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A networking culture to benefit from open innovation - a comparison between technology and business services industries in The Netherlands

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Abstract. This paper aims to improve our understanding of why some companies are more successful in implementing open innovation strategies than others, by building a framework of capabilities required to benefit from open innovation. It argues that companies can benefit from open innovation when they have the capabilities to connect closed and open approaches to innovation. This requires building a culture conducive to developing networking capabilities. In the article, a comprehensive set of networking capabilities is developed intended as an analytical tool to evaluate to what extent companies are equipped to benefit from open innovation. As a first step to further validating the framework, empirical research has been carried out in The Netherlands to compare networking capabilities of companies in the technology industry and in the knowledge intensive business services sector. The results indicate that according to the framework, technology companies are in the lead in benefiting from open innovation, which may be explained by their previous experience in innovation networking. The results suggest that the networking capabilities framework is a promising tool for analysis that can help companies to become better equipped to jointly create value and capture value in innovation networks. The research has policy implications for regions as well, because it indicates that regional open innovation strategies need to address the development of networking capabilities of companies and other actors in the regional innovation system.

Keywords. Innovation, organizational culture, regional culture, service industry, technology industry, networking capabilities, regions in The Netherlands

1. Introduction: benefiting from open innovation-capabilities and culture

The concept of Open innovation, launched by Chesbrough (2003), has quickly gained acceptance among researchers (Christensen et al., 2005; Gann, 2005) and practitioners (Kirschbaum, 2005), and its introduction has resulted in a growing body of literature and ongoing research (Chesbrough et al., 2006; Chesbrough and Birkinshaw, 2006; Chesbrough and Schwartz, 2007; Cooke, 2005a, 2005b, 2007; Dahlander and Gann, 2010; Gassmann et al., 2010; Fleming and Waguespack, 2007; Lee et al., 2010; West and Bogers, 2014).

Open innovation can be defined as "The use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation" (Chesbrough et al, 2006, p. 1). Chesbrough (2007, p. 22) argues that "to get the most out of this new system of innovation, companies must open their business models by actively searching for and exploiting outside ideas and by allowing unused internal technologies to flow to the outside". While early literature on open innovation focused on open innovation strategies, recent publications pay

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more attention to requirements for how to successfully implement an open innovation strategy (Cheng and Chen, 2013; Chesbrough, 2012; du Chatenier et al., 2011; Gassmann et al., 2010; Lichtenthaler, 2011; Mortara and Minshall, 2011). However, the challenges of organizing for open innovation are still a relatively underexplored area of research (West et al., 2014). This paper aims to improve our understanding of why some companies are more successful in implementing open innovation strategies than others, by building a framework of capabilities required to benefit from open innovation.

Chesbrough (2012) contrasts "open innovation" with the "old" model of "closed innovation". In "closed innovation", innovation processes are controlled by the company by investing in internal R&D and innovations coming out of these investments are protected by controlling intellectual property rights. However, recent studies suggest that successful innovation strategies *connect* internal and external sources of innovation by developing a dynamic balance between closed and open approaches to innovation (Marques, 2014; Prud'homme van Reine and Dankbaar, 2011; Tödtling et al., 2011). This can be understood with the help of the 'absorptive capacity' concept, defined as the ability to identify, assimilate and exploit knowledge from the environment (Cohen and Levinthal, 1989, 1990). By definition, absorptive capacity is a capacity necessary to 'absorb' open innovation. It has been called 'a precondition to open innovation' (Spithoven et al., 2010). However, as already demonstrated by Cohen and Levinthal and reiterated by Vanhaverbeke et al. (2008), companies use internal R&D capabilities to recognize and monitor external technologies and effectively exploit them. Without investing in own R&D and innovation activities, in other words in closed innovation, absorptive capacity cannot develop and external knowledge cannot be effectively exploited. Therefore, capabilities to create and share knowledge and ideas in networks, and to facilitate dynamic interaction of internal and external knowledge, are essential to make open innovation strategies work. Open innovation has strong links to the dynamic capabilities perspective (Teece, 2007; West et al., 2014). Networking capabilities are dynamic innovation capabilities, defined by Zollo and Winter (2002) as 'hard to transfer and hard to imitate innovation capabilities that firms use to develop, integrate, and reconfigure existing and new resources and operational capabilities'. Networking capabilities do not emerge spontaneously when a company implements Open Innovation strategies. It can be argued that opening up the innovation process starts with a mindset (Gassmann et al., 2010, p. 214)-it requires building a culture which is conducive to developing networking capabilities. Organizational culture is closely linked to network embeddedness (Noorderhaven et al., 2002) and plays an important role in the willingness and ability of an organization to identify, assimilate and exploit external sources of innovation in such a way that it contributes to performance. Dynamic innovation capabilities can be embedded in an organizational culture over time by building experience in open innovation networks, but this is a slow process. Therefore, part of the explanation why some companies are more successful in open innovation, may be that their previous experience in collaborative innovation has resulted in the development of networking capabilities (Frankenberger et al., 2014), further opening up their business model and building a culture conducive to open innovation.

Although the cultural perspective has been identified previously as one of the perspectives needed to develop an open innovation theory more fully (Gassmann et al., 2010), there is still a gap in the literature when it comes to the impact of competencies and culture on open innovation (Bogers and West, 2014). Studies of the role of organizational culture in connecting internal and external knowledge are relatively rare and often do not go much further than identifying obstacles for implementation of open innovation such as the classic 'Not Invented Here' (NIH)-

syndrome (Katz and Allen, 1982). E.g. Van de Vrande et al. (2009), in a study of the implementation of open innovation in SMEs, identified organizational and cultural issues as key barriers to implement open innovation, but did not investigate these issues in detail. Henkel et al. (2014) report that existing cultures and corresponding organizational processes can slow down the change toward openness, and point at the need to go through a learning curve, but do not make a systematic analysis of the effects of culture. Mortara and Minshall (2011) find that internal cultural heritage may actually facilitate the adoption of open innovation. They conclude that a firm's cultural background can overrule other implementation drivers, and recommend further qualitative studies to reveal the dynamics of open innovation adoption. The research of Herzog and Leker (2010) on characteristics of closed and open innovation cultures is probably the most detailed study linking culture and open innovation to date, but it does not address the cultural implications of the interaction between closed and open innovation needed to integrate external ideas. Moreover, the open innovation literature lacks a connection to established theories of corporate culture researchers who derived cultural characteristics of innovative companies in a systematic way based on culture models (Prud'homme van Reine and Dankbaar, 2009, 2011; Schein, 2003; Trompenaars, 2007).

This paper will make an attempt to fill this literature gap by developing a framework that connects the role of culture and network capabilities in the adoption and implementation of open innovation. The impact of culture on open innovation will then be further explored by using the framework to investigate differences in open innovation adoption between companies in different industries. It is well known that different industrial sectors may have distinctively different innovation patterns (Malherba, 2005; Pavitt, 1984). For instance, sources of innovations and how companies interact with these sources, which are closely related to open innovation, may differ significantly between industries. The industries that we selected for this comparative research are the technology industry and the services industry. In his original taxonomy, Pavitt classified the technology industry as 'science based' and the services industry as 'supplier-driven', however, in a later publication (Pavitt, 1994) he put software services into the "specialized supplier" group and added a category of "information intensive" firms. Malherba (2005) built further on this by proposing an integrated and comparative way to look at sectors based on a sectoral systems framework that allows for detailed analyses of innovation in sectors in terms of, among others, knowledge and learning processes and network relationships. Malherba (2005) explicitly mentions networks as a rather underexplored key variable and comparative work as particularly relevant for further research. This paper reports a comparative research between two sectors with different innovation patterns, focused on the specific issue of innovation networking.

The technology industry was selected for our research because the evidence of open innovation was first discovered in technology oriented companies (Chesbrough, 2003; Chesbrough and Kardon, 2006; Schroll and Mild, 2011). We argue that technology companies might be in the lead in benefiting from open innovation because of previous experience in developing network capabilities and building a culture conducive to open innovation. For many technology companies, several elements of open innovation such as external networking, co-development partnerships and outsourcing of R&D to public research institutes are by no means new. Hargadon (2003) has shown that already at the end of the 19th century, technology-brokers developed competences for breakthrough innovations by bridging the gaps in existing networks that separated industries and firms and by building new networks to guide the market acceptance of these breakthroughs. The European Industrial Research Management Association (EIRMA-in itself a collaborative organization of major European companies to provide a pool of knowledge in R&D working methods)

published reports on "Research bought outside the firm" (EIRMA, 1969), "Improving industry-university relations" (EIRMA, 1988) , "Cooperative R&D in industry" (EIRMA, 1989), "Effective collaboration R&D" (EIRMA, 1995), "Outsourcing R&D" (EIRMA, 1997) and "Innovation through spinning in and spinning out" (EIRMA, 2003) before the term Open Innovation was popularized. The author of this article represented the innovation sector of a Dutch technology company in one of EIRMAs workgroups in the early 1990s and personally witnessed how European technology companies already in that period changed their attitude from the "NIH-syndrome" to a more open attitude. Important triggers for this more open attitude were the influential 5th generation model of R&D management (Rothwell, 1992), which highlighted the need for increased external focus and Tidd's publication on an open and connected innovation model through intraorganizational and interorganizational networks (Tidd, 1993). Government support for European cooperative projects between technology companies and knowledge institutes was instrumental in the process of opening up innovation in the technology industry as well. Other data confirm that during the 1990s the importance of innovation networks as a source of knowledge, increased rapidly, triggering the interest for what were later called "Open Innovation" strategies. While in 1969 only 3% of research was bought outside the firm (EIRMA, 1969), in 2000 outsourced and collaborative R&D had risen to over 10% of total research. This percentage was estimated at 15% in 2008 (OECD, 2008) and still increases rapidly (Schroll and Mild, 2011). Some firms have outsourced their entire R&D to other firms or universities. These developments are due to the ever more rapid cycles of innovation, rapidly increasing investments necessary for R&D, the increased mobility of knowledge workers and the rising importance of venture capital, which made the closed model difficult to sustain and made companies look for new sources of innovation beyond a specific industry, discipline, or type of collaborative partner.

So, the insight that creation of useful knowledge and ideas takes place in a variety of settings, not just in the own R&D labs of a company, but also at universities, entrepreneurial firms, spin-offs of established firms, companies supplying essential components, sub-assemblies or complementary products and competitors, is for technology companies by no means new. Many technology companies were also already familiar with another aspect of open innovation, involving customers and lead-users in the innovation process, way before the open innovation concept was launched. The term "open innovation" was first used in 1999 in the title of a seminar on the benefits of networking for innovation with lead users in the open source software development movement (Horwitch et al., 2000). However, the experiences of technology companies in collaborative innovation with lead users were already described in the work by Von Hippel (1986). The introduction of the open innovation concept has definitely stimulated involving "customer-innovators" (Thomke and Von Hippel, 2002) and "lead users" (Von Hippel, 2005) in the innovation process, but many technology companies had experience in innovation networks with customers and lead users already. This overview of antecedents of open innovation in the technology industry suggests that technology companies with a strong history in R&D and experience in developing networking capabilities are in a good position to benefit from open innovation, because they are able to develop a dynamic balance between closed and open innovation by combining their absorptive capacity and networking capabilities and to develop a "culture of innovation" which connects strengths in closed innovation and external networking capabilities. The need for such a dynamic balance is related to Clippinger's reflections on the need for enterprises to balance between order and chaos because traditional top-down management methods no longer work in an age of fast technological change and world competition-Clippinger (1999) describes the balance as "that 'sweet spot' where creativity and resilience are at their maximum".

The services industry was selected for the comparative research, because although the focus of open innovation research has been on technology-oriented companies, there has recently been more attention for open innovation in the services industry (Chesbrough, 2011, 2012). Moreover, the services sector has an increasingly important role in building knowledge-based economies while over a long period of time it has suffered from a lack of attention to innovation:

- "Many services are poorly linked into wider innovation systems, and the formal institutions that support them" (Miles, 2005, p. 449)
- "Policies in support of services innovation have remained relatively underdeveloped in many regions" (EC Commission Staff, 2009, p. 53).

Den Hertog et al. (2010) argue for more attention to service innovation in open innovation studies: "New services are increasingly realised through combinations of service functions provided by a coalition of providers, both parties in the value chain, and actors in the wider value network-it is remarkable in this context that open innovation literature has started at the R&D and manufacturing side, whereas the relevance for service innovation might be even greater" (Den Hertog et al. 2010, p. 494). Several publications of the European Commission emphasize that it is of vital importance to understand how especially the Knowledge Intensive Business Services sector (KIBS) can benefit from open innovation:

- "The economic importance of services means that improvements in European living standards are likely to depend more and more on productivity improvements in business services than in manufacturing" (European Commission, 2007, p. 13)
- "KIBS are likely to be one of the main engines for future growth within the European Union." (European Commission, 2007, p. 7)

KIBS are private companies or organisations, relying heavily on professional knowledge i.e. knowledge or expertise related to a specific (technical) discipline or (technical) functional domain; and supplying intermediate products and services that are knowledge-based (Miles et al., 1995). KIBS are recognized as innovators in their own right and as contributing to innovation systems (Di Bernardo et al., 2012) but attention for how KIBS interact with other actors and their contribution to innovation dynamics is relatively recent (Doloreux et al., 2010).

In this paper we intend to address the literature gap in understanding the impact of culture and network capabilities on adopting and implementing open innovation by answering the following research questions:

- Is it possible to develop a comprehensive framework of networking capabilities, rooted in theories of how organizational cultures impact innovation that can be used to evaluate to what extent companies are equipped to benefit from open innovation?
- If this is the case, can the framework be tested by using it to compare to what extent companies in different industries which are likely to have different innovation patterns and cultures (the technology sector and the knowledge intensive business service sector) are equipped to benefit from open innovation, as a first step to further validating?

2. Theoretical background: networking capabilities and open innovation cultures

In order to understand how companies can build a culture conducive to developing

network capabilities, the extensive literature on knowledge transfer in networks (Dyer and Singh, 1998; Levin and Cross, 2004; March, 1991; Powell et al., 1996) and the concept of dynamic capabilities (Teece et al., 1996, 1997, 2007) are relevant. "Dynamic capabilities" refer to the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Teece et al., 1997) and are therefore directly connected to open innovation.

Networks enable partners to create knowledge and share knowledge. The extensive literature on the relationship between different types of networks and knowledge transfer provides insight in how companies interact with their environment to benefit from open innovation. E.g. Powell et al. (1996), in a discussion of interorganizational networks as locus of innovation, argue that sources of innovation are usually found in the gaps between firms, universities, research laboratories, suppliers and customers so that the degree to which firms learn about new opportunities depends on their participation in networks.

March (1991) makes the useful distinction between explorative and exploitative network ties, based on a discussion of different ways of organizational learning. Explorative ties are about experimentation with new alternatives, with uncertain returns. Exploitative ties relate to the refinement and extension of existing competencies, technologies and paradigms, and generate predictable returns. March argues that adaptation requires both exploitation and exploration to achieve persistent success. Gupta et al. (2006) argue that there are two different possible balancing mechanisms: ambidexterity, which refers to the synchronous pursuit of both exploration and exploitation via loosely coupled and differentiated subunits or individuals, each of which specializes in either exploration or exploitation, and punctuated equilibrium, which refers to alternating cycles of exploration and exploitation. Gupta et al. (2006) conclude that either ambidexterity or punctuated equilibrium may serve as the more appropriate balancing mechanism between exploration and exploitation, depending on the context. Both approaches are viable in open innovation networks. Vanhaverbeke (2006) and Simard and West (2006), in their discussion on open innovation and networks, build further on this when they distinguish "deep ties" that enable a firm to capitalize on existing knowledge and resources and "wide ties" that enable a company to find new technologies and markets. Deep network ties are associated with geographical proximity. These are usually networks based on trust because of long relationships. They are important for innovation potential but usually limited to incremental innovation. Wide network ties give access to a wider variety of knowledge, making it possible to access new opportunities and resources and to stimulate creativity and innovation leading to more radical innovation. Open innovation benefits from building ties that are wide and deep and from finding the right balance between these ties (Simard and West, 2006).

Powell et al. (1996) make another useful distinction in types of networks, between formal and informal network ties. Formal ties refer to knowledge exchange between organizations based on contracts or other formal agreements and are associated with sharing explicit knowledge. Informal ties are often based on personal relationships at different levels in organizations and are associated with sharing implicit knowledge. Formal ties, such as alliances, research consortia and licensing agreements and informal ties often go hand in hand: formal relationships may emerge from informal arrangements, and "beneath most formal ties, lies a sea of informal relations" (Powell et al., 1996, p. 120). Open innovation strategies benefit from both formal and informal ties for effective transfer of knowledge in collaboration (Simard and West, 2006). Formal ties can be part of an explicit, planned open innovation strategy. Informal ties give opportunities for unplanned, spontaneous knowledge sharing but require special attention for abilities to capture external innovation by tacit knowledge sharing.

Strategies to stimulate open innovation often include facilitating networks e.g. by

organizing events and supporting network organizations. However, in order to benefit from such networks in a structural way, firms need to strengthen their network capabilities. Building further on Penrose (1959), who identified knowledge and learning processes as a factor in determining the growth of the firm, Teece et al. (1997) introduces "dynamic capabilities", also defined as "the firm's capacity to sense and seize opportunities to reconfigure its knowledge assets and competencies" (Teece, 1998, p. 64), as a source of sustained competitive advantage. Eisenhardt and Martin (2000), building on the work of Teece, argue that dynamic capabilities reflect an organization's ability to innovate e.g. via knowledge brokering and alliancing and that dynamic capabilities are closely tied and build upon "absorptive capacity" (Cohen and Levinthal, 1990), the concept which we introduced already as the ability to identify, assimilate and exploit knowledge from the environment. Individuals in the network, so-called "gatekeepers" or "boundary spanners", play an important role in building and maintaining these dynamic capabilities (Fleming and Waguespack, 2007). Dynamic capabilities partly reside in knowledge networks resulting in what has been called "dynamic knowledge capabilities" (Dawson, 2000) of firms and their networks, which are a prerequisite for open innovation strategies. The capabilities based literature (Dosi et al., 2000; Helfat et al., 2007; Teece, 2000; Teece et al., 1996, 1997; Zander and Kogut, 1995;) focuses mostly on strategies to transform companies to become knowledge-based companies, but as observed by Chatzkel (2004), "efforts to develop knowledge-based companies and knowledge regions need to be co-joint and co-equal if a region is to become a true knowledge region over time" (Chatzkel 2004, p. 61). In order to become knowledge-based companies, companies need to tap into geographically based knowledge networks and contribute to them. Local and global networks need to be connected as well (Malecki, 2011; OECD, 2008).

Empirical evidence confirms that firms implementing open innovation need a number of networking capabilities. E.g., Huston and Sakkab (2006) describe the different types of networks at the heart of a Procter & Gamble's model of open innovation. Perkmann and Walsh (2007) describe innovation networks with universities and research Institutions, EmdenGrand et al. (2006) describe innovation networks with suppliers and Von Hippel (2005) and Simard and West (2006) describe innovation networks with users and customers. As predicted, not just formal networks at firm-level but also informal interpersonal networks allow firms to access important external innovation sources, e.g. the social networks of R&D managers with scientists. Fichter (2009) reports on the role of networks of promotors in the interaction in 'innovation communities'. He distinguishes different promotor roles, each focusing on different barriers in the innovation process: expert promotor (contributing through expert knowledge), power promotor (contributing through hierarchical power), relationship promotor (encouraging innovation by means of innovation-related business relationships inside the organization and with external partners) and process promotor (arbitrating between the technical and the economic world through organizational knowledge) and also points at interlinking organizations that enable other actors to innovate. Each of these promotor roles requires distinct networking capabilities. Lee et al. (2010) point at the evidence that firms involved in multiple types of ties are more innovative than those which only utilise one type of tie. They show the need for innovation networking capabilities in open innovation in SMEs and emphasize the role of intermediaries in supporting SMEs' ability to make collaboration networks and the importance of networking between big companies and SMEs, to make use of the capacity of big companies to manage the whole innovation process and the flexibility of small companies in accelerating innovation.

So, theoretical research and empirical evidence confirms that benefiting from open innovation requires internal and external networking and that the network capabilities required, reflect the need to balance open and closed innovation. However, a systematic approach to develop a complete framework of networking capabilities is

still lacking. An early attempt to develop such a framework is the three core processes archetype model developed by Gassmann and Enkel (2004), consisting of three capabilities needed for the different core processes in order to successfully approach open innovation: absorptive capacity, multiplicative capacity and relational capacity. Gassmann and Enkel refer to their model as 'first steps towards a framework for open innovation' and acknowledge the need for further research to develop a more complete framework. Lichtenthaler and Lichtenthaler (2009) and Lichtenthaler (2011), building further on the work of Gassmann and Enkel and also drawing on the work of Helfat et al. (2007), developed a capability-based framework for open innovation based on six knowledge capacities, that actually represent three fundamental tensions: inventive capacity (internal) vs absorptive capacity (external); transformative capacity (internal) vs. connective capacity (external); innovative capacity (internal) vs. desorptive capacity (external). Lichtenthaler's framework does consider the dynamic interaction of internal and external knowledge in open innovation processes. However, it mainly deals with the acquisition and assimilation of knowledge and does not specify what capabilities are required for a company to benefit from open innovation in term of outcomes such as effects on products and processes. Robertson et al. (2012) take Lichtenthaler's work one step further by explicitly discussing the capacities needed in knowledge application. They develop a framework of 'Innovative Capacities' consisting of 'accessive capacity' (similar to absorptive capacity), 'adaptive capacity' (related to putting new knowledge to use) and 'integrative' capacity, which is directed by 'innovative management capacity'. However, Robertson et al. acknowledge the limitations of their framework and point at the need for further research to unpack their categories into more fine-grained sets of underlying capabilities and to come to a better understanding of how the capabilities interact. Den Hertog et al. (2010) developed, based on a theoretical discussion, a framework of six dynamic innovation capabilities specifically for the service industry. However, they link only two of these dynamic capabilities to open innovation: 'conceptualizing capability' (capability to think out of the box by multidisciplinary teams within the firm) and 'co-producing and orchestrating capability' (capability to manage service innovation across the boundaries of the individual firm). Later in this section, it will be shown how these capabilities fit into a comprehensive framework of open innovation networking capabilities. Cheng and Chen (2013) also made an effort to link dynamic innovation capabilities to open innovation activities. However, networking capabilities are not included in the items they use to measure dynamic innovation capabilities, which underline the lack of an innovation capabilities framework rooted in theory.

So, despite the extensive research on networking capabilities and open innovation, the insight in networking capabilities required for open innovation is still not complete and there is the need for a framework rooted in theory. Mortara and Minshall (2011), in their research of implementation of open innovation, point at the importance of the development of appropriate culture and skills to enable the operation of an Open Innovation strategy. We argue that in order to develop such a framework findings on networking capabilities and open innovation have to be connected to theories on innovation that start from a cultural perspective (Prud'homme van Reine and Dankbaar, 2009, 2011; Schein, 2003; Trompenaars and Prud'homme, 2004; Trompenaars, 2007). In the following section we will make this connection between open innovation networking capabilities and the fundamental innovation dilemmas, which have been identified as a comprehensive set to characterize innovation cultures by Trompenaars (2007) and Prud'homme van Reine and Dankbaar (2009, 2011).

In the dilemma approach, cultures are not assessed as a fixed set of value orientations, but by how they pursue paradoxical criteria simultaneously. This approach builds further on the work of corporate culture researchers Schein (1985), who pointed at the paradox of culture as a way of making things predictable versus culture as by its very

nature learning oriented and innovative and Cameron and Quinn (1999), who see organisational culture as a continuous process of finding a balance between competing values. In the dilemma approach of organizational culture (Hampden-Turner and Trompenaars, 2000; Trompenaars and Prud'homme, 2004), the patterns of meaning of corporate culture are described by the pattern of connections between different value orientations-such as global standardisation versus local adaptation, people orientation versus achievement orientation, quick decision-making versus consensus seeking, focus on co-operation versus focus on competition. Companies can work to improve their ability to reconcile such values, for instance by learning to co-operate in innovation networks in order to become a more competitive innovative company. Several authors have translated traditional dilemmas facing organizations to innovation dilemmas that need to be resolved for innovation to be achieved (Heidenreich et al., 2010; Prud'homme van Reine & Dankbaar, 2011; Prud'homme van Reine and Dankbaar, 2009; Trompenaars and Hampden-Turner, 2010). In this article, we will use the comprehensive set of 9 innovation culture dilemmas identified by Prud'homme van Reine and Dankbaar (2009), by translating the 9 fundamental organisation culture dilemmas (Hampden-Turner and Trompenaars, 2000; Trompenaars and Prud'homme, 2004) to dilemmas in creating cultures of innovation (Dougherty, 1996; Flynn et al., 2003; Takeuchi et al., 2008). The nine innovation culture dilemmas are:

1. Strong identification with the own culture versus openness for cultural diversity
2. Big (with ample resources to invest in innovation) versus small and agile
3. Applied innovation versus fundamental research
4. Process orientation versus room for creativity and entrepreneurship
5. Incremental innovation versus radical innovation
6. Technology push versus market pull
7. Egalitarian versus hierarchical approaches in leadership of innovation
8. Stimulating individual performance versus cooperation and knowledge sharing in teams
9. Short term focus versus long term view in innovation

Developing a culture of innovation is according to this model a matter of connecting both sides of each innovation dilemma by finding a dynamic balance. The connection with networking capabilities for open innovation as discussed in the above is that these can be seen as fundamental tensions which can also be described as dilemmas: balancing formal and informal networks (Powell et al., 1996), balancing deep and wide networks (Simard and West, 2006), balancing explorative and exploitative network ties (Gupta, 2006), balancing internal and external networks (Lichtenthaler and Lichtenthaler, 2009; Lichtenthaler, 2011), balancing global and local networks (Malecki, 2011), balancing networking between big and small companies (Lee et al., 2010), balancing internal technology/product/service oriented innovation networks and user/customer innovation networks (Simard and West, 2006; von Hippel, 2005) etc. The required networking capabilities for open innovation can be categorized as follows by framing them in line with the 9 innovation dilemmas mentioned above:

Capability to connect global and local networks

One of the main challenges of open innovation is how companies can benefit from connecting to and participating in global innovation networks. The willingness to consider foreign operations as significant sources of innovation has increased. The foreign share of R&D sites increased from 45% in 1975 to 66% in 2004 (Doz et al., 2006). Companies do more of their R&D away from headquarters and in their location decisions for R&D activities, obtaining rapid access to local centres of knowledge across the world by open innovation plays a major role, e.g. benefiting from spill-overs from other R&D units, access to trained personnel, links with

universities or government institutions and the existence of an appropriate infrastructure for specific kinds of research (OECD, 2008; Malecki, 2011). The capability to connect global and local networks is therefore crucial in order to benefit from open innovation.

Capability to network between big and small companies

Historically, big companies have been dominant in research and innovation. However, innovation is increasingly being done in small and midsize entrepreneurial companies. Between 1981-2001, the share of small/midsize firms in total R&D increased from 4.4% to 24.7%, while the share of large firms (>25000 employees) decreased from 70% to 39.4% in the same period (Chesbrough, 2003). As shown by Christensen et al. (2005), the interplay between technology entrepreneurs and incumbents can be quite complex and may make that open innovation has to be conducted under conditions of high transaction costs. Co-producing and orchestrating managing service innovation across the boundaries of the individual firm and managing and engaging in networks is a key dynamic capability for being able to put a new service concept or configuration on the market. Therefore, in line with findings of Lee et al. (2010), one of the capabilities required to benefit from open innovation is networking between big and small companies.

Capability to connect innovation networks to networks in fundamental research.

The term 'knowledge paradox' refers to regions where high investment in good quality fundamental research results in insufficient innovative products/services and economic returns. It is closely related to the need to balance explorative and exploitative network ties (Gupta, 2006). The knowledge paradox exists e.g. in The Netherlands (Boekema et al., 2000). Despite attempts to enable knowledge transfer from universities and research institutes to companies by shaping 'entrepreneurial researchers' (Kooij, 2014) and attention for the role of 'gatekeepers' (Gemünden et al., 2007), the knowledge paradox still exists. This can be seen as a weak connection between 'inventive capacity' and 'absorptive capacity' (Lichtenthaler and Lichtenthaler, 2009). One of the capabilities required to benefit from open innovation is connecting innovation networks to networks in fundamental research.

Capability to connect formal and informal networks

The need to balance formal and informal networks in collaborative innovation, shown by Powell et al. (1996), holds for open innovation as well. Open innovation strategies often entail formal alliances, license contracts and formal consortium agreements to address competitive issues. The informal component is often forgotten: how professionals involved in open innovation can generate new knowledge, build trust, broker solutions and deal with low reciprocal commitment in open innovation cooperation (du Chatenier et al., 2010). In service innovation, informal networks suit the launch of an innovative service in an experimental setting, but creating a consistent set of service experiences or service solutions ('Scaling and stretching'- Den Hertog et al., 2010) requires a more formal approach. The capability to connect formal and informal networks is therefore another requirement to benefit from open innovation.

Capability to connect deep and wide network ties.

Radical innovation often requires open innovation with partners in adjacent industries so that cross-fertilization can take place. Lee et al. (2010) suggest a network model for open innovation in which intermediaries are used that help companies establish cross-functional collaborative networks. These intermediates can take the role of 'boundary spanners' who have the capability to connect deep and wide network ties. Similarly, Den Hertog et al. (2010) discern in service innovation 'recombinative innovation', which requires what they call 'bundling capability'. The capability to connect deep and wide network ties is another requirement to benefit from open

innovation.

Capability to connect to customer and lead-user innovator networks.

Von Hippel (2005) and Von Hippel and Thomke (2002) have pointed at networks with lead-users and customer innovators as a way to create value in open innovation e.g. by using knowledge brokers who are able to signal user needs and connect these to technological options. The capability to connect to customer innovators and lead-user innovation networks is another capability required to benefit from open innovation. It is related to 'innovative capacity' in the capabilities model of Lichtenthaler and Lichtenthaler (2009), which is associated with matching inventions with the context of their final market.

Capability to connect to regional innovation networks.

Connecting to regional open innovation networks, e.g. by participating in the governance of the regional innovation system in a triple helix between knowledge institutes, business and regional government (Etzkowitz and Leydesdorff, 2000), results in companies and regions capturing value of external transfer in open innovation. It requires striking a balance between top-down ways of managing innovation and a more co-operative culture, interactive learning and consensus approach at the regional level. This requires the capability to connect to regional open innovation networks.

Capability to connect inter-functional company networks.

Paradoxically, open innovation requires internal networking capabilities as well. If a company has opened up the flow of knowledge and ideas to and from other companies, internal boundaries may still limit the benefit of open innovation. This apparent contradiction was observed in companies such as Philips and DSM (Hacievliyagil, 2007). This capability is related to the need to connect internal transformative capacity and external connective capacity in the capabilities model of Lichtenthaler and Lichtenthaler (2009), reflecting the need for knowledge retention in internal and external networks and using the knowledge for innovation activities. Open innovation requires that ideas of every individual need to be used, not just ideas from the R&D department: "a good idea does not care who has it" (Flynn et al., 2003, p. 425). This capability is similar to what den Hertog et al. (2010), in relation to innovation in the services industry, call 'conceptualizing capability': capability to think out of the box by multidisciplinary teams within the firm. Employees who are traditionally not involved in the innovation process may not be motivated to participate in organizational innovation communities (Wendelken et al., 2014). Benefiting from open innovation therefore requires networking capabilities to connect creative, entrepreneurial, technology, R&D, business and managerial staff, surpassing hierarchical and functional boundaries.

Capability to connect to societal networks

One of the challenges of open innovation is to connect innovation aimed at short term profit to innovation aimed at long term solutions for societal problems such as transportation, energy, climate and health. This requires the capability to connect to societal networks involved in these issues.

The framework of 9 innovation network capabilities developed in the above is rooted in the dilemma approach to understand organizational cultures and incorporates the main findings of prior research on networking capabilities for (open) innovation. Based on the theoretical discussion in this section, we expect that the framework can be used to evaluate to what extent a company has developed a set of innovation networking capabilities or an 'innovation networking culture' conducive to benefiting from open innovation.

As argued in the previous section, technology companies with a strong history in

R&D and in external networking are likely to be in an advantageous position to benefit from open innovation because they developed networking capabilities and a 'networking culture' because of their previous experience in innovation networks. In the following sections of the paper, we report exploratory research to get insights into the applicability of the framework: a comparative study of the extent that companies in the technology industry and companies in the knowledge intensive business services sector are equipped to benefit from open innovation.

3. Research method

The aim of the empirical research was to get insight into the applicability of the networking capabilities framework by comparing two regions dominated by different industries: the technology sector and the knowledge intensive business service sector. These regions are likely to have different innovation patterns (Pavitt, 1984, 1994) and networking cultures. The framework developed in section 2 was used to evaluate to what extent companies are equipped to benefit from open innovation, as a first step to further validating the framework. Empirical research was conducted in the following regions:

- One region in which the economy is dominated by technology oriented companies: Southeast Netherlands (the region around the city of Eindhoven, also dubbed the 'Brainport region')
- One region in which the economy is dominated by knowledge intensive business services (KIBS) companies: the Utrecht region (the region around the city of Utrecht, also in The Netherlands).

It was decided to study companies in two regions with specialized clusters because this allows for studying the interaction between companies and other actors in the regional innovation systems such as innovation support intermediaries, regional government agencies and knowledge institutes. Studying open innovation in a setting that allows for studying interaction between different actors has many advantages for studying dynamic open innovation processes, as shown e.g. by Ollila and Elmquist (2011), who studied open innovation in an 'open innovation arena', Belussi et al. (2010), who studied open innovation processes within one region, and Tödtling et al. (2011), who studied the interaction between companies and regional actors in open innovation processes in different European regions.

The Brainport region and the Utrecht region were selected for this research because these regions have on the one hand a very different sectoral specialization (technology industry in Brainport versus KIBS in Utrecht), while on the other hand they are very similar in other aspects:

- They are both regions around a medium-sized main city: Eindhoven, the main city in the Brainport region is the 5th biggest city in The Netherlands; the city of Utrecht, centrally located in the Utrecht province, is the 4th biggest city in The Netherlands.
- They are both home to major universities which play an important role in the regional innovation system.
- They are both known as innovative regions.
- They are regions in the same country (The Netherlands), so that national cultural differences and differences in national innovation policies do not play a role in the comparison.

The region of Southeast Netherlands positions itself as "Brainport". The regional economy is dominated by technology oriented companies such as Philips, DSM,

ASML and FEI. The region has two major universities: the University of Technology in Eindhoven and the University of Maastricht. The region has embraced the concept of open innovation and is described by the regional development agency as "an open innovation ecosystem". The region has a dynamic mix of innovative global companies, SME businesses, techno start-ups and research institutes, which collaborate in an open environment, e.g. on the two open innovation campuses in the region, the High Tech Campus in Eindhoven (focus on High Tech Systems) and the Chemelot campus near Maastricht (focus on Life Sciences and High performance materials). Key companies in the region are Philips and DSM, which are both often mentioned as pioneers in open innovation: Philips (van der Meer, 2007), which transformed itself from an electronics company to a high-tech systems company over the past decades and DSM (Kirschbaum, 2005), which has been transformed into a life sciences and materials technology company. Both companies have a long tradition in investing on own R&D and patents, which is proudly described in books sponsored by Philips (de Vries, 2005) and DSM (van Rooy, 2007) itself. In fact, Philips took the initiative for the development of the High Tech Campus in Eindhoven by transforming its gated Research Lab into an Open Innovation Campus in 1999. This was an important step in a culture change to a more collaborative innovation culture. Similarly, DSM has made its R&D labs the centre of an open innovation campus on the integrated industrial site Chemelot. This was an important step in changing its innovation culture from strongly relying on in-house technological strengths to a more open innovation attitude as well.

The Utrecht region has a central location in The Netherlands, a highly educated workforce and was among the top ten innovative regions according to the EU Regional Competitiveness Index 2013. It positions itself as a 'Knowledge region': "a region of knowledge, culture and sustainable development". The regional economy is dominated by the knowledge intensive business service sector such as advisory services, ICT-services, financial services, legal services and engineering services. The biggest company in the region is the regionally rooted banking and financial services company Rabobank, which is organized as a cooperative. The biggest university of The Netherlands (University of Utrecht) and several other leading knowledge institutes are based in the region as well. The Utrecht Science Park, home to knowledge-intensive companies and institutions, is located on the University campus in the centre of the region. The Utrecht Science Park was established in 2011. Its primary aim is to attract companies and university spinoffs that provide a powerful impulse for innovation. The region comprises of several networking organisations to stimulate innovation such as the Utrecht Development Board, the Economic Board Utrecht, the Task Force Innovation (TFI) and the Utrecht Entrepreneurship Academy.

The research in the Brainport and the Utrecht regions can be considered as exploratory research, since it is aimed at getting more insight into the applicability of the innovation networking capabilities framework by comparing two regional cases of open innovation. It concerns investigation of interaction in networks and cultural phenomena. Exploratory research, social interaction, cultural phenomena and a case study approach are all associated with qualitative research approaches (Bryman and Bell, 2007; Punnett and Shenkar, 2004). Following Mortara and Minshall (2011), who argue, based on their own research of open innovation implementation, that studies with qualitative approaches are most likely to reveal the dynamics of Open Innovation adoption, we have chosen for a qualitative approach, drawing data from a combination of written sources/ documents, interviews, and observations.

Our empirical investigation of open innovation in two regions is a qualitative multiple case study, based on Yin's approach (Yin, 2003). Bansal and Corley (2011) emphasize that qualitative research can accommodate different paradigms and different styles of research and research reporting, but that this should not go at the

expense of theoretical contribution and methodological rigor. In order to ensure methodological rigor, we conducted the case study according to the definition of qualitative field research by Polgar and Thomas (1995, p. 109): as a disciplined inquiry examining the meaning that actors attach to experiences and actions in the context of their social environment and cultural situation, in which 'disciplined' refers to methodological principles for theory formulation, problem definition, data collection and analysis guiding the inquiry. The data collection followed the concept of triangulation (Bryman and Bell 2007, p. 291; Punnett and Shenkar, 2004, p. 50). Multiple sources of evidence were used and the research issue was analysed from different perspectives to acquire more reliable results. The methods used were participant observation, document analysis and semi-structured interviewing. Using participant observation, semi-structured key informant interviews and other qualitative methods has strong roots in the study of cultural phenomena in organisations (Bryman and Bell, 2007, p. 13; Sackmann, 1997). It enables the collection of rich and varied material. For the semi-structured interviews, highly knowledgeable key informants were selected (Eisenhardt and Graebner, 2007), who had a good overview of the innovation processes and networking activities in the regions and were able to view these processes from diverse perspectives.

The data collection process in both regions consisted of three steps:

- The first step was to collect information and data from publicly available sources such as company websites, newspaper articles, company reports, etc.
- The second step was participant observation at events such as conferences and seminars on innovation policies and practices in the regions. In total 9 such events were attended. Data were systematically collected in the form of field notes. The researcher participated e.g. by acting as one of the presenters during a 1-day seminar, as a member of a working group at a work conference, by active participation in discussions and by participating in social gatherings at these events.
- The third step was carried out in parallel to step 2: interviews with key informants at companies, regional government departments, innovation support agencies and knowledge institutes involved in the innovation systems. These informants were identified in the document analysis phase and during participation in events as key players in innovation activities in their company or organization and in the region. Interviewees at companies were typically board members or managers with responsibility for innovation, business development and/or regional activities. Interviewees at (semi-) government agencies and knowledge institutes were typically department heads and project leaders involved in developing innovation policies or in innovation (support) projects. Data were collected using a semi-structured interview guide with open-ended questions. The focus in these interviews on was how people engage in open innovation, how they collaborate in practice, how they deal with openness and how they perceive the collaboration with innovation partners. Each of the 9 network capabilities was addressed in the interviews, either because the issue came up in answers on the open-ended questions, or by asking explicit questions per network capability towards the end of the interview. A total of 50 interviews have been conducted.

Summarizing, the data collection consisted in both regions of:

- Extensive documentation study of companies and other actors in the regional innovation systems of both regions: company documents, regional economic development and innovation policy documents, open sources (newspapers, business publications, academic articles and books, websites). The

documentation study was used to describe the regional economic context, to identify suitable companies and regional organizations for the research, and to identify key players for the interviews in phase 3.

- Participant observation at 9 conferences and seminars on innovation policies and practices in total:
  - ❖ In the Brainport region, the researcher participated in the following 5 events:
    - Interregional Innovation Workshop in Eindhoven
    - Colloquium 'Top economy, smart society' at the Chemelot Open Innovation Campus
    - Brainport 2020 'Top economy, smart society' programme meeting in Eindhoven
    - Conference on Open Innovation held at the Chemelot Open Innovation Campus
    - Open Friday afternoon innovation lecture at the High Tech Campus Eindhoven
  - ❖ In the Utrecht region, the researcher participated in the following 4 events:
    - 'Get connected' meeting 'The learning economy', organized by the Utrecht Economic Board
    - SURE (Sustainable Innovation in the Utrecht Region) event
    - Working conference 'City agenda Knowledge and Culture'
    - Utrecht Development Board conference
- Semi-structured interviews with key informants at companies, knowledge institutes and (semi-) government agencies supporting the innovation system.
  - ❖ In the Brainport region, 28 interviews were conducted:
    - Technology companies (in total 14 interviews at technology companies out of which 4 SMEs): High Tech Systems (8), Life Sciences (6).
    - Knowledge institutes (in total 7 interviews): Universities and College of Higher Education (3), Technological Research Institutes (4)
    - Regional government and regional organization/agencies supporting the innovation system (in total 7 interviews): Eindhoven City economic policy department and regional development agencies (3); Regional entrepreneurship support agencies (2); Open Innovation Campus management (2)
  - ❖ In the Utrecht region, 22 interviews were conducted:
    - KIBS Companies (in total 11 interviews at KIBS companies, out of which 3 SMEs): Financial services (3); Management Consultancy services (4); ICT services (2); Engineering & design services (2).
    - Knowledge institutes (in total 5 interviews): University and College of higher education (3), Research Institutes/Science Park (2)

- Regional government and regional organization/agencies supporting the innovation system: (in total 6 interviews): Utrecht City and Utrecht Province economic/innovation policy departments (2); Regional entrepreneurship support agencies (2); Regional economic/ innovation support agencies (2)

The framework of innovation network capabilities developed in section 2 was used as a conceptual framework for the analysis of the interviews, which allowed for axial coding of the transcripts (Strauss and Corbin, 1998), using the 9 network capabilities as an organising device. The data collected during the document analysis and participant observation were also categorized according to the framework of networking capabilities. This resulted in a case study database of research outcomes (excerpts from interviews, observation data, information from document analysis) for each innovation networking capability. The database was then analysed per company and per networking capability for evidence to assess each networking capability. Based on this analysis, the different network capabilities were rated as 'high', 'intermediate' or 'low'. After completing the analysis, the average per region/sector was determined. In the presentation of the results in the next section, citations from interviews, results of document analysis and observations are used to illustrate the interpretation of the empirical material.

4. Results

In the following section, the results are presented for each of the 9 networking capabilities discussed in section 2, both for the Brainport region (Southeast Netherlands) and the Utrecht region.

Capability to connect global and local networks

Brainport region:

From the document analysis it was derived that the capability to connect culturally diverse networks and a regional culture conducive to open innovation, started already when "immigrants" came to this (at the time) peripheral region in The Netherlands because of the founding of Philips in Eindhoven (end 19th century) and its rapid growth in the early 20th century. This "opening-up" of the region resulted in openness for diversity. Lead companies in the region Philips and DSM have a history of creation and sharing of knowledge and ideas in networks. Philips, for instance, started an alliance with its competitor Sony in 1979 to further develop the innovations that resulted in the CD. Moreover, Philips participated already in international research consortia, sharing ideas and knowledge with universities, competitors such as GE and suppliers such as Corning in the mid-1980s. Philips also cooperated with European competitors by participating in European technology projects such as Eureka, launched in 1985 (Eureka, 2006).

In a later stage, Philips and its high tech spin-offs and spin-outs such as ASML (semiconductor manufacturing equipment) attracted knowledge workers, entrepreneurs and managers from all parts of the world to the region. This has resulted in a mix of a traditional local culture characterized by informality, community feeling, inclination to networking and cooperation and a "modern" international, business and engineering oriented culture. We observed that most innovation networking meetings were conducted in English, while informal conversations were mostly in Dutch and the atmosphere at the events radiated the regional "gemoedelijkheid" (sociability and informality). Large companies in the technology sector such as Philips, ASML, FEI

and DSM, are part of a global open innovation system, but at the same time strongly rooted in the local environment. An interviewee of an SME in the region: "as a supplier of one of the globalized companies based in the region, we got involved in the regional innovation network. They helped us with their existing contacts to get access to global innovation networks as well. We would not have had the resources to do that on our own". The capability to connect global and local networks in innovation is evaluated as high.

Utrecht region

Although several of the major business service companies in the region are subsidiaries of international companies, the international orientation in innovation turns out to be surprisingly low. An interviewee: "Utrecht is the biggest village in The Netherlands. We do not have any companies that were founded in the region and grew into international companies". Innovation tends to be "local-for-local", with relatively few connections to global networks. An interviewee from a financial services company: "even in the rural areas in the east of The Netherlands, companies are more internationally oriented than here in Utrecht, at least they are close to the German border and find customers and partners across the border". Moreover, although the regional university and knowledge institutes have strong global networks, companies in the business services sector hardly capitalize on these networks. One interviewee from a consultancy company: "we should embrace entrepreneurial talent from abroad, the PhD's from China and India". Technology-based KIBS companies are the exception here. An interviewee about an engineering services company: "Because of their international client base, they play a role as knowledge intermediaries between international and local". However, on average the capability to connect global and local networks in innovation in the Utrecht region is low.

Capability to network between big and small companies

Brainport region

The open innovation campuses in the region play a major role in networking between big and small companies. Research and business facilities on these campuses are shared between large companies, SMEs and start-ups, including spin-offs from lead companies Philips and DSM. One SME owner/manager based on the high tech campus Eindhoven: "it is very easy to get in touch with high level managers of large companies when you are based here. One phone call or email is sufficient to arrange a meeting and they are happy to share ideas and contacts".

Large companies in the region actively contribute to the existence of a network of big and small innovative companies in the region. E.g. Philips has used spin-in acquisitions to get access to new technologies in health care and LED-lighting and actively spins out technology that is no longer part of the core business such as semiconductors (NXP), semiconductor manufacturing equipment (ASML) and electron microscopes (FEI). These companies subsequently become part of the open innovation ecosystem in a natural way, because of the existing personal contacts and because these spinoffs 'inherit' the open innovation culture. An interviewee at one of these spinoffs: 'we have a different shareholder now, but the culture is still the same'. Part of the open innovation strategy of Philips is to look for different paths of technology and to create new companies from non-core activities via the Philips Incubator, which supports start-ups with advice, business contacts and financing. Similarly, DSM has established a ventures business, through, which it invests in commercial products from small biotechnology and food ingredient companies, regularly spins out innovative companies, licenses technology out and invests in business accelerators. DSM supports, through its incubator initiative in cooperation with the regional development agency, spin-offs on the Chemelot open innovation

campus such as Isobionics, positioned as "a biotechnology company powered by DSM", and spin-offs from nearby University of Maastricht. Philips and DSM both have venture investment business, which contribute to innovation networks between big and small companies as well.

The risk of too much dominance of these large companies in the innovation networks in the region has been recognized and addressed. An interviewee at one of the SMEs: "The regional development company facilitates the formation of consortia and platforms of SMEs in the technology sector and knowledge institutes in the region to co-develop new products with large OEM's, so that we benefit from the advantages of being relatively small while also benefiting from being part of a larger network. The knowledge institutes are usually in the lead in these consortia so that there is more of a balance".

The capability to network in innovation between big and small companies in the Brainport region is evaluated as high.

Utrecht region

Large business services companies use small companies in the region mainly for outsourcing activities and to maintain a flexible capacity, not for collaborative innovation. However, there are some initiatives that contribute to the capability to network in innovation between big and small companies. E.g. the leading regional Rabobank has a Ventures department, which supports small entrepreneurial firms that innovate in order to make the global food supply chain more sustainable. Other large companies in financial services (pension funds, insurance companies and banks) invest via regionally based growth capital firms in small entrepreneurial companies to support innovative models in health care. Another initiative that facilitates innovation networking between big and small companies is the Utrecht Entrepreneurship Academy, a network organisation in which experienced managers from large companies act as coaches for starting entrepreneurs. Still, these initiatives are not sufficient to compensate for the lack of collaborative innovation between big and small companies. An interviewee at a regional agency for stimulating innovation/entrepreneurship: "what lacks in this region, is a large company that is known as very innovative. Currently, the leading companies in the region such as Rabobank are not seen that way. Innovation and entrepreneurship doesn't have a 'face' in this region, there is no company or person representing a large company who is seen as symbol for innovation".

The capability to network between big and small companies in the Utrecht region is evaluated as intermediate.

Capability to connect innovation networks to fundamental research.

Brainport region

There are many cohesive research programs in knowledge institutes in the region, which are structured as public-private partnerships and are designed in line with the ideas of open innovation. This involves collaborative R&D between companies and academia, aligning with industry needs. One example is the Holst Research Centre at the open innovation campus in Eindhoven, an open innovation initiative by the research organizations Imec (Belgium) and TNO (The Netherlands) in the field of technologies for flexible electronics, where research institutes and industrial partners, including global companies and SMEs, collaborate in pre-competitive research projects. Another example of a program on the campus where a range of different companies and knowledge institutes share knowledge and cooperate in innovation projects is the Centre for Translational Molecular Medicine. One more example of open innovation with knowledge institutes is the Incubator3+ organization in which

Philips partners with the University of Technology Eindhoven. It encourages a regional culture of entrepreneurship by stimulating initiatives by providing pre-seed and seed capital, supply of know-how, coaching and exchange of experience for prospective entrepreneurs in the region. DSM is actively involved in open innovation programs with knowledge institutes as well e.g. the Biomedical Materials research program, the Chemical Open Innovation Centre and Dutch Polymer Institute, all structured as public-private partnerships. The knowledge institutes in the region are aware that they should not just target R&D staff of big companies but also technical people involved in daily innovation activities and SMEs. An interviewee at one of the institutes for higher education in the region: "We try to contribute to boosting innovation by 'educating the innovators' e.g. the design of a program to educate the actual builders of high tech systems and an educational program for systems integrators" and: "We are establishing a High Tech Systems Centre at the university next to more fundamental research groups, this will lead to a better match between academic capabilities and industrial needs, thereby strengthening their innovation capabilities". The capability to connect innovation networks to fundamental research in the Brainport region is evaluated as high.

Utrecht region

The interaction between business services companies and knowledge institutes in the region is limited. Universities do little fundamental research to support innovation in business services. One explanation for this limited interaction seems to be that there is simply a lack of knowledge about business services at the academic side. One interviewee from a consultancy company: "we are problem solvers. The focus of the university in organizational science is still very much on fundamental research". An interviewee from another consultancy company emphasizes that proximity to the university and other knowledge institutes is not significant for the company: "we are independent of the local environment; we could decide to shift our offices to Amsterdam at any moment". Moreover, the role of gate-keepers as intermediates between companies and knowledge institutes does not seem to be appreciated as much as in the technology sector. An interviewee from a consultancy company: "if we need specific knowledge, we hire a specialist with the required background". There is one promising recent initiative to involve the business services sector in open innovation activities with knowledge institutes: the Utrecht Sustainable Finance Lab. This is an initiative of banks based in the region (Rabobank, Triodos Bank) and Utrecht University to develop innovative ways of financing sustainable development and creating a sustainable finance sector. However, there is also criticism on this initiative: "to some extent, it is about image building, not about innovation". Therefore, the capability to connect innovation networks to fundamental research in the Utrecht region is evaluated as low.

Capability to connect formal and informal networks

Brainport region

The Brainport region is very much a region where people know each other; are members of all kind of associations and networks, have frequent informal meetings, and are willing to give and take and to do business based on trust. It was observed that 'The Strip' (a 400 m long building with restaurants, bars, shops, services such as a fitness centre and a conference centre), at The High Tech Campus Eindhoven, serves as an informal meeting place for people involved in innovation from different companies and support organizations. It was also observed that innovation events in the region always finish with an informal 'borrel' (drinks) or even an 'after-party' and that people from big and small companies, regional government, innovation support agencies and knowledge institutes stay for this informal part of the event. Many people involved in the innovation system know each other already for years and see

each other not just as colleagues, but as personal friends. Most technology companies were founded in the region and are still embedded in the region, even in the cases where they have been acquired by companies from outside the region. This culture of cooperation facilitates open innovation e.g. in the network of suppliers and business partners. However, dealing with intellectual property rights (IP) in the open innovation environment is getting more difficult, because the "trust based" regional culture sometimes conflicts with a "contract based" business culture. An interviewee from an SME: "Sometimes you think that you have an informal agreement, and then the lawyers come in with extensive contracts, please sign here". Top managers of larger companies argue that formal agreements and detailed contracts are necessary, even in open innovation, to remain in control of IP. Negotiations between companies and universities about patent licenses also get more complicated because of increased attention for knowledge valorisation at the university side. Still, the capability to connect formal and informal networks in the Brainport region is evaluated as high.

Utrecht region

Business service companies in the Utrecht region are somewhat hesitant to practice open innovation. An interviewee from a consultancy company: "Our services are difficult to patent and the sector is characterized by a certain lack of trust". The 'product' of business services companies is less tangible than in technology companies, and often easy to copy. Although there are many informal networks the tendency is to work 'contract based' because of the lack of trust. Although there is often an informal part after innovation events in the Utrecht region as well, most people from the company side leave after the formal meeting, while people from support agencies, regional government and knowledge institutes tend to stay longer. An interviewee from a financial services company: "Business leaders do not see each other very frequently in this region". In general, people are less closely connected to the region in comparison with the Brainport region. An interviewee: "The main reason to be based in the Utrecht region is not to be part of a cluster, but to be in a central location with good road and rail connections". Indeed most offices of KIBS companies in the region are located at the edge of the city of Utrecht, near the highway. An exception is Rabobank which has its head office right in the centre of the city near the train station. Quality of life in the city is seen as high, so that it is relatively easy to attract talented people. However, companies are too dispersed and there are no informal meeting places where innovation networking takes place. It is the ambition of the Science Park, located on the grounds of the University on the outskirts of the city of Utrecht, to fulfil the role of "match between innovative knowledge and business", "in an inspiring environment", but it is not (yet) seen that way. One promising development in the region is that knowledge institutes have started to stimulate business services companies to cooperate in open innovation projects. Still, the capability to connect formal and informal networks in the Utrecht region is evaluated as low.

Capability to connect deep and wide network ties

Brainport region

Technology companies in the region are involved in the development of several innovation platforms, all based on cross-fertilization with partners in adjacent industries:

Smart mobility platform: Interface of High Tech Systems, Automotive, ICT and Design clusters

Medical Technology platform: Interface of High Tech Systems, Life Sciences, Performance Materials and Design clusters

Food for Life platform: Interface of Food Technology and Life Sciences clusters

Smart grids platform: Interface of High Tech Systems, Energy and ICT clusters

The interaction in these platforms has a self-perpetuating effect because participants develop into 'boundary spanners' who feel comfortable in connecting deep networks in their own sector with wide cross-sectoral networks. The capability to connect deep and wide network ties in the Brainport region is evaluated as high.

Utrecht region

Cross-sector collaboration in the business services sector in the region is very limited. Although there is willingness to explore new business service propositions together with partners, perceived difficulties in co-exploiting new services, lack of capabilities to coordinate co-development and lack of willingness to invest in learning from each other lead to a lack of a real open business services innovation system. The exception is cross-sector innovation with ICT companies, because ICT is seen more as an enabling technology in services. An interviewee: "Business services in all fields are represented on this office park: strategic consulting, HR-services, ICT, legal, you name it. And it is very strategically located near the University Science Park. But it seems that the only reason that we are based close to each other is that the location is so convenient. We could do much more together". An interviewee from a finance company: "There is a lot of hidden innovation power in the region". An interviewee from a consultancy company: 'We act as a source of state-of-the art knowledge but most of what we do is transferring best practices, we do not really act as a source of innovation. We facilitate innovation, but the customer implements the innovation". KIBS companies act to some extent also as a carrier of innovation from one company in the region to the other but "we are more knowledge brokers than bridgers". The capability to connect deep and wide networks in the Utrecht region is evaluated as low.

Capability to connect to customer-innovator and lead-user innovator networks.

Brainport region

Companies in the region are traditionally very technology-oriented but the need to connect to a more customer-focused culture is strongly felt. One of the initiatives to connect to customer and lead-user innovator networks is the Creative Conversion Factory on the open innovation campus in Eindhoven. It acts as a knowledge broker, encouraging attention for design and cooperation with the creative industry. One of the criteria in the evaluation of patentable creative and technological innovations as a potential project is the extent to, which, it enables participating organizations to achieve synergies and improve their capabilities. Another initiative is called "ExperienceLab": "we let people experience a new innovative concept in a very early stage of development to discover the practical, social and psychological implications of differentiating technologies-it means more innovation with the final customer". The growing importance of design has influence as well: "The growing attention for design leads to a different approach to innovation. It results in more cooperation with the creative industry and more attention for what customers want".

For some companies in the region, innovation networking is already inherent in their business model. The supply chain of semiconductor manufacturing equipment, an important business in the region, is an open innovation ecosystem in which suppliers, intermediate customers (equipment builder ASML) and final customers (buyers of the equipment-based outside the region) closely cooperate.

Still, not all companies have completed the transformation from technology to more customer and user orientation. The capability to connect to customer and lead-user innovator networks in the Brainport region is evaluated as intermediate.

Utrecht region

The emphasis put on the business service industry is on customized, client specific solutions. Although this is done in cooperation with the customer, the way of working doesn't match the definition of open innovation because the inflows and outflows of knowledge result in one-off solutions, not into building permanent innovation networks. An interviewee: "A lot of our work is relatively routine; based on professional, financial and business expertise and repeated business with clients-we keep on re-inventing the wheel". This has been recognized in the region and business services companies together with regional economic and innovation boards have launched initiatives to establish more permanent innovation networks between companies and customers. One of these is the Colab Services Innovation, a regional platform for digital services innovation. Colab matches launching customers to business services companies. It is a network of public and private partners and a 'pilot plant' to co-develop new digitals services and share knowledge in continuously changing combinations of business service companies, institutions and end users. The objective of the Colab initiative is to work as a marketplace matching supply and demand and as a learning organization connecting different domains. However, one interviewee from the regional government remarks: "we could do more to direct innovation towards targeting customers and sectors with a strong position in the region, such as health care, education, life sciences, creative industry, sustainable development, and other business services.

The ability to connect to customer and user innovator networks in the Utrecht region is evaluated as intermediate.

Capability to connect to regional innovation networks.

Brainport region

The Brainport region established the 'triple helix' model of intensive cooperation between regional (semi) government agencies, business and knowledge institutes already during the 1990s. Brainport is also the name of the regional development organization, a close cooperation between companies, knowledge institutes and regional authorities, with a board that represents these three parties. Brainport has embraced the open innovation approach and its development program addresses stimulating innovation (via knowledge creation, exchange, and transfer), developing human capital via education and stimulating entrepreneurship, creating and strengthening networks in business and international cooperation and improving the 'soft' and 'hard' infrastructure for open innovation. The Open Innovation Campus campuses in the region were driven by companies such as Philips and DSM and regional leaders in the Triple Helix of university-industry-government collaboration. The main open innovation campuses in the region, the High Tech Campus Eindhoven and the Chemelot campus have become new symbols for the region, because of their visibility from the highway and the good fit with the Brainport "brand". Interviewees frequently mention the names of 'visionary leaders' of leading companies, regional government and knowledge institutes who are credited for making the triple helix work and making the open innovation campuses reality. The capability to connect to regional innovation networks in the Brainport region is evaluated as high.

Utrecht region

Paradoxically, the economic success of the region over a long period of time has caused the region to fall behind other regions in terms of involvement of companies in the governance of innovation. Innovation policy initiatives in the region often remained top-down or isolated initiatives. Moreover, the regional knowledge institutes have been too dominant in the existing innovation networks. A KIBS company interviewee: "Knowledge does not equal innovation". However, other interviewees believe that companies should take more initiative: "Companies in this

region do not want to take leadership in innovation, they want to stay under the radar"; "Maybe our business leaders are too modest". Interviewees from the regional government side also point at the different leadership style in business services compared to the Brainport region: "the leadership style here is more transactional, almost detached". Recently, the region has established an economic board in an effort to come to more joint efforts by government, knowledge institutes, industrial companies and the services sector, e.g. by organizing "get connected" meetings with collaborative innovation as the main theme. The economic board works closely together with the Task Force Innovation (TFI), a network organization promoting regional innovation. Unfortunately, the participation of business services companies in these networks seems to be motivated to some extent by opportunities to acquire business from (semi-) government institutes: "conversations at networking events between regional government, support agencies and business services companies often end up in sales pitches". Moreover, the role of TFI is seen as limited: "Part of TFI's role is to initiate and encourage partnerships in innovation, however, it is a temporary organization that will be discontinued after 4 years-the local government doesn't realize that changing the mindset takes more time". An exception is the creative industry, where the networking organization Immovator plays a regional role towards promoting open innovation, e.g. in the Cross Media Innovation centre. The Dutch Game Garden, based in Utrecht, is another example of promoting regional innovation networks in the creative industry. It brings small companies in the gaming industry, many of them active in 'serious games', together in one building as a kind of 'small-scale open innovation campus'. The capability to connect to regional innovation networks in the Utrecht region is evaluated as intermediate.

Capability to connect inter-functional company networks.

Brainport region

The open innovation campuses in the region play an important role into building innovation communities and encourage interaction between 'creative minds', craftsmen, engineers, scientists and entrepreneurs to turn ideas into profitable business. Especially the high tech campus Eindhoven is a very open and attractive environment. The meeting places within the campus encourage external networking, but also inter-functional company networks. However, there are also some regional factors that currently hamper open innovation. For instance, finding entrepreneurs who combine technology insight, business insight, drive and willingness to take risk turns out to be difficult, despite efforts of regional agencies and open innovation campus management to seek and develop entrepreneurial talent. An interviewee at a regional development company: "there are more ideas for innovative businesses than entrepreneurial talent to pursue these ideas". The capability to connect inter-functional company networks in the Brainport region is evaluated as intermediate.

Utrecht region

Business services companies are often based close to each other in the region, e.g. on the Rijnsweerd and Papendorp business parks, but these locations do not radiate the same openness as the open innovation campuses in the Brainport region. Even during lunch hours on working days, the streets in the business park are empty. An 'Open Innovation Services Campus' does not yet exist. There are plans to extend the Science Park Utrecht, based on the University campus, to the nearby Rijnsweerd business park; however, without a change in mindset to a more collaborative attitude, it is doubtful whether this will result in a significant increase in networking for innovation. An interviewee from an ICT-company: "The distance between this business park and the science park is about 1 kilometre, but it's like two worlds apart". The culture of sharing knowledge and ideas is different from the Brainport region. An interviewee from a consultancy company: "We have very creative individuals, but that doesn't

automatically lead to innovation for the firm. Our people have a nomadic mentality. When they leave for another job or start their own business, they take their ideas and knowledge with them". The capability to connect inter-functional company networks in the Utrecht region is evaluated as low.

Capability to connect to societal networks

Brainport region

The Brainport region supports and stimulates sustainability initiatives and has embraced the 'Cradle to Cradle' concept of sustainable design and innovation (McDonough and Braungart, 2002). The pioneer of Cradle to Cradle in the region is DSM, which runs a 'Climate-Induced Innovation' initiative in collaboration with societal partners and has realized innovations in renewable energy, biofuels, innovative composites that enable energy-saving in transport and environmental friendly solvents. However, some companies in the region are sceptical about 'Cradle to Cradle', because the economic value is not always clear. Several companies have long-term mission statements related to sustainability (e.g. "improving the quality of life through the introduction of meaningful innovations"), but investors demand short-term profitability. Companies try to connect short-term and long-term by introducing new products that contribute to creating sustainable societies e.g. products to improve health and well-being, products to conduct research in the fields of energy and environment, or environmental friendly solutions. We participated in a seminar on one of the open innovation campuses with the aim to bring people together to stimulate innovative thinking in the use of renewable energy and "green" raw materials. The seminar was successful in bringing together researchers, product developers, regional government and politicians, but was not successful regarding the start of a dialogue with society at large. Transforming the need for sustainable solutions into innovative products, systems and services is still a challenge. The capability to connect to societal networks in the Brainport region is evaluated as intermediate.

Utrecht region

Business services companies in the region are rather reluctant to invest in longer term knowledge development which is necessary to get involved in sustainable innovation initiatives with societal partners and knowledge institutes, unless it creates business value in the short-term as well. An interviewee from a consultancy company: "We get involved in sustainability projects because our clients face new demands due to new legislation and regulation-however these are solution oriented projects to comply with legislation and regulation, not long term investments". Exceptions are companies like Ecofys, an advisory services company specialized in sustainability and Royal Haskoning DHV, an engineering services company, which puts a strong focus on innovation for sustainable development. Financial services company Rabobank is innovative in its contribution to social responsibility and sustainable development related to its strong position in the agricultural sector. Recently more business services companies started to participate in initiatives in order to turn sustainability challenges into innovative solutions with the objective of creating value for business and society. One of these is the University Utrecht Sustainability Institute, which targets innovations for sustainable urban development in cooperation with advisory, ICT, engineering, design, legal and financial services companies based in the region, thereby linking science, technology, financial-economic and socio-cultural issues in an open innovation environment. An interviewee from an engineering consultancy company: "We cooperate with other engineering companies, building companies and the regional knowledge institutes in the Centre of Expertise for smart sustainable cities, directed at innovation in services to realize smart sustainable cities". However,

these initiatives are seen as too limited: "The region could do more to raise its profile as a sustainable region. That would encourage open innovation with regional KIBS companies with a sustainable development strategy". The capability to connect to societal networks in the Utrecht region is evaluated as intermediate.

5. Discussion

Figure 1 summarizes the findings in the Technology sector (Brainport region) and the Knowledge Intensive Business Services sector (Utrecht region) on networking capabilities for each networking type.

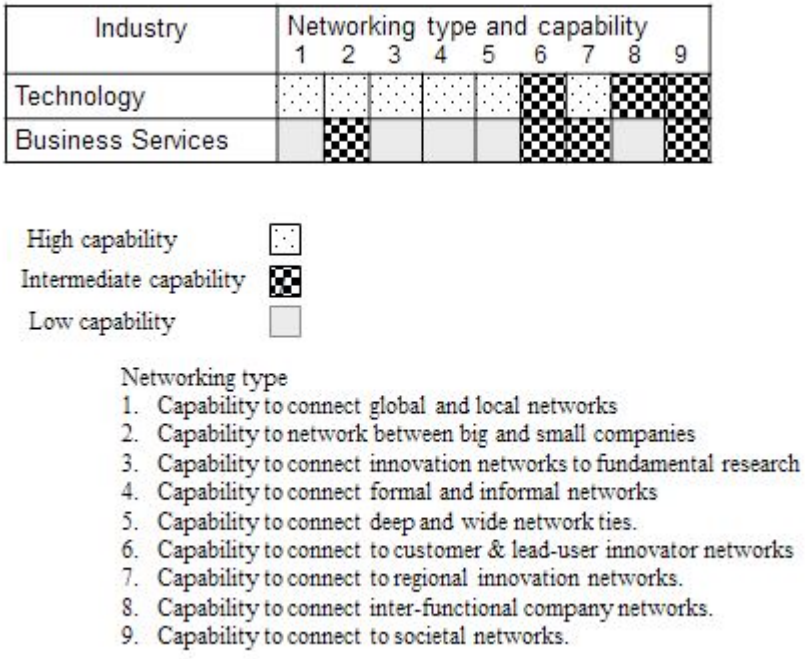

Fig.1. Summary of findings in Technology sector (Brainport region) and Knowledge Intensive Business Services sector (Utrecht region) on networking capabilities for each networking type.

The results show that, according to the framework, technology companies in the Brainport region have on average higher networking capability than KIBS companies in the Utrecht region and are in the lead of benefiting from open innovation. In the technology sector, there is room for improvement in connecting to customer and lead-user innovator networks, in connecting inter-functional company networks and in connecting to societal networks. These weaknesses can be explained by the still dominant technology orientation in the sector, which goes at the expense of customer orientation, inter-functional cooperation and anticipating societal needs. It means that on the Technology Push-Market Pull innovation dilemma, the emphasis is still at the technology push side, that on the 'Stimulating individual performance versus cooperation and knowledge sharing' innovation dilemma the emphasis is on the individualistic side and that on the short-term focus versus long-term focus in innovation dilemma, the emphasis is on the short-term side. On the other innovation

dilemmas, a dynamic balance is maintained. The business services sector main weaknesses are, according to the framework, in connecting global/local networks, connecting innovation networks to fundamental research, connecting formal/informal networks, connecting deep/wide networks and connecting inter-functional networks. This can be explained by the predominant orientation towards local-for-local and one-off customer specific solutions, the short-term orientation and the lack of openness and trust in the business services sector. It means that there is no dynamic balance on most innovation dilemmas.

The preliminary research confirmed that all networking capabilities in the framework, and the tensions implied by them, are relevant for benefiting from open innovation The results suggest that the framework of networking capabilities is comprehensive, and a promising tool for analysis that can serve as a checklist for companies how they can become better equipped to benefit from open innovation, providing an agenda for culture change.

This article builds on the results from a comparison of two regional cases, which means that the scope for generalizations is limited. However, it is a step towards a better understanding of the requirements for companies to benefit from open innovation. More research is needed so as to provide a more thorough understanding; but the exploratory research provides evidence for the proposition that technology companies are in an advantageous position to benefit from open innovation because of their previous experiences in innovation networking. Companies in the Brainport region, such as Philips, DSM, ASML and FEI, combine a long history in closed innovation with external networking resulting in a "culture of innovation" including innovation networking capabilities. This can be partly explained by the embeddedness of these companies in this region where they were founded. The region is known for its networking culture and the research shows that corporate innovation cultures and regional innovation cultures can reinforce each other. This supports the conclusions of Tödtling et al. (2011) who show that corporate innovation cultures and regional innovation cultures can influence each other into creating an environment conducive to open innovation. It also supports the conclusions of Belussi et al. (2010) who studied the life sciences sector in a specific region and found that relational and coordination capabilities of firms and research labs allow the establishment of a positive spiral of learning conducive to the development of an 'ORIS' ('Open Regional Innovation System'). The Brainport region seems to be on its way to become such an ORIS as well. The difference between a traditional RIS and an open ORIS is in the high score on the capability to connect global and local networks, which means that companies in the region can combine exploiting the advantages of local knowledge spill-overs and getting access to non-local sources of knowledge and information.

The research also provides evidence that the presence of a KIBS cluster in a region, combined with a regional open innovation strategy stimulating networking and cooperation, is not sufficient for creating an open innovation culture. KIBS companies in the region score low or intermediate on the networking capabilities. The literature on collaborative innovation involving KIBS firms to date shows mixed results (Doloreux et al., 2010). Qualifications of KIBS in terms of innovation range from "remarkable innovators in her own right", "knowledge intermediaries" and "central to the innovation processes of other firms" to "routine service providers". E.g. Aslesen and Isaksen (2010), in a study of KIBS in different Norwegian regions, find that KIBS do engage in collaborative learning processes and act as intermediaries between knowledge infrastructure and firms. Kautonen and Hyypiä (2010), in a study of management-KIBS in Finland, find that only a small number of KIBS companies play a role as intermediaries between local clients and the international business environment. Freel (2010, p. 93) concludes that technology-based KIBS

disproportionate engage in collaborative innovation with other KIBS but that there is relatively limited collaborative contribution of KIBS to other sectors. Miles (2005) finds that some technology-based KIBS are well linked to innovation systems, while IT services and more professional services tended to have low levels of contact, relying more on professional associations to refresh their knowledge. Our results for the Utrecht region are in line with Miles (2005), Freel (2010) and Kautonen and Hyypiä (2010). Overall, applying the framework to KIBS companies in the Utrecht region results in relatively low scores on innovation networking capabilities and low involvement in open innovation, with technology-based KIBS as the exception, and we find a limited role of KIBS companies in connecting local and global innovation networks. However, we have to be careful to draw conclusions on differences between technology industry and KIBS sector based on the comparison between two regions with a different sectoral specialization. E.g. Aslesen and Isaksen (2010) and Kautonen and Hyypiä (2010) report differences between the role of KIBS in innovation systems in different regions within one country. Differences between regions, such as high level of specialization versus more generic services, level of globalization, proximity of different KIBS-partners and differences in knowledge sources, may influence the role of KIBS in innovation systems.

The research indicates that the networking capabilities framework is a promising tool for analysis that can be used to compare to what extent companies from two different sectors are equipped to benefit from open innovation. The comprehensive framework of network capabilities for open innovation has been developed by connecting fundamental innovation culture dilemmas to networking capabilities and seems to offer a more complete framework than existing models on open innovation and capabilities (Cheng and Chen, 2013; Den Hertog et al., 2010; Fichter, 2009; Gassmann and Enkel, 2004; Lee et al., 2010; Lichtenthaler, 2011; Lichtenthaler and Lichtenthaler, 2009; Robertson et al., 2012; Simard and West, 2006; Vanhaverbeke, 2006;), also because differences in capabilities can be related to the way companies handle the innovation dilemmas. However, further research to validate the framework is necessary.

Next to the already mentioned managerial implications for companies, the research has important policy implications for regions as well. E.g., in the Utrecht region, several KIBS companies are not convinced that they can benefit from being involved in regional innovation networking. The innovation networking capabilities framework can help regional innovation policy makers to convince companies that they can benefit from open innovation by developing these capabilities.

6. Conclusion

Companies can benefit from open innovation when they have the capabilities to connect closed and open approaches to innovation. Benefiting from open innovation is not just a matter of implementing an open innovation strategy consisting of cooperative agreements, external technology acquisition, investing in start-ups, spinning-off activities etc. Benefiting from open innovation requires a culture change in the direction of a culture conducive to developing networking capabilities. The first research question has been answered by developing a comprehensive framework of nine networking capabilities, rooted in theories of how organizational cultures impact innovation and showing how the framework can be used to evaluate to what extent companies are equipped to benefit from open innovation. The research results suggest that the framework can serve as an analytical tool to evaluate to what extent companies are equipped to benefit from open innovation, and can help regions to develop policies to encourage and assist companies to improve their networking

capabilities and embark on culture change processes. The second research question has been answered by preliminary empirical research to test the framework by a comparative study of a region dominated by the technology industry and a region dominated by the business services industry in The Netherlands. The results indicate that technology companies are in the lead of benefiting from open innovation. A possible explanation for this advantageous position in being able to benefit from open innovation is that many technology companies have a long experience in improving their innovative performance by combining internal R&D capabilities and innovation activities with developing networking capabilities to recognize, monitor and use external knowledge resources and innovations developed elsewhere. Companies with previous experience in making internal skills and resources work together in innovation and a culture conducive to external networking benefit from networking in innovation with customers, competitors, suppliers, partners, knowledge institutes and other external stakeholders. However, definitive conclusions cannot be drawn because the comparative case study between two regions served as a first step to further validating the framework of network capabilities. Further research is necessary to investigate the influence of other differences between regions such as high level of specialization versus more generic services, level of globalization and differences in knowledge sources.

The framework of networking capabilities is a promising tool to serve as a checklist for companies how they can become better equipped to jointly create value and capture value in open innovation networks. The research has important policy implications as well, because it indicates that regional open innovation strategies need to address the development of networking capabilities of companies and other actors in the regional innovation system to create an open innovation environment. The framework of networking capabilities can potentially serve as an analytical tool to assess under which conditions companies can benefit from open innovation in a regional cluster.

Limitations of the study are the case study approach limited to two different industries in two different regions and the qualitative approach due to a lack of quantitative data on the benefits of open innovation. Further research should be aimed at assessing the generalizability of the approach by comparative research of other sectors and regions, detailed research of benefits of open innovation in specific companies and more quantitative research. Another possible area of research is in the new category of 'tech-service' companies-the growing group of technology firms with a large service component. It would be interesting to use the innovation network capabilities framework to assess to what extent these firms are able to transfer elements of an open innovation culture from the technology side of their business to the service side and possibly the other way around.

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