased interaction (Thune & Gulbrandsen, 2011, 2014). Hence, research partners should be motivated to involve industry partners early on and during the collaboration. To develop the proximity needed to support academic research and innovations, industry and university partners might be made aware of the value of forging relationships and mutual understanding, which can be developed through repeated interaction and commitment from both parties.

Our findings clearly illustrate the role of proximities in complying with both university and industry partners' goals over time and highlight some of the key activities that contribute to proximity development. We therefore echo Huber (2012) by calling for studies that extend beyond the statement that 'proximity matters' to study the key activities that support proximities in UIC. Because few scholars have studied the individual and firm levels in the UIC literature (with the exception of individual academics' research output, which has received substantial attention) (Chai & Shih, 2016), further research might benefit from examining firm and university representatives who are key performers in UICs (Boardman & Bozeman, 2015; Santoro & Chakrabarti, 2002). Future research could also explore and measure the extent to which the development of social and cognitive proximity improves collaborative outputs.

Note

1. Although our secondary data provide annual publication and innovation outcomes, the findings are not based on these because the report system of the research centres in Norway makes it possible for the partners to report publications and innovations that take place outside the research centre (e.g., spin-off or affiliated projects).

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References

Adler, N., Elmquist, M., & Norrgren, F. (2009). The challenge of managing boundary-spanning research activities: Experiences from the Swedish context. *Research Policy*, *38*(7), 1136–1149.

Alvesson, M., & Sköldberg, K. (2009). *Reflexive methodology: New vistas for qualitative research*. London: Sage.

Anderson, E., & Weitz, B. (1992). The use of pledges to build and sustain commitment in distribution channels. *Journal of Marketing Research*, *29*(1), 18–34.

Balland, P.-A. (2011). Proximity and the evolution of collaboration networks: Evidence from research and development projects within the global navigation satellite system (GNSS) industry. *Regional Studies*, *46*(6), 741–756.

Balland, P.-A., Boschma, R., & Frenken, K. (2015). Proximity and innovation: From statics to dynamics. *Regional Studies*, *49*(6), 907–920.

Barnes, T., Pashby, I., & Gibbons, A. (2002). Effective university – industry interaction: A multi-case evaluation of collaborative R&D projects. *European Management Journal*, *20*(3), 272–285.

Belderbos, R., Carree, M., Lokshin, B., & Sastre, J. F. (2015). Inter-temporal patterns of R&D collaboration and innovative performance. *The Journal of Technology Transfer*, *40*(1), 123–137.

Ben Letaifa, S., & Rabeau, Y. (2013). Too close to collaborate? How geographic proximity could impede entrepreneurship and innovation. *Journal of Business Research*, *66*(10), 2071–2078.

Berggren, C., Bergek, A., Bengtsson, L., & Söderlund, J. (2011). Exploring knowledge integration and innovation. In C. Berggren, A. Bergek, L. Bengtsson, M. Hobday, & J. Söderlund (Eds.), *Knowledge integration & innovation: Critical challenges facing international technology-based firms* (pp. S. 3–19). Oxford: Oxford University Press.

Bjerregaard, T. (2010). Industry and academia in convergence: Micro-institutional dimensions of R&D collaboration. *Technovation*, *30*(2), 100–108.
Boardman, P. C. (2012). Organizational capital in boundary-spanning collaborations: Internal and external approaches to organizational structure and personnel authority. *Journal of Public Administration Research and Theory*, *22*(3), 497–526.
Boardman, P. C., & Bozeman, B. (2015). Academic faculty as intellectual property in university-industry research alliances. *Economics of Innovation and New Technology*, *24*(5), 403–420.
Boardman, P. C., & Gray, D. (2010). The new science and engineering management: Cooperative research centers as government policies, industry strategies, and organizations. *The Journal of Technology Transfer*, *35*(5), 445–459.
Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies*, *39*(1), 61–74.
Boschma, R., & Lambooy, J. G. (1999). Evolutionary economics and economic geography. *Journal of Evolutionary Economics*, *9*(4), 411–429.
Bozeman, B., Fay, D., & Slade, C. (2013). Research collaboration in universities and academic entrepreneurship: The-state-of-the-art. *The Journal of Technology Transfer*, *38*(1), 1–67.
Broekel, T., & Boschma, R. (2012). Knowledge networks in the Dutch aviation industry: The proximity paradox. *Journal of Economic Geography*, *12*(2), 409–433.
Broström, A. (2012). Firms' rationales for interaction with research universities and the principles for public co-funding. *The Journal of Technology Transfer*, *37*(3), 313–329.
Bruneel, J., D'Este, P., & Salter, A. (2010). Investigating the factors that diminish the barriers to university–Industry collaboration. *Research Policy*, *39*(7), 858–868.
Chai, S., & Shih, W. (2016). Bridging science and technology through academic–Industry partnerships. *Research Policy*, *45*(1), 148–158.
Cohen, W., . M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152.
Cohen, W., . M., Nelson, R. R., & Walsh, J. P. (2002). Links and impacts: The influence of public research on industrial R&D. *Management Science*, *48*(1), 1–23.
D'Este, P., & Perkmann, M. (2011). Why do academics engage with industry? The entrepreneurial university and individual motivations. *The Journal of Technology Transfer*, *36*(3), 316–339.
Davids, M., & Frenken, K. (2017). Proximity, knowledge base and the innovation process: Towards an integrated framework. *Regional Studies*, 1–12. doi:10.1080/00343404.2017.1287349
De Fuentes, C., & Dutrenit, G. (2016). Geographic proximity and university-industry interaction: The case of Mexico. *The Journal of Technology Transfer*, *41*(2), 329–348.
Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550.
Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, *50*(1), 25–32.
Eisenhardt, K. M., Graebner, M. E., & Sonenshein, S. (2016). Grand challenges and inductive methods: Rigor without rigor mortis. *Academy of Management Journal*, *59*(4), 1113–1123.
Estrada, I., Faems, D., Martin Cruz, N., & Perez Santa, P. (2016). The role of interpartner dissimilarities in industry-university alliances: Insights from a comparative case study. *Research Policy*, *45*(10), 2008–2022.
Filippetti, A., & Savona, M. (2017). University–Industry linkages and academic engagements: Individual behaviours and firms' barriers. Introduction to the special section. *The Journal of Technology Transfer*, *42*(4), 719–729.
Fitjar, R. D., Huber, F., & Rodríguez-Pose, A. (2016). Not too close, not too far: Testing the goldilocks principle of 'optimal' distance in innovation networks. *Industry and Innovation*, *23* (6), 465-487. doi: 10.1080/13662716.2016.1184562
Fonti, F., Maoret, M., & Whitbred, R. (2017). Free-riding in multi-party alliances: the role of perceived alliance effectiveness and peers' collaboration in a research consortium. *Strategic Management Journal*, *38*(2), 363-383. doi: 10.1002/smj.2470

Franco, C., Marzucchi, A., & Montresor, S. (2014). Absorptive capacity, proximity in cooperation and integration mechanisms. Empirical evidence from CIS data. *Industry and Innovation*, *21* (4), 332–357.
Galán-Muros, V., & Plewa, C. (2016). What drives and inhibits university-business cooperation in Europe? A comprehensive assessement. *R&D Management*, *46*(2), 369–382.
Geisler, E. (2003). Benchmarking interorganisational technology cooperation: The link between infrastructure and sustained performance. *International Journal of Technology Management*, *25*(8), 675–702.
Gephart, R. P. (2004). Qualitative research and the academy of management journal. *Academy of Management Journal*, *47*(4), 454–462.
Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology*, *91*(3), 481–510.
Gray, D. O., Lindblad, M., & Rudolph, J. (2001). Industry–university research centers: A multivariate analysis of member retention. *The Journal of Technology Transfer*, *26*(3), 247–254.
Greenwood, R., Hinings, C. R., & Whetten, D. (2014). Rethinking institutions and organizations. *Journal of Management Studies*, *51*(7), 1206–1220.
Greenwood, R., Raynard, M., Kodeih, F., Micelotta, E. R., & Lounsbury, M. (2011). Institutional complexity and organizational responses. *The Academy of Management Annals*, *5*(1), 317–371.
Gulbrandsen, M., Thune, T., Borlaug, S. B., & Hanson, J. (2015). Emerging hybrid practices in public–Private research centres. *Public Administration*, *93*(2), 363–379.
Hansen, T. (2014). Juggling with proximity and distance: Collaborative innovation projects in the Danish cleantech industry. *Economic Geography*, *90*(4), 375–402.
Hansen, T. (2015). Substitution or overlap? The relations between geographical and non-spatial proximity dimensions in collaborative innovation projects. *Regional Studies*, *49*(10), 1672–1684.
Heringa, P. W., Hessels, L. K., & van der Zouwen, M. (2016). The influence of proximity dimensions on international research collaboration: An analysis of European water projects. *Industry and Innovation*, *23*(8), 753–772.
Heringa, P. W., Horlings, E., van der Zouwen, M., van den Besselaar, P., & van Vierssen, W. (2014). How do dimensions of proximity relate to the outcomes of collaboration? A survey of knowledge-intensive networks in the Dutch water sector. *Economics of Innovation and New Technology*, *23*(7), 689–716.
Herrmann, A. M., Taks, J. L., & Moors, E. (2012). Beyond regional clusters: On the importance of geographical proximity for R&D collaborations in a global economy—The case of the flemish biotech sector. *Industry and Innovation*, *19*(6), 499–516.
Hewitt-Dundas, N., Gkypali, A., & Roper, S. (2019). Does learning from prior collaboration help firms to overcome the 'two-worlds' paradox in university-business collaboration? *Research Policy*. doi:10.1016/j.respol.2019.01.016
Howells, J., Ramlogan, R., & Cheng, S.-L. (2012). Innovation and university collaboration: Paradox and complexity within the knowledge economy. *Cambridge Journal of Economics*, *36*(3), 703–721.
Huber, F. (2012). On the role and interrelationship of spatial, social and cognitive proximity: Personal knowledge relationships of R&D workers in the cambridge information technology cluster. *Regional Studies*, *46*(9), 1169–1182.
Jarvenpaa, S. L., & Valikangas, L. (2016). From governance void to interactive governing behaviors in new research networks. *Academy of Management Discoveries*, *2*(3), 226–246.
Kaiser, U., & Kuhn, J. M. (2012). Long-run effects of public–Private research joint ventures: The case of the Danish innovation consortia support scheme. *Research Policy*, *41*(5), 913–927.
Knoben, J., & Oerlemans, L. A. G. (2006). Proximity and inter-organizational collaboration: A literature review. *International Journal of Management Reviews*, *8*(2), 71–89.
Knockaert, M., Spithoven, A., & Clarysse, B. (2014). The impact of technology intermediaries on firm cognitive capacity additionality. *Technological Forecasting and Social Change*, *81*, 376–387.
Langley, A. (1999). Strategies for theorizing from process data. *The Academy of Management Review*, *24*(4), 691–710.

Leszczyńska, D., & Khachlouf, N. (2018). How proximity matters in interactive learning and innovation: A study of the Venetian glass industry. *Industry and Innovation*, 1–23. doi:10.1080/13662716.2018.1431524

Lind, F., Styhre, A., & Aaboen, L. (2013). Exploring university-industry collaboration in research centres. *European Journal of Innovation Management*, *16*(1), 70–91.

Mattes, J. (2012). Dimensions of proximity and knowledge bases: Innovation between spatial and non-spatial factors. *Regional Studies*, *46*(8), 1085–1099.

Meyer-Krahmer, F., & Schmoch, U. (1998). Science-based technologies: University–Industry interactions in four fields. *Research Policy*, *27*(8), 835–851.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. Los Angeles: Sage.

Mittion, C., Adair, C. E., McKenzie, E., Patten, S. B., & Perry, B. W. (2007). Knowledge transfer and exchange: Review and synthesis of the literature. *The Milbank Quarterly*, *85*(4), 729–768.

Mora-Valentin, E. M., Montoro-Sanchez, A., & Guerras-Martin, L. A. (2004). Determining factors in the success of R&D cooperative agreements between firms and research organizations. *Research Policy*, *33*(1), 17–40.

Mueller, P. (2006). Exploring the knowledge filter: How entrepreneurship and university–Industry relationships drive economic growth. *Research Policy*, *35*(10), 1499–1508.

Nooteboom, B. (2000). *Learning and innovation in organizations and economies*. Oxford: Oxford University Press.

Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., & Van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity. *Research Policy*, *36*(7), 1016–1034.

Núñez-Sánchez, R., Barge-Gil, A., & Modrego-Rico, A. (2012). Performance of knowledge interactions between public research centres and industrial firms in Spain: A project-level analysis. *The Journal of Technology Transfer*, *37*(3), 330–354.

Okamuro, H., & Nishimura, J. (2017). Whose business is your project? A comparative study of different subsidy policy schemes for collaborative R&D. *Technological Forecasting and Social Change*. doi:10.1016/j.techfore.2017.07.017

Omobhude, C., & Chen, S. H. (2019). The roles and measurements of proximity in sustained technology development: A literature review. *Sustainability*, *11*(1). doi:10.3390/su11010224

Pentland, B. T. (1999). Building process theory with narrative: From description to explanation. *The Academy of Management Review*, *24*(4), 711–724.

Perkmann, M. (2017). How boundary organizations facilitate collaboration across diverse communities. In F. Tell, C. Berggren, S. Brusoni, & A. Van de Ven (Eds.), *Managing knowledge integration across boundaries* (pp. 155–170).Oxford: Oxford University Press.

Perkmann, M., & Walsh, K. (2007). University–Industry relationships and open innovation: Towards a research agenda. *International Journal of Management Reviews*, *9*(4), 259–280.

Ponomariov, B. L., & Boardman, P. C. (2010). Influencing scientists' collaboration and productivity patterns through new institutions: University research centers and scientific and technical human capital. *Research Policy*, *39*(5), 613–624.

Rajalo, S., & Vadi, M. (2017). University-industry innovation collaboration: Reconceptualization. *Technovation*, *62–63*(42–54). doi:10.1016/j.technovation.2017.04.003

Research Council of Norway. (2008). Centres for environment-friendly energy research (CEER). (Description of the CEER scheme).Oslo

Santoro, M. D., & Chakrabarti, A. K. (2002). Firm size and technology centrality in industry–University interactions. *Research Policy*, *31*(7), 1163–1180.

Sauermann, H., & Stephan, P. (2013). Conflicting logics? A multidimensional view of industrial and academic science. *Organization Science*, *24*(3), 889–909.

Spithoven, A., & Knockaert, M. (2012). Technology intermediaries in low tech sectors: The case of collective research centres in belgium. *Innovation: Management, Policy & Practice*, *14*(3), 375–387.

Steinmo, M. (2015). Collaboration for innovation: A case study on how social capital mitigates collaborative challenges in university–industry research alliances. *Industry and Innovation*, 1–28. doi:10.1080/13662716.2015.1105127

Steinmo, M., & Rasmussen, E. (2016). How firms collaborate with public research organizations: The evolution of proximity dimensions in successful innovation projects. *Journal of Business Research*, *69*(3), 1250–1259.

Styhre, A., & Lind, F. (2010). Balancing centripetal and centrifugal forces in the entrepreneurial university: A study of 10 research centres in a technical university. *Technology Analysis & Strategic Management*, *22*(8), 909–924.

Thune, T., & Gulbrandsen, M. (2011). Institutionalization of university-industry interaction: An empirical study of the impact of formal structures on collaboration patterns. *Science and Public Policy*, *38*(2), 99–107.

Thune, T., & Gulbrandsen, M. (2014). Dynamics of collaboration in university–Industry partnerships: Do initial conditions explain development patterns? *The Journal of Technology Transfer*, *39*(6), 977–993.

Villani, E., Rasmussen, E., & Grimaldi, R. (2017). How intermediary organizations facilitate university–Industry technology transfer: A proximity approach. *Technological Forecasting and Social Change*, *114*, 86–102.

Wright, M., Clarysse, B., Lockett, A., & Knockaert, M. (2008). Mid-range universities' linkages with industry: Knowledge types and the role of intermediaries. *Research Policy*, *37*(8), 1205–1223.

Yin, R. K. (2013). *Case study research: Design and methods*. Los Angeles, California: SAGE.