

## **Paper draft**

# **Social Capital in Open Innovation Projects: How Firms Achieve Persistent Collaboration with Public Research Organizations**

**Marianne Steinmo and Einar Rasmussen**

**Bodø Graduate School of Business, University of Nordland, Norway**

**Contact: [einar.rasmussen@uin.no](mailto:einar.rasmussen@uin.no)**

## **ABSTRACT**

Open Innovation, or the use of external knowledge in the innovation process, is seen as a major driver for competitiveness. The literature on open innovation often refers to the firm's absorptive capacity to explain why firms are able to engage with external actors. However, the organizational dynamics underlying successful external relationships remains poorly understood. Based on a longitudinal study of R&D projects in 15 firms, we examine how different dimensions of social capital interplay when firms sustain fruitful collaborations with public research institutions (PROs). We show how different types of social capital are important for sustaining successful collaborations depending on firm characteristics and firm strategies. Firms with weak cognitive social capital compensate by relying on relational social capital and we observe that firms differ in their ability to build persisting collaborations based on organizational rather than individual social capital. Our study contributes to the open innovation and absorptive capacity literatures by examining the social integration mechanisms that influence how firms can realize their absorptive capacity. We conclude by discussing the strengths and weaknesses of relying on different social capital mechanisms and implications for different types of firms.

## **1.0 Introduction**

Innovation is a central driving force behind firm performance and profitability (Teece, 2007). However, many firms find it difficult to develop new innovations (Katila and Ahuja, 2002), especially non-incremental innovations that breaks with prior firm internal knowledge, technology and competence (Stuart and Podolny, 1996). The open model of innovation and related traditions within innovation studies highlight the importance of external sources of knowledge as a complement to internal knowledge (Chesbrough, 2003, Chesbrough et al., 2006, Von Hippel, 1988). Innovative organizations have to engage external actors to get access to ideas and resources (Dahlander and Gann, 2010) and enrich and expand their technological resource base. However, it is far from easy to identify and assimilate relevant external knowledge sources (Cohen and Levinthal, 1990).

The concept of absorptive capacity has been seen as a precondition of open innovation (Spithoven et al., 2011). Absorptive capacity is defined as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal, 1990). The positive effect of absorptive capacity on successful collaboration is well documented (Van Wijk et al., 2008). However, the organizational antecedents of absorptive capacity have been largely neglected in the literature (Van Wijk et al., 2008) and the organizational mechanisms behind the creation and persistence of absorptive capacity is not well documented (Schleimer and Pedersen, 2013). This paper will build theory on the social integration mechanisms facilitating successful external collaboration for innovation.

It is widely accepted that social processes is highly influential for organizational behavior and effectiveness (Granovetter, 1985b). Zahra and George (2002) suggested that

firms' displaying similar levels of potential absorptive capacity could differ in their level of realized absorptive capacity depending on their use of social integration mechanisms. Hence, different dimensions of social capital, such as structural, cognitive, and relational social capital, may be crucial for firms to be able to create and transfer knowledge (Nahapiet and Ghoshal, 1998b). A key benefit of social capital is access to new sources of knowledge (Inkpen and Tsang, 2005).

One of the most important open innovation practise relates to the use of PROs as sources for knowledge during the development of innovations (Mina et al.). Although collaboration with PROs is generally seen as beneficial for firm performance (Aschhoff and Schmidt, 2008), empirical evidence is contradicting. Some studies find that collaboration with other companies enhance performance, but no effect for collaboration with universities (Medda et al., 2006, Miotti and Sachwald, 2003). Studies of SMEs have even detected a negative effect of PRO collaboration (Okamuro, 2007, Bougrain and Haudeville, 2002). The challenges in achieving fruitful collaborations with PROs is also evident in that a significant share of research partnerships with PROs fail (Lhuillery and Pfister, 2009).

While the effects of links between firms and PROs on innovation are extensively studied, the organizational dynamics underlying these relationships remain under-researched (Perkmann and Walsh, 2007). Firms may face difficulties in absorbing knowledge from PROs because firms and academic scientists approach problems differently and with different goals. While PROs are driven to educate and build new knowledge, firms seek to develop commercially valuable products and services. This gives rise to tensions between academic and commercial activities (Ambos et al., 2008), and different organizational barriers (Bruneel et al., 2010).

To release the potential of using PROs as collaboration partners in the development of innovations, a better understanding of the microfoundations underlying such collaborations is needed. A more detailed theory of how firms use external knowledge sources requires a better understanding of the micro-level mechanisms, such as individuals, processes, structures, and their interactions (Felin et al., 2012). This paper looks at the role of social capital in the development of successful collaborations between firms and PROs. Social capital seems to be an important mechanism behind successful collaborations, but how this works is not clear. Hence, we pose the following research questions: 1) How do different dimensions of social capital contribute to successful innovation projects in collaboration between firms and PROs?, 2) How do different dimensions of social capital interact?, and 3) *How do firms develop and maintain social capital towards PROs?*

To fully understand the role of social capital in open innovation, we need to consider both the individual level and the organizational level of analysis. Social capital can relate to both these levels (Inkpen and Tsang, 2005). Hence, the outcomes of innovation projects are likely to be influenced by both individual and organizational social capital and the interplay between these. Moreover, social capital theory has a relational focus and is based in the connection between actors as unit of analysis. Most studies of absorptive capacity and inter-organizational collaboration takes the boundaries of the firms for granted, focusing on factors perceived to be either inside or outside of the firm. Recent qualitative evidence suggests that firm boundaries are blurred and hard to define, particularly in the development of new innovations (Easterby-Smith et al., 2008, Santos and Eisenhardt, 2009). Hence, it is particularly insightful to study the project level, because this is the context where individuals from different organizations meet to pursue a common outcome.

Social capital is an important condition for knowledge transfer to occur, but not a sufficient condition. Our aim is to study the role of social capital for actual knowledge transfer. Therefore, this study is based on longitudinal case analysis of only successful innovation projects in 15 firms of varying size and age. All innovation projects are successful

because they have produced innovations that are considered profitable or potentially profitable by the firms. Hence, our case material provides novel insights into the determinants of successful open innovation.

By studying the interplay of social capital dimensions in collaborative innovation projects, we contribute to research on social capital and open innovation in several ways. First, we go behind the emphasis on the outcomes of social capital by studying the content and the creation of inter-organizational social capital. Although a better understanding of the interrelationship between different dimensions of social capital has been called for (Nahapiet and Ghoshal, 1998b, Inkpen and Tsang, 2005), few empirical studies have examined this relationship in any detail.

Second, we contribute to a better understanding of the multilevel nature of inter-organizational social capital by exploring how individual level social capital can be an important resource in collaborations and that firms can build upon individual level social capital to develop organizational level social capital.

Third, we provide new insights into the role of firm characteristics for the use and development of different social capital dimensions. Prior firm level experience of collaboration is typically seen as an important dimension of absorptive capacity because it creates cognitive social capital. Our study shows that firms lacking such prior experience may compensate by relying on individual level relational social capital.

This article proceeds as follows. Section 2 presents our theoretical framework. The third section presents the methodological approach used to study radical innovation projects in 15 Norwegian firms. In Section 4 our findings and discussion are presented and propositions are developed to sum up the main findings. Finally, conclusions and implications for further research and practice are provided.

## **2.0 Theoretical framework**

### *2.1. Social capital*

It has been suggested that social capital is important to open innovation because it helps the firm to identify and forge effective relationships with relevant partners (Tether and Tajar, 2008). Social capital can be defined as “the aggregate of resources embedded within, available through, and derived from the network of relationships possessed by an individual or organisation” (Inkpen and Tsang, 2005). To achieve effectively knowledge transfer, firm should proactively build social capital (Inkpen and Tsang, 2005). Social capital can be seen from a bridging perspective or a bonding perspective. The bonding view of social capital focuses on the internal characteristics of collective actors, where the boarder can reflect organizations, communities or nations. The bridging view, which this paper builds upon, relates to social capital as a source to enhance networks tying with external relations (Adler and Kwon, 2002). This study follows (Nahapiet and Ghoshal, 1998a) who outlined the role of the structural, cognitive, and relational dimensions of social capital. The first dimension reflects the *formal structure* of collaborative ties and the two last focuses on the *content* of the ties (Adler and Kwon, 2002). All dimensions of social capital are found to be important for inter- and intra-organizational knowledge transfer, with relational capital as the strongest driver (Van Wijk et al., 2008).

*Structural* social capital describes the advantages related to an actors’ network of contacts. It relates to the linkages between people and organizational units and can be seen as an overall pattern of connections which shows who and how actors reach each other (Burt, 1992). It concern on the importance of network configuration and tie bindings of the actors in innovative processes (Ahuja, 2000, Powell et al., 1996). The structural dimension of social capital is important for knowledge transfer, because network ties enhance learning for all the actors and reduces their competitive attitude towards learning (Inkpen and Tsang, 2005).

Especially the stability of network ties determine its effects on learning and innovation (Inkpen and Tsang, 2005). Firms with central network positions are better able to accumulate knowledge from collaborative partners (Van Wijk et al., 2008). Factors that strengthen ties include prior and repeated contacts between actors (Gulati, 1995).

*Cognitive* social capital refers to shared interpretations and systems of meanings (Cicourel, 1974), common language and codes (Monteverde, 1995), and shared narratives (Orr, 1990) among parties. When organizations have shared visions and systems it is easier to learn from each other (Hult et al., 2004). Cognitive social capital have been divided in two categories related to shared goals or shared culture (Adler and Kwon, 2002). Shared goals refer to common understanding and approach concerning the network tasks (Inkpen and Tsang, 2005), and common perspectives about goals (Masiello et al., 2013). Shared culture refers to rules and norms that determine appropriate behavior in the network. (Inkpen and Tsang, 2005) highlight that when actors within a network have cultural linkages it is easier to transfer knowledge. However, firms that are too cognitive similar may reduce the creation of innovation in inter-organizational learning as (Cowan et al., 2007) have found an inverted U-shape relationship between cognitive social capital and innovation in collaborative innovative performance.

*Relational* social capital focuses on relational closeness and trust and refers to: “Those assets created and leveraged through relationships” (Nahapiet and Ghoshal, 1998a). It describes personal relationships through prior contacts (Granovetter, 1992) and concerns mutual respect and friendship, expectations and reputations (Adler and Kwon, 2002). Strong relations and trustworthiness between actors make knowledge transfer easier (Reagans and McEvily, 2003). (Van Wijk et al., 2008) found that relational social capital is the most important dimension of social capital as a driver for inter-organizational knowledge transfer given the effect of trust and tie strengths. Firms with high levels of relational social capital with collaborative partners transfer knowledge easily because of openness to share information and low transaction costs (Adler and Kwon, 2002). Trust is an important determinant when firms select collaborative partners, as an actor is more willing to share resources with trustworthy partners (Tsai, 2000). High levels of trust reduce opportunistic behavior and knowledge monitoring costs (Putnam, 1993). Conversely, (Yli-Renko et al., 2001) argue that when trust reaches a very high level it can be detrimental for knowledge transfer. This is because perceiving actors need to control decreases as well as the level of conflicts and information persuade which may diminish the creation of new knowledge (Masiello et al., 2013).

All three dimensions of social capital can play an important role for inter-organizational learning. Structural social capital can be required to gain access to networks that contain valuable and diverse knowledge for a firm. Relational and cognitive social capital can facilitate effective knowledge transfer (Van Wijk et al., 2008). However, social capital may have some negative consequences. A high level of social capital can impede creativity and idea generation because social capital may limit the access to diverse sources of new knowledge (Nahapiet and Ghoshal, 1998a).

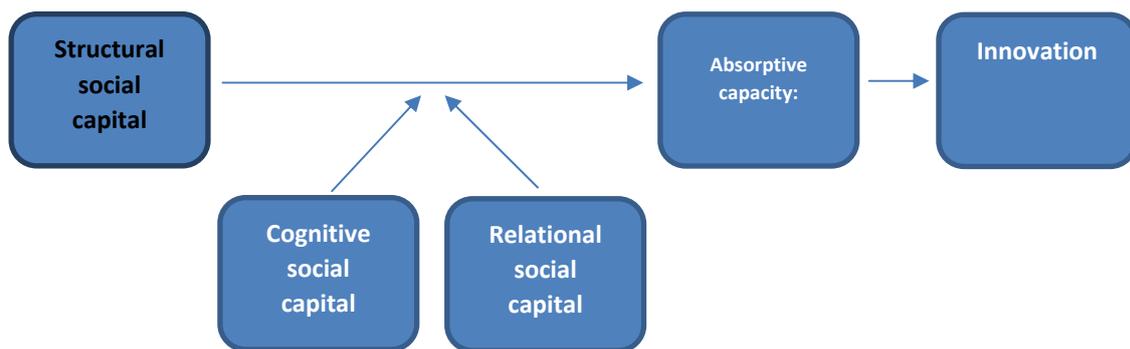
Researchers have explored the interplay between the different dimensions of social capital. Actors with strong symmetrical ties have been associated with interpersonal trustworthy relations (Granovetter, 1985a). Additionally, interdependency between shared language (cognitive social capital) and social relations (relational capital) has been highlighted (Ashforth and Mael, 1996). Moreover, not all the dimensions of social capital are mutually dependent. A network consisting of strong structural ties may not contribute to cognitive and relational social capital which enables effective operation (Nahapiet and Ghoshal, 1998a).

### 2.1. Conceptual framework

This study focuses on how firms can develop strong ties to PROs and thereby examine the content and strengths of ties by cognitive and relational social capital, which is known as determinants for tie strengths (Capaldo, 2007).

We examine how individual and organizational social capital can benefit firms in collaborating with PROs. Figure 1 shows a conceptual framework relating to the role of social capital in developing collaborative innovative performance, where firms manage to identify and acquire knowledge from collaborative PROs to facilitate the creation of innovations. Structural social capital is not enough? Needs to study the interplay between different types of social capital

Several studies have examined the formal collaboration structure between firms and PROs, and thereby focused on the structural part of social capital. Development and realization of technological innovations is a complex process that requires comprehensive collaboration between firms and PROs. Hence, our attention is mainly on the content of the formal structures which we study through the cognitive and relational dimensions of social capital. We assume structural social capital is not enough to take full advantage of PRO collaboration in order to develop innovations. In addition, cognitive and relational social capital may provide valuable content to collaboration and increase firms' ability to absorb and use external knowledge (see Figure 1).



**Figure. 1.** Conceptual framework

Moreover, variations in firm characteristics may influence how firms are able to benefit from the different social capital dimensions. Hence, our attention is how cognitive and relational social capital influence firms' ability to identify and acquire knowledge from collaborative PROs, which in turn facilitates innovation.

## 3.0. Methodology

### 3.1. Research design

Our aim is to build theory on the development and use of social capital between firms and PROs in the development of innovations. A longitudinal case-study design was chosen to key into the interplay between different dimensions of social capital between the collaborative partners. This facilitated richer contextual insights and an in-depth understanding of a process that has been scarcely investigated in prior studies (Eisenhardt, 1989). Multiple-case studies provide a stronger base for theory building (Yin, 1989) as emergent findings can be compared across cases and the findings may be grounded in varied empirical evidence (Eisenhardt and Graebner, 2007).

### *3.2. Case selection*

The cases are selected from a population of projects that received support from a public support scheme - called BIP (user-driven innovation projects) - that supports high-potential innovation projects in Norwegian firms. In total, 709 projects have received BIP-support between 1996 and 2005. Each project was managed by a lead firm and always included at least one research institution and often other firms as partners. Since we wanted to explore cases where actual knowledge transfer had taken place, this study includes 15 projects that were among the top-performing in the sense that the lead firms had reported high contribution to profit from the project three years after the project was finished. The projects were conducted by firms that vary in size from small start-ups to large industrial firms, which provides a variety in context (Yin, 1989). Moreover, the firms varied in R&D experience and organization, as shown in Table 1.

### *3.3. Data Collection*

Typically, archival data regarding the pre start-up and start-up activities of innovation projects are scarce. Because these projects had been part of a public support program, we were able to obtain similar information about all cases. The data includes archival material, such as the initial project description, the final report, and the assessment made by the R&D program, as well as survey responses from the firm at the start, the finish, and three years after the project period. In addition, relevant written documentation was collected from sources such as press articles and web pages.

Furthermore, we interviewed, in average, three key persons in each case to get an in-depth understanding of how the innovation process unfolded in each case, including the interactions between the firm and their collaborating partners. In total, we conducted face-to-face interviews with 34 persons and telephone interviews with 10 persons in October and November 2010. The interviews were recorded and transcribed by the authors as part of the data analysis process.

To get an in-depth understanding of how the innovation process unfolded in each case we followed a narrative approach (Polkinghorne, 1988). The interviewers asked the informant to describe the process from inception to present with a minimum of interruptions by the interviewers. As an overall interview template, we aimed at revealing the history in chronological order starting with the background for the initiation of the innovation project, then the planning of the project, the execution of the project and finally the results gained from the project. To gain more detailed information concerning the critical events and the actors involved throughout the process, we used open follow-up questions such as: "Why did you do that?" "Who was involved in this event?" "Did you consider alternative actions?" "When did this happen?" To avoid biases, the interviewers did not explicitly refer to the theoretical concepts used in this paper. This type of narrative interviewing was done to get a better understanding of the actual events and to avoid the influence of personal views and theoretical perspectives on the data collection. Done properly, the use of retrospective reports is a good research methodology (Miller et al., 1997).

### *3.4. Data Analysis*

Our data provided both narrative accounts of the process (Pentland, 1999) and factual descriptions of context, actors, and events from different sources. Based on the interviews and available documents we wrote case descriptions of each case that were verified by the firm's project manager as a validity check. The data analysis is based on triangulation of data sources to analyze each case, followed by cross-case comparison, in order to get a comprehensive picture about how the project and firm levels interact with external collaboration partners such as research organizations. To derive theoretical explanations for

the processes observed, we identified observations that matched theoretical concepts (Orton, 1997, Borch and Arthur, 1995). To avoid conflating the multiple levels of analysis, the strategy of retrodution was used (Leca and Naccache, 2006, Downward and Mearman, 2007). Thus, as the analysis proceeded, the overarching logical frame shifted from exploring data, to building theoretical models, and empirically scrutinizing these models (Van de Ven and Poole, 2002). Coded each firm on key dimensions of social capital.

### 3.0. Results and discussion

#### 3.1. Collaboration between firms and PROs

The R&D projects in our study had a well developed collaboration with external PROs, usually a university or public research institute. Typically, the external PRO partners added new knowledge, as expressed by one project manager: *"We would not be able to succeed without them. We did not have enough knowledge in our R&D department or in the company to succeed with this project"*. Table 1 summarizes the types of innovations developed in the projects, firm size, and each firm's R&D experience.

**Table 1.** Firm size, type of innovation, and R&D experience at project start.

Firm	Size*	Type of innovation developed in the R&D project	Quotes related to the type of innovation	Level of R&D experience at project start
1 Biotech (2 Projects)	Large	New technology	<i>"We managed to transform a high tech research tool to be applicable on a lower level"</i>	High level. Long experience with internal R&D. R&D a key part of the firm's operations.
2 ICT	Micro	New technology	<i>"This project was the first of its kind in Norway...in retrospect it turns out that we were the first in the world on this"</i>	High level. R&D is main activity of firm. Close relationships with academic research.
3 Large process industry	Large	Improved tool- technology	<i>"...we developed a radically new tool-technology which improved the duration of tools by 400-500 percent"</i>	High level. Own R&D department. Long experience with R&D.
4 Large process industry	Large	Improved energy efficiency	<i>"To be competitive we had to improve our concept, which we succeed in"</i>	High level. Internal R&D team. Long experience with R&D
5 Science-based	Micro	New technology	<i>"Developed a new method that was cheaper and easier to use than competing technologies"</i>	High level. R&D is main activity of firm. Firm established by researcher
6 Science-based	Small	Method improvement	<i>"Increased value by developing a more predictable method"</i>	High level. R&D a key part of firm's operations. Firm spun-off from research institute
7 Biotech	Micro	New technology	<i>"Diagnostic and treatment methods that can detect disease at an early stage, and slow or stop a disease process"</i>	High level. R&D is main activity of firm. Close relationships with academic research
8 Engineering	Large	Technology improvement	<i>"This technology has led to a quadruple efficiency, which has given a noticeable sale-effect"</i>	Moderate level. Own R&D department Experience from similar projects
9 Large process industry	Large	Technical improvement	<i>"Unfortunately we had to close down the plant where this technology was implemented, but in the time period from implementation to plant closure it had a substantial effect"</i>	Moderate level, but longstanding R&D experience and own R&D department
10 Network, several firms	Small	Improved knowledge in a new business area	<i>"There has been a large increase in the utilization of [Technology X] in Norway...this project has contributed to this increase both through building knowledge and diffusion of interests"</i>	Moderate level. Project initiated by public research institute. Project initiated by public research institute
11 Engineering	Large	Technology improvement	<i>"Fundamental technological changes to secure marked position"</i>	Moderate level. Internal R&D team. Ongoing R&D activity

12 Engineering	Medium	New technology	<i>"First product in the marked"</i>	Moderate level, but R&D a key part of firm's operations. R&D important in building the firm.
13 Engineering	Medium	Organizational (Product development and brand improvement)	<i>"It was about building a brand; integrated product development, innovative solution-methods and differentiation through industry-design"</i>	Low level. Internal R&D and strong intention of increasing the R&D activity
14 Engineering	Large	New technology	<i>"We developed new technology for a conservative industry and needed a reference installation to convince [Customer group] to go for our technology"</i>	Low level. Good knowledge about prior R&D projects
15 Process industry	Large	Technology improvement	<i>"That improvement was worth a lot; over a 100 million NOK per year"</i>	Low level. R&D important building the firm

\*EUs measures of firm sizes are used: large > 250, medium < 250, small < 50, and micro < 10 employees.

Table 1 shows that all of the firms have relatively extensive R&D experience or knowledge. Seven firms in our sample are highly familiar with academic research, while eight firms are less familiar with R&D.

### 3.2. Research collaboration and the dimensions of social capital

All firms have achieved successful collaboration with PROs. However, we observed variety in the level of social capital dimensions for each firms. Table 2 provides an overview of the relationship between each firm and PROs in terms of structure, measured as structural social capital, and content, measured as cognitive and relational social capital. Each type of social capital is mapped trough theoretical core dimensions.

**Table 2.** Dimensions of the firms' social capital at project start.

Formal tie structure	Dimensions	Indicators	Cases														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>Structural social capital</b>	Number of ties towards PROs	Several	X	X			X		X								
		Few			X	X		X		X	X	X	X	X	X	X	
	Tie diversity	High	X	X	X				X		X	X					
		Moderate/low				X	X	X		X			X	X	X	X	
Tie stability	High			X	X		X		X	X	X	X	X	X	X		
	Moderate/Low	X	X			X		X		X							
Tie content	Dimensions	Indicators	Cases														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>Cognitive social capital</b>	Shared goals	High	X		X	X	X	X	X			X	X				
		Moderate/low		X						X	X			X	X	X	X
	Common language	High	X	X	X	X	X	X	X		X	X					
		Moderate								X			X	X	X	X	X
Shared culture	High	X	X	X	X	X	X	X				X	X	X	X	X	
	Moderate/low								X	X	X	X	X	X	X	X	
<b>Sum</b>		High	X	X	X	X	X	X	X								
		Moderate/low								X	X	X	X	X	X	X	X
<b>Relational social capital</b>	Prior contacts with PROs	High			X	X	X	X	X	X	X	X		X	X	X	
		Moderate/low	X	X									X				X
	Trust	High			X	X	X	X	X	X	X			X	X	X	
		Moderate/low	X	X								X	X				X
Mutual respect and friendship	High			X	X		X						X	X	X		
	Moderate/low	X	X			X		X	X	X	X		X			X	
<b>Sum</b>		High			X	X	X	X	X	X	X	X		X	X	X	
		Moderate/low	X	X									X				X

Structural social capital is mapped according to the number of ties towards PROs (Burt, 1992), the diversity of these ties (Reagans and Zuckerman, 2001), and the stability of these ties (Inkpen and Tsang, 2005). The firms with extensive prior experience (Cases 1-7) seem to have a variety of structural social capital towards PROs. The firms with less prior experience

(Cases 8-15) display a pattern of fewer ties of moderate to low diversity, but with high stability.

The level of cognitive social capital is mapped according to the level of shared goals (Inkpen and Tsang, 2005), common language (Monteverde, 1995) and shared culture (Inkpen and Tsang, 2005) with the PROs. It seems like the firms with much prior experience in sum have a higher level of cognitive social capital compared with the less experienced firms that have less cognitive social capital with the collaborating PROs.

Finally, the relational social capital is mapped by looking at the level of prior contacts (Granovetter, 1992), trust (Nahapiet and Ghoshal, 1998a), and mutual respect and friendship (Adler and Kwon, 2002) with the PROs. Trust is mapped through confidence, desirable behavior and interaction frequency (Ring and Van de Ven, 1994).

From Table 2 we can observe that all the firms with high level of prior experience (Cases 1-7) are characterized with a high level of cognitive social capital. This is in line with the absorptive capacity thesis and extensive empirical research that emphasizes the importance of prior R&D experience for building cognitive social capital that facilitates collaboration. In contrast, all firms with low level of prior experience (Cases 8-15) are firms with moderate/low level of cognitive social capital. Despite their low level of cognitive social capital, these firms are equally successful in their collaboration with PROs. Table 3 summarizes the different dimensions of social capital related to the two groups of firms.

**Table 3.** Social capital dimensions related to firms with higher and lower levels of prior R&D experience

Firm	Structural social capital	Cognitive social capital	Relational social capital
Cases 1-7	Several and diverse connections towards PROs	Shared culture, goals and understanding with PROs. Effective communication.  <i>“It is very close communication before, during and after the collaboration to explain which results we want to achieve and which of them we have succeeded with”</i> (firm representative)  <i>“It is important for us academics to be aware that the industry operates with different conditions than us. Moreover, that the industry understands our way of working. Such collaborations should be conducted in terms of both”</i> (research partner)	High level of relational social capital consisting of trust and personal relations. Strategic choice of collaborating with known partner.  <i>“He [the project manager] had a good relationship with [University X]...and they were willing to participate in the project”</i> (research partner)  <i>“We know each other very well. [The firm] has been very open with us into issues that for them are very confidential. We have been willing to operate with the same degree of confidentiality as [The Firm] themselves, so they can have complete trust in us”</i> (firm representative)
Cases 8-15	Few, similar and stable connections towards PROs.	Differences in culture, goals, and understanding with PRO. In addition to different knowledge bases this sometimes creates communication challenges.  <i>“In collaboration with PROs we often experience that the focus is directed towards their desires. They [PRO] want to get more research contracts, but we are interested in finishing the project when the technology is ready”</i> (firm representative)  <i>“The competent people on each side of the table had a very good relationship, whilst the lower competent people did not get along well”</i> (firm representative)  <i>“A form of communication may had helped. Very many specialized partners are too specialized which makes it difficult for us to understand”</i> (firm representative)	High level of relational social capital which helps the firms to overcome challenges regarding lack of cognitive social capital. Selection of collaboration partners based on prior relations.  <i>“When it comes to collaborative partners, it was natural to choose partners we have worked with before”</i> (firm representative)  <i>“I graduated from [university X] and know many of the people from that time. It was many of the same professors too. [Person X], my boss at that time, he had several contacts [in the research environment] that we used”</i> (firm representative)  <i>“It is not easy in day-to-day life to read heavy scientific articles you don’t understand, but when working together with someone for a few years, you really understand more”</i> (firm representative)  <i>“I was employed there [the firm] for 4 years”</i> (firm representative)

To explore the role and interplay of different dimensions of social capital for the PRO collaboration, we start by discussing the formal structure of collaboration between firms and PROs in terms of structural social capital. Then, we look at the content of the connections between firms and PROs by discussing cognitive social capital and relational social capital.

### *3.3. Structural social capital*

All of the firms had already established a formal collaboration with at least one PRO when the project covered by our study started. An application including a detailed project description and a signed collaboration agreement was required to receive the grant from the public support scheme. Hence, all of the firms possessed some level of structural social capital towards PROs. However, we find variety in the number of connections, as well as the diversity and stability of the connections. Firms with high R&D experience tend to have several and diverse connections with PROs. They are likely to have the expertise needed to know what kind of complementally expertise they need to develop innovations, and identify relevant knowledge sources.

In contrast, less experienced firms had fewer and similar contacts with PROs. Because of low R&D experience, they may rely on one specific partner they are familiar collaborating with. Almost all of the firms in our sample have stable connections towards their collaborative PROs. Only four of the firms show low degree of stability, not surprisingly, they are all experienced firms and are proactive in searching newer knowledge for further develop innovations. Less experienced firms may lack awareness of when they need new knowledge on and from what kind of knowledge sources they can find relevant knowledge, which may prevent them in searching for different types of external knowledge sources. Individuals' network plays a role in extending the number of PRO collaborations. This is especially the case for less experienced firms, that tend to establish collaborations with research partners they know, and often with individuals in PROs who previously have worked in the firm or vice versa. The more experienced firms mainly chose collaborative PROs based on relevance rather than personal networks.

On the one hand it is valuable with stable connections towards PROs because the firm can build valuable knowledge over time. On the other hand, few and stable connections may be vulnerable for the firms over time. For instance, if individuals in collaborative PROs quit, it will have negative consequences for the firm's social capital which relies on specific employees in the PRO. Hence, to strengthen the foundation of R&D collaboration it may be advantageous for these firms to build more connections to PRO and thereby strengthen the innovation capabilities over time. Thus we propose that:

Proposition 1: Firms with low levels of research experience are more likely to base their PRO collaborations on fewer and more stable social relationships than firms with high levels of prior research experience.

Proposition 2: Firms with low levels of research experience are more likely to base their PRO collaborations on individual social relationships than firms with high levels of prior research experience.

### 3.4. Cognitive social capital

Not surprisingly, firms with high R&D experience also have a high level of cognitive social capital towards their PRO partners. This group of firms have common understanding and approach to the development of technological innovations (Inkpen and Tsang, 2005). Some of these firms seem very conscious about the value of shared goals between them and the collaborating PROs and they highlighted the importance of common understanding, as one firm representative said: *“It is very important that we [the firm] and our collaborative research partners are clear on our goals and about our wishes. In addition, that we make space to the involved research collaborators, to make room for creating something new. The combination of shared goals and space for creation of newness is very important”*.

This group of firms have common language and codes (Monteverde, 1995) related to the technologies. They have similar core knowledge as the PROs and added specialized knowledge from the PROs relevant for further technology development. Some of the experienced firms highlighted that communication between them and their collaborative PROs are good and they have also very integrated teams of academics and company employees, because of being R&D experienced.

The less experienced firms find it more challenging to collaborate with PROs as they lack common understanding and shared goals. Differences in goals between these firms and PROs created challenges and in many cases there were different opinions about the technology between the firm and its PRO partner: *“They [PRO partner] comes with a very strong wish of making a “store” of their contributions”* (firm representative).

Some of the less experienced firms see the value of collaborating with PROs but do not communicate effectively with them because the PROs are too specialized and use a language it is difficult for the firm to understand. The differences in knowledge bases were expressed as challenging by several informants. It is likely that the less experienced firms do not see the total value of collaborating with PROs and keep them at a distance, which may end up in frustration: *“He [PRO representative] was always frustrated and wanted to be nearer us [the firm]. We kept him at a distance as it always is a consideration about the confidentiality”* (firm representative).

Our cases show that employees in the firms are of special importance in building cognitive social capital and function in many cases as “research-translators”. This is particularly the case for the firms with low levels of R&D experience because they relied more on specific individuals. One example is an employee that previously was employed by the PRO partner. This employee enabled to build cognitive social capital among other employees in the firm that lead to increased level of collaboration with the PRO over time.

As expected, the more experienced firms have high levels of cognitive social capital, because several of the employees were either researchers themselves or had worked closely with researchers, and manage to collaborate effectively with PROs. However, despite their lack of R&D experience, the less experienced firms also managed to successfully collaborate with PROs and were able to identify and acquire external knowledge. However, due to their lack of cognitive social capital, relying on few and stable PRO connections is risky and not very flexible. We observed that by collaborating close with PROs over time, some of these firms were able to develop their cognitive social capital and their ability to accumulate new knowledge increased. When this group of firms develop their cognitive social capital it makes

them better able to search and establish collaborations with other PROs. Firms with lower levels of R&D experience need longer time to build cognitive social capital, because they need time to build common understanding and language as the research partner from the collaboration start. We argue that because their lack of cognitive social capital, the less experienced firm relies on relational social capital when drawing on external knowledge in innovation processes. Thus, we propose that:

Proposition 3: Firms with low levels of research experience are less likely to base their PRO collaborations on organisational cognitive social capital than firms with high levels of prior research experience.

Proposition 4: Firms with low levels of research experience are more likely to base their PRO collaborations on individual cognitive social capital than firms with high levels of prior research experience.

### 3.5. Relational social capital

All the cases shows that collaboration with PROs are important for developing innovations and that long standing close relations is important for the choice of collaborative research partners. This is especially the case for the less experienced firms. They rely more on relational social capital when connecting with research organizations because they are less familiar with using external knowledge. These connections are typically based on contacts with specific individuals inside the research organization they know.

Relational social capital is also important for the experienced firms. Only two of these firms had low level of relational social capital towards the PRO partners. These firms approached collaboration partners based on what type of knowledge they needed, rather than because of prior relations. The remaining five firms in this category have all prior relations to some of their collaborative partners, in particular the core partners.

Several of the PROs highlighted previous social relations as important for the collaboration, as expressed by a research partner collaborating with a less experienced firm: *“It was acquaintances which started talking about the technology as a possibility”*. Primary, it was employees in the firms that influenced the collaboration establishment, the additional partners were chosen because of relevant expertise. Although many of the informants from both more and less experienced firms claimed that they had not collaborated with the research partners before, it appeared several times in the interviews that strong connections between the collaborative partners existed, as one of the experienced firm representative passingly expressed: *“I had been working there [research partner] for a long time. I knew the system very well”*. Within both groups of firms, many representatives put a weight on the easiness of working with known partners.

All firms in our study firms have high degree of relational social capital. The main difference lies in the consciousness of the value of personal relations. Generally, the experienced firms were more strategic about why they involved external partners in innovation projects. This quote from a relatively small firm illustrates how they seek to integrate their internal R&D activity with the PRO partner: *We have had a key person at [the Research Institute] who has followed us since 1994, I think. He is still there and is often used in new projects. He has been very good for [the Firm]. The reason for [this collaboration] is*

*that we thought that if we [hired a researcher in the Firm] [...], he would fade as researcher. Then it is better to have him situated and mingling in a research group.”*

For the experienced firms, the choice of PRO partners was strategic, as the following quote from a project manager indicates: *“It was a strategic choice of which research institutes you want to go for and develop over time; these are the ones you choose”*. This firm representative also highlighted that they purposefully invested to build relevant competence in the collaborative PRO. The result was a very close relationship between the firm and the PRO, as explained by one of the PRO researchers: *“I have more and closer contact with them [firm employees] than I have with many colleges here [research institute]”*. One of the research partners collaborating with an experienced firm expressed the reason why the collaborative firm have chosen them as collaborative partner for such a long time: *“It is because they [the firm] see it as knowledge-building for us [research partner]. When we then eventually build on that specific competence, we are very useful for them [the firm], and can go directly into the production and solve the problems as good as their own researchers”*. We observe that in contrast to experienced firms which strategically choose relevant PRO partners, less experienced firms select partners among PROs they already know through personal relations.

We observed collaborations characterized by a high level of openness and interaction between the firms and their PRO partners. An important reason may be related to the confidentiality and trust developed between the firms and PRO over time. It seems clear that relational social capital is very important for accumulation of external knowledge. However, this may be the dimension of social capital which takes longest time to develop. For the firms with highest degree of relational social capital it is rooted back to old acquaintances such as fellow students and colleagues. One of the research partners collaborating with an experienced firm express the role of trust: *“We have shown that we are able to take care of [the firm’s] confidentiality and [the firm] invests in our knowledge building”*. Further, he explained the time consuming process of trust building: *“It take long time for [the firm] to involve other research partners because you have to show that you manage confidentiality”*. Some of the PROs are very consious about the value of trust and one of them who collaborated with a less experienced LC firm quoted: *“If we are going to end up doing something that break the trust-based relationship, such as we slips with the confidentiality, it can destroy the collaboration very quickly”*.

The absorptive capacity theory argues that high dissimilarity between partners facilitates the creation of novel innovations had it not been for the associated difficulties in communication. Our cases suggest that a high level of relational social capital between the firm and its PROs can counteract the negative effects associated with dissimilarity between partners (low cognitive social capital). We observe that relational social capital is important for different types of firms, but we see that relational social capital is of special importance for the less experienced firms. These firms compensate lack of cognitive social capital with relational social capital. Another important observation is that relational social capital helps the LC firms to build more cognitive social capital during the collaboration.

Few papers in the literature on R&D collaboration have examined the role of the relational dimension for beneficial external knowledge sourcing. Even recent review papers are quite silent on the role of social capital and trust for successful external knowledge sourcing from R&D alliances. Our case studies point clearly towards the importance of trust and relational social capital between the firms and their PRO partners. Thus we propose that:

**Proposition 5:** Firms with low levels of research experience are less likely to base their PRO collaborations on organizational relational social capital than firms with high levels of prior research experience.

Proposition 6: Firms with low levels of research experience are more likely to base their PRO collaborations on individual relational social capital than firms with high levels of prior research experience.

### *3.6. The interplay of social capital dimensions*

Our results show that both firms with high and low levels of prior experience manage to identify and acquire knowledge from PROs when developing new innovations. Not surprisingly experienced firms have R&D knowledge and experience (cognitive social capital) to understand collaborative PROs and take advantage of collaborating with them. All firms have high level of relational social consisting of personal relations and trust. However, despite low levels of cognitive social capital, the less experienced firms still manage to accumulate knowledge from collaborative PROs. We claim that this group of firms is highly dependent on relational social capital and stable connections to PROs over time which in many cases function as the firms' main R&D activity and knowledge builders. However, relying on few and stable connections to PROs may have some negative consequences. First, it may be vulnerable for the less experienced firms over time. Because these firms have few employees that collaborate with individuals in the PRO, the entire R&D activity of the firm is at risk if for instance some of the collaborative individuals quit or change work assignments. Another negative consequence may be that stable connections with particular PROs prevents the firms from involving other research partners, which may add newer and more valuable knowledge to the firm than the existing collaborative partners.

To reduce the vulnerability of having few and stable collaborative PROs the less experienced firms may increase their level of cognitive social capital to PROs in order to identify and acquire knowledge that contributes to innovation development. We see that relational social capital can lead to the development of cognitive social capital. As firm have trust and mutual respect to relational partners it helps them in building the cognitive social capital needed to reach common understanding and shared goals towards PROs which in turn increase the ability to collaborate with several and diverse PROs. Further, by transferring individuals' relations to an organizational level, the firm will strengthen its organizational cognitive social capital. Moreover, transferring R&D competence from individuals in the firms it will strengthen the firms' organizational cognitive social capital and thereby strengthen the firms' R&D fundament. It is a good starting point that less experienced firms are able to collaborate and create innovations in collaboration with PROs through relational social capital, but to maintain their innovation performance they should lift their R&D focus on a higher level by internalizing R&D orientation in a broader firm's perspective, relating to strategies and management. By internalizing R&D orientation they may also increase the firm's consciousness of the value of collaboration with PROs in innovation performance. Thus, we propose:

Proposition 7: Firms with low levels of research experience are more likely to initially base their PRO collaborations on individual level relational social capital that is leveraged into organizational level cognitive social capital over time.

#### 4.0. Conclusions and implications

This paper contributes with new evidence that refines our understanding on how social capital facilitates collaboration between firms and PROs in developing new innovations.

More to be added.

The development and maintenance of social capital is costly and resource demanding (Nahapiet and Ghoshal, 1998b). Our study shows how firms with limited levels of cognitive social capital can build effective social relationships through relational social capital at the individual level. Although relying on relational social capital can have drawbacks, this may be a cost efficient solution for smaller firms with limited amounts of resources to develop cognitive social capital to PROs.

##### 4.1. Limitations and implications for further research

Have not looked into the different knowledge types exchanged in these collaborations.

We observed that some firms over time develop a very open relationship with selected PROs characterized by very close interaction. In these cases the organizational boundaries were very ambiguous during the innovation processes we studied. This way of opening the firm's border in the innovation process was clearly dependent on the level of social capital and warrants further study.

##### Implications for practice

To capitalize on their relationships and be able to create efficient new relationships, firms need to understand how to manage and organize their social relationships. Our study suggests that how to best organize social relationships towards PROs may depend on the firm's level of prior research experience. Firms with limited experience are likely to have low levels of cognitive social capital and may compensate for this by relying on relational social capital among their employees.

#### References

- ADLER, P. S. & KWON, S.-W. (2002) Social Capital: Prospects for a New Concept. *The Academy of Management Review*, 27, 17-40.
- AHUJA, G. (2000) The Duality of Collaboration: Inducements and Opportunities in the Formation of Interfirm Linkages. *Strategic Management Journal*, 21, 317-343.
- AMBOS, T. C., MÄKELÄ, K., BIRKINSHAW, J. & D'ESTE, P. (2008) When Does University Research Get Commercialized? Creating Ambidexterity in Research Institutions. *Journal of Management Studies*, 45, 1424-1447.
- ASCHHOFF, B. & SCHMIDT, T. (2008) Empirical Evidence on the Success of R&D Cooperation—Happy Together? *Review of Industrial Organization*, 33, 41-62.
- ASHFORTH, B. E. & MAEL, F. A. (1996) Organizational identity and strategy as a context for the individual. *Advances in Strategic Management*, 13, 19-64.
- BORCH, O. J. & ARTHUR, M. B. (1995) Strategic Networks among Small Firms - Implications for Strategy Research Methodology. *Journal of Management Studies*, 32, 419-441.
- BOUGRAIN, F. & HAUDEVILLE, B. (2002) Innovation, collaboration and SMEs internal research capacities. *Research Policy*, 31, 735-747.
- BRUNEEL, J., D'ESTE, P. & SALTER, A. (2010) Investigating the factors that diminish the barriers to university–industry collaboration. *Research Policy*, 39, 858-868.
- BURT, R. S. (1992) Structural holes: The social structure of competition. 1992. *Harvard Univ. Pr.*
- CAPALDO, A. (2007) Network structure and innovation: The leveraging of a dual network as a distinctive relational capability. *Strategic management journal*, 28, 585-608.

- CHESBROUGH, H. W. (2003) *Open innovation : the new imperative for creating and profiting from technology*, Boston, Mass., Harvard Business School Press.
- CHESBROUGH, H. W., VANHAVERBEKE, W. & WEST, J. (2006) *Open innovation : researching a new paradigm*, Oxford, Oxford University Press.
- CICOUREL, A. V. (1974) Cognitive sociology: Language and meaning in social interaction.
- COHEN, W. M. & LEVINTHAL, D. A. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35, 128-152.
- COWAN, R., JONARD, N. & ZIMMERMANN, J.-B. (2007) Bilateral collaboration and the emergence of innovation networks. *Management Science*, 53, 1051-1067.
- DAHLANDER, L. & GANN, D. M. (2010) How open is innovation? *Research Policy*, 39, 699-709.
- DOWNWARD, P. & MEARMAN, A. (2007) Retrodution as mixed-methods triangulation in economic research: reorienting economics into social science. *Cambridge Journal of Economics*, 31, 77-99.
- EASTERBY-SMITH, M., GRAÇA, M., ANTONACOPOULOU, E. & FERDINAND, J. (2008) Absorptive Capacity: A Process Perspective. *Management Learning*, 39, 483-501.
- EISENHARDT, K. M. (1989) Building Theories from Case-Study Research. *Academy of Management Review*, 14, 532-550.
- EISENHARDT, K. M. & GRAEBNER, M. E. (2007) Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50, 25-32.
- FELIN, T., FOSS, N. J., HEIMERIKS, K. H. & MADSEN, T. L. (2012) Microfoundations of Routines and Capabilities: Individuals, Processes, and Structure. *Journal of Management Studies*, 49, 1351-1374.
- GRANOVETTER, M. (1985a) Economic action and social structure: the problem of embeddedness. *American journal of sociology*, 481-510.
- GRANOVETTER, M. (1985b) Economic action and social structure: the problem of embeddedness. *American Journal of Sociology*, 91, 481-510.
- GRANOVETTER, M. (1992) Problems of explanation in economic sociology. *Networks and organizations: Structure, form and action*, 25-56.
- GULATI, R. (1995) Social structure and alliance formation patterns: A longitudinal analysis. *Administrative science quarterly*, 619-652.
- HULT, G. T. M., KETCHEN, D. J. & SLATER, S. F. (2004) Information processing, knowledge development, and strategic supply chain performance. *Academy of Management Journal*, 47, 241-253.
- INKPEN, A. C. & TSANG, E. W. K. (2005) Social Capital, Networks, and Knowledge Transfer. *The Academy of Management Review*, 30, 146-165.
- KATILA, R. & AHUJA, G. (2002) Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal*, 45, 1183-1194.
- LECA, B. & NACCACHE, P. (2006) A critical realist approach to institutional entrepreneurship. *Organization*, 13, 627-651.
- LHUILLERY, S. & PFISTER, E. (2009) R&D cooperation and failures in innovation projects: Empirical evidence from French CIS data. *Research Policy*, 38, 45-57.
- MASIELLO, B., IZZO, F. & CANORO, C. (2013) The structural, relational and cognitive configuration of innovation networks between SMEs and public research organisations. *International Small Business Journal*.
- MEDDA, G., PIGA, C. & SIEGEL, D. S. (2006) Assessing the returns to collaborative research: Firm-level evidence from Italy. *Economics of Innovation and New Technology*, 15, 37-50.
- MILLER, C. C., CARDINAL, L. B. & GLICK, W. H. (1997) Retrospective Reports in Organizational Research: A Reexamination of Recent Evidence. *The Academy of Management Journal*, 40, 189-204.
- MINA, A., BASCAVUSOGLU-MOREAU, E. & HUGHES, A. Open service innovation and the firm's search for external knowledge. *Research Policy*.

- MIOTTI, L. & SACHWALD, F. (2003) Co-operative R&D: why and with whom?: An integrated framework of analysis. *Research Policy*, 32, 1481-1499.
- MONTEVERDE, K. (1995) *Applying resource-based strategic analysis: Making the model more accessible to practitioners*.
- NAHAPIET, J. & GHOSHAL, S. (1998a) Social Capital, Intellectual Capital, and the Organizational Advantage. *The Academy of Management Review*, 23, 242-266.
- NAHAPIET, J. & GHOSHAL, S. (1998b) Social Capital, Intellectual Capital, and the Organizational Advantage. *Academy of Management Review*, 23, 242-266.
- OKAMURO, H. (2007) Determinants of successful R&D cooperation in Japanese small businesses: The impact of organizational and contractual characteristics. *Research Policy*, 36, 1529-1544.
- ORR, J. E. (1990) Sharing knowledge, celebrating identity: Community memory in a service culture. *Collective remembering*, 169, 189.
- ORTON, J. D. (1997) From inductive to iterative grounded theory: zipping the gap between process theory and process data. *Scandinavian Journal of Management*, 13, 419-438.
- PENTLAND, B. T. (1999) Building process theory with narrative: From description to explanation. *Academy of Management Review*, 24, 711-724.
- PERKMANN, M. & WALSH, K. (2007) University–industry relationships and open innovation: Towards a research agenda. *International Journal of Management Reviews*, 9, 259-280.
- POLKINGHORNE, D. E. (1988) *Narrative knowing and the human sciences*, Albany, State University of New York Press.
- POWELL, W. W., KOPUT, K. W. & SMITH-DOERR, L. (1996) Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative science quarterly*, 116-145.
- PUTNAM, R. D. (1993) The prosperous community. *The american prospect*, 4, 35-42.
- REAGANS, R. & MCEVILY, B. (2003) Network structure and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly*, 48, 240-267.
- REAGANS, R. & ZUCKERMAN, E. W. (2001) Networks, Diversity, and Productivity: The Social Capital of Corporate R&D Teams. *Organization Science*, 12, 502-517.
- RING, P. S. & VAN DE VEN, A. H. (1994) Developmental processes of cooperative interorganizational relationships. *Academy of management review*, 19, 90-118.
- SANTOS, F. & EISENHARDT, K. (2009) Constructing Markets and Shaping Boundaries: Entrepreneurial Power in Nascent Fields. *Academy of Management Journal*, 52, 643-671.
- SCHLEIMER, S. C. & PEDERSEN, T. (2013) The Driving Forces of Subsidiary Absorptive Capacity. *Journal of Management Studies*, 50, 646-672.
- SPITHOVEN, A., CLARYSSE, B. & KNOCKAERT, M. (2011) Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation*, 31, 10-21.
- STUART, T. E. & PODOLNY, J. M. (1996) Local search and the evolution of technological capabilities. *Strategic Management Journal*, 17, 21-38.
- TEECE, D. J. (2007) Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28, 1319-1350.
- TETHER, B. S. & TAJAR, A. (2008) Beyond industry–university links: Sourcing knowledge for innovation from consultants, private research organisations and the public science-base. *Research Policy*, 37, 1079-1095.
- VAN DE VEN, A. H. & POOLE, M. S. (2002) Field research methods. IN BAUM, J. A. C. (Ed.) *Companion to Organizations*. Oxford, Blackwell.
- VAN WIJK, R., JANSEN, J. J. P. & LYLES, M. A. (2008) Inter- and Intra-Organizational Knowledge Transfer: A Meta-Analytic Review and Assessment of its Antecedents and Consequences. *Journal of Management Studies*, 45, 830-853.
- VON HIPPEL, E. (1988) *The sources of innovation*, Oxford, Oxford University Press.
- YIN, R. K. (1989) *Case study research. Design and methods*, Newbury Park, SAGE Publications Ltd.

- YLI-RENKO, H., AUTIO, E. & SAPIENZA, H. J. (2001) Social capital, knowledge acquisition, and knowledge exploitation in young technology-based firms. *Strategic management journal*, 22, 587-613.
- ZAHRA, S. A. & GEORGE, G. (2002) Absorptive Capacity: A Review, Reconceptualization, and Extension. *The Academy of Management Review*, 27, 185-203.