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Learning and Innovation in Food SMEs:

Network Composition and Management

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Preface

This PhD dissertation combines a collection of individual papers that are submitted to or have been accepted for publication in peer-reviewed journals.

It was performed within the framework of the NetGrow project (2010-2014) which was funded under the Seventh Framework Programme of the European Commission (grant agreement no. 245301). The overall objective of the NetGrow project was *'to enhance network learning leading to increased innovation, economic growth and sustainable competitive advantage for food SMEs'*. Instrumental for achieving this was *'usable know-how about network learning, the attitude of food SMEs in different EU member states and the functioning and performance of different types of networks*'.

The NetGrow project (*www.netgrow.eu*) was coordinated by Ghent University (Belgium) and involved the following partners: Teagasc Food Research Centre, Astown (Ireland), Stichting Food Valley (Netherlands), Debrecen University (Hungary), Skåne Food Innovation Network (Sweden), Institute for Food Studies & Agro Industrial Development (Denmark), Bologna University (Italy), LaSalle Beauvais Polytechnic Institute (France) and Bonn University (Germany).

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Table of contents

List of figures

List of tables

List of abbreviations

CFA	=	Confirmatory Factor Analysis
CFI	=	Comparative Fit Index
df	=	Degrees of Freedom
EU	=	the European Union
GFI	=	Goodness of Fit Index
IP	=	Intellectual Property
NACE	=	the statistical classification of economic activities in the European Community
R&D	=	Research and Development
RBV	=	Resource-Based View of the firm
RMSEA	=	Root Mean Square Error of Approximation
SE	=	Standard Error
SEM	=	Structural Equation Model
SME	=	Small and Medium-Sized Enterprise
SRMR	=	Standardized Root Mean Square Residual
VIF	=	Variance Inflation Factors

Chapter 1

Introduction

1.1 General introduction

Since the work of Schumpeter on a *theory of economic development* almost a century ago (1934), innovation is seen as the driving force behind economic development (Cantner *et al.*, 2011). In a world where globalization and information technology have resulted in increased competition (Du Chatenier *et al.*, 2009), firms have to constantly seek to innovate in order to stay competitive (Van de Ven *et al.*, 1999; Freeman and Soete, 1997). While innovation was traditionally regarded as the result of the firms' isolated efforts, it is now argued that it results from an interactive process that requires cooperation between different actors, both within firms and between firms and other organizations, for example research institutes and consultants (Edquist, 2006; Tödtling and Trippl, 2005). Indeed, in order to innovate, firms have to seek resources from other firms and organizations as the increasing complexity and dispersion of knowledge and resources does not allow them anymore to pursue innovations alone (Möller and Svahn, 2006; Powell *et al.*, 1996).

There are several ways by which firms can access to external resources. A common strategy for obtaining new resources is through acquisitions (Morrow *et al.*, 2007; Granstrand and Sjölander, 1990). Another is to engage in networks. Firms can participate in networks in order to access additional resources from their partners that can help them to enhance their innovation performance (Mu *et al.*, 2008).

There is a now an abundance of studies that underpin the importance of networks for innovation (Lasagni, 2012). Simultaneously, 'open innovation', that is the firm's targeted use of knowledge coming in and out of its boundaries in order to accelerate internal innovation and expand the markets for external use of innovation (Chesbrough, 2012; Chesbrough, 2003a, 2003b), is *'one of the hottest topics in innovation management'* (Huizingh, 2011: 2). A growing number of empirical studies show the positive link that exists between the use of external relationships and the innovation performance of the firm, regardless of the firm's industry (i.e. high-tech vs. low-tech industries) or size (i.e. large vs. small firms) (e.g. Beckeman *et al.*, 2013; Purcarea *et al.*, 2013; Gronum *et al.*, 2012; Köhler *et al.*, 2012; Zeng *et al.*, 2010; Tödtling *et al.*, 2009; Beckeman and Skjöldebrand, 2007; Knudsen, 2007; Nieto and Santamaría, 2007; Amara and Landry, 2005; Menrad, 2004). In their systematic review, Pittaway *et al.* (2004) find that the main benefits of networking include risk sharing, accessing to new markets, technologies and knowledge, pooling complementary skills, speeding products to market and safeguarding property rights.

Nonetheless, networking for learning, that is the process by which an organization or any of its units acquires knowledge that is recognized as potentially useful to the organization (Huber, 1991), and networking for innovation poses key organizational and managerial challenges to firms (Columbo *et al.*, 2012). When 'opening up' for innovation, firms need to deploy large efforts in screening and testing several sources and solutions (Lazzarotti and Manzini, 2009). Moreover, they have to set up coordination mechanisms in order to deal with the differences in mentality between parties and the distribution of ownership of assets and intellectual properties

resulting from collaborative innovation activities (Giannopoulou *et al.*, 2011; Wallin and von Krogh, 2010). Furthermore, they expose themselves to the risk that partners act opportunistically (Dahlander and Gann, 2010), and that unintended knowledge leakage occurs (Ozman, 2009). Besides, when firms overly rely on or commit to a few exchange partners, they become exposed to the risk of being 'locked' in the relationships at the expense of their own innovative and learning capacity (Andersen, 2013; Boschma, 2005).

These challenges may be particularly stark for small and medium-sized enterprises (SMEs). On the contrary to large firms, SMEs do not possess the resources and have in place the routines that are necessary to develop and manage wide and diverse networks of partners (Columbo *et al.*, 2012; Hausman, 2005). They are often characterized by a specialized knowledge base associated with their core business which confront them with complications when they encounter and need to exploit new knowledge in unfamiliar areas (Bianchi *et al.*, 2010; Huggins and Johnston, 2009). Also, they often experience difficulties to reflect on their business strategically, which on the one hand, makes them at the mercy of unscrupulous partners (Vos, 2005) and on the other hand, prevents them to clearly define their demand regarding external knowledge inputs (Klerkx and Leeuwis, 2008). Besides, they struggle with enforcing their will upon other. They must therefore hope that the results of collaborative efforts will be shared fairly (van Gils & Zwart, 2004 in Batterink *et al.*, 2010).

In that context, and given the perceived importance of SMEs to the economy and to employment, governments across the globe have started to support the creation and maintenance of networks with an emphasis on the competitiveness of SMEs (Kingsley and Malecki, 2004; Barnett and Storey, 2000). Since the shift from the traditional linear model of innovation, which assumes '*a linear, one-directional causality from science to technology, and from technology to economic development*' (Caraça *et al.*, 2009: 862), to the 'interactive', 'systemic' model of innovation in the 1990s, many innovation policies have focused on fostering collective efforts rather than on the traditional provision of financial supports for single actors (Wazenböck *et al.*, 2013; Edler and Georghiou, 2007; Tödtling and Trippl, 2005). Networks and alike (e.g. clusters) are seen as a possible agent for economic development, and network policy initiatives have literally mushroomed in both advanced economies and developing countries (Ebbekink and Lagendijk, 2013; Hallencreutz and Lundequist, 2003; Martin and Sunley, 2003; Huggins, 2000).

There are many different designs for networks and an even broader variety of approaches when implementing them (Bek *et al.*, 2012; Nauwelaers, 2001). Networks differ for example in terms of configuration (e.g. structure and position), composition (e.g. type of participants) and operation or management (e.g. use of brokers or intermediaries to coordinate the network) (Turrini *et al.*, 2010; Pittaway *et al.*, 2004; Bessant and Tsekouras, 2001). Despite the fact that much research has been conducted on the nature and form of networks, no consensus has been reached about the optimal design for networks to foster learning and innovation (Corsaro *et al.*, 2012b; Thorpe *et al.*, 2005; Pittaway *et al.*, 2004). What actually

constitutes the success of networks is still open to debate (Hanna and Walsh, 2008; Huggins, 2001).

In particular, it is more and more acknowledged that firms rely on specific knowledge sources and partners for different types of innovations. A growing number of studies show that different types of innovations are associated with different types of partners (e.g. Tödtling *et al.*, 2009; Nieto and Santamaría, 2007; Amara and Landry, 2005). Nonetheless, studies that investigate the type of partners upon which firms rely for different types of innovations remain scarce, especially when non-technological innovations (e.g. market and organizational innovations) are concerned. Besides, there are still important gaps in the understanding of how networks operate in order e.g. to facilitate learning and innovation (Bessant *et al.*, 2012; Provan *et al.*, 2007). In particular, there is a limited knowledge on how to construct and manage networks and deal with the managerial challenges encountered in them (Levén *et al.*, 2014; Bessant *et al.*, 2012; Partanen and Möller, 2012; Fromhold-Eisebith and Eisebith, 2005; Möller *et al.*, 2005; Varamaki and Vesalainen, 2003).

The above research gaps set the frame of this PhD dissertation. The main objective of the present work is to investigate the impact of a series of factors related to network composition and management (i.e. type of network members, innovation broker, formal coordination mechanisms, and social capital) on the success of networks for learning and innovation in food SMEs.

The choice to focus on the food industry was motivated by the following underlying aspects. The food industry is the largest manufacturing sector in terms of turnover, value added and employment in the European Union (EU) (FoodDrinkEurope, 2014). Its maintenance and development is therefore important for the competitiveness of the EU. The food industry is also a diversified sector. It entails a variety of sub-sectors among which the 'bakery', 'meat', 'dairy', and 'drinks' sectors account for around 60% of the total turn-over and for more than 70% of the total number of employees and firms. It is characterized also by a wide range of company size, with SMEs representing the majority of the firms (i.e. 99% of the food firms are SMEs) and accounting for more than 50% of the food industry turnover (FoodDrinkEurope, 2014). While the food industry is traditionally regarded as a relatively mature and slow-growing area of business with low research intensity, it has undergone important changes in recent years that have rendered innovation an important activity for any food firm wishing to stay in business (Sarkar and Costa, 2008). Examples of these changes are stringent legal requirements, new opportunities for added-value applications caused by new development in Science, and increased pressure of consumers who demand singular foods of quality, convenient to cook and eat (Sarkar and Costa, 2008; van der Valk and Wynstra, 2005). Besides, in light of the global character of food markets, '*innovation may become more of a necessity than an option*' (Triguero *et al.*, 2013: 273). Also, most innovation studies, including studies on networks, have paid attention to large, high-tech, and multinational enterprises. Few have focused on SMEs and traditional or low-tech industries (Parida *et al.*, 2012; Gassmann *et al.*, 2010;

Hoffman *et al.*, 1998); and this even though it has been acknowledged that the innovation processes of these types of firms and industries are different and so require specific analysis (Hirsch-Kreinsen *et al.*, 2006; Hausman, 2005).

1.2 Overview of network research

1.2.1 Definition of network

The literature on networks is extensive. Networks have been studied in a wide range of disciplines, including, but not limited to, organizational theory and behaviour, strategic management, business studies, health care services, public administration, sociology, communications, and psychology (Provan et al., 2007). As a consequence, a general confusion or vagueness exists around the concept of network. Depending on the disciplines and the theoretical perspectives taken, 'networks' take different meanings and are defined differently (Pickernell et al., 2007; Varamaki and Vesalainen, 2003). '*Even the term network is not always used. Many who study business, community, and other organizational networks prefer to talk about partnerships, strategic alliances, interorganizational relationships, coalitions, cooperative arrangements, or collaborative agreements*' (Provan *et al.*, 2007: 480).

In its most abstract definition, a network is a set of nodes (i.e. actors) connected by a set of ties (i.e. relationships) (Brass *et al.*, 2004; Borgatti and Foster, 2003; Håkansson and Ford, 2002). According to this view, a network may refer to many different social interaction processes. Grandori and Soda (1995: 184) highlight that networks are '*modes of orgazing economic activities through inter-firm coordination and cooperation*'. They therefore see networks as means to organize activities, which implies that the behaviour of actors must necessarily be intentional and goal-oriented (Järvensivu and Möller, 2009). This perspective is closely related to what Kilduff and Tsai (2003) refer to as 'goal-oriented' as opposed to 'serendipitous' networks. In the scope of this PhD dissertation, both Grandori and Soda's (1995) and Kilduff and Tsai's (2003) perspectives are followed, that is networks are viewed as intentionally assembled entities.

Following Provan and Kenis (2008), a network is defined as a group of three or more legally autonomous organizations that cooperate to achieve not only their own goals but also a collective goal. A network is said to be vertical when it involves firms at different point of the value-chain (i.e. suppliers, customers and distributors), horizontal when it entails the firms from the same industry (i.e. peers and competitors) (Hanna and Walsh, 2008; Chetty and Wilson, 2003), or diagonal when it includes firms from different industries (Folkerts and de Jong, 2013 in Garbade, 2014). Next to these three types of inter-firm network, it exists networks that includes firms and other types of organizations such as universities and other public research centres (Roper *et al.*, 2008). Networks may also take the form of 'hard' networks (e.g. co-marketing and co-production networks) or 'soft' networks (e.g. learning networks) depending on the level of interdependence between the

network members (Sherer, 2003; Huggins, 2001). Networks can be divided further into defined or not-defined networks depending on whether the number of partners and their identity are known in advance (Sala *et al.*, 2011).

In this dissertation, the focus will be on learning and innovation networks. A learning network is viewed here as a defined group of three or more legally autonomous organizations, formally set up and operated in order to support knowledge sharing among members and generate learning that is useful for business purposes (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001). So described, they encompass a variety of forms of organizations such as innovation networks. Innovation networks are thus a particular type of learning networks where organizations collaborate in one or more steps of the innovation cycle in order to develop and/or market their products or services (Landsperger and Spieth, 2011; Batterink *et al.*, 2010).

1.2.2 Network composition

Innovation, which can be defined as the succesful exploitation of new ideas into e.g. new products, processes, markets and ways of organizing (Pittaway *et al.*, 2004; Lundvall, 1995), is determined not only by factors internal to the firm but also by external ones (Souitaris, 2002). Increasingly, a firm's capacity to innovate is being dependent on its capacity to mobilize and integrate resources that lies beyond its organizational boundaries (Tether, 2002). Firms therefore gradually get involved in external collaboration in order to innovate (Ritter and Gemünden, 2003).

Prior studies have shown that firms can rely on a broad range of external partners in order to innovate (e.g. Lasagni, 2012; Cassiman and Veugelers, 2006; Faems *et al.*, 2005). Interacting with customers may provide firms with new ideas for innovation and reduce the risk of uncertainty that is associated with the introduction of these innovations in the market (von Hippel, 1988 in Belderbos *et al.*, 2006). Cooperating with suppliers is likely to help firms to improve input quality and reduce costs through process innovation (Hagedoorn, 1993). Collaborating with competitors may also be attractive to reduce the costs and risks for large projects or to work on common problem especially when these fall outside of the sphere of competition (Miotti and Sachwald, 2003; Tether, 2002). Besides, linkages with science base actors such as universities and other public research organizations can provide firms with access to new scientific and technical knowledge (Belderbos *et al.*, 2004; Lundvall, 1995).

It is more and more acknowledged that firms rely on specific knowledge sources and partners for different types of innovations. A growing number of studies show that different types of innovations are associated with different types of partners. An overview of these studies is presented in Table 1.1. Nonetheless, studies that investigate the type of partners upon which firms rely for different types of innovations remain scarce (Chen *et al.*, 2011b; Nieto and Santamaría, 2007). In addition, the studies reviewed have all focused on technological innovations (i.e.

product and process innovations). The role of different types of partners for non-technological innovations such as market and organizational innovations has yet to be investigated.

Table 1.1 Overview of studies investigating the relation between types of collaborative partners and types of innovation

Authors	Methodology	Focus – types of innovations	Main findings
(Gemünden *et al.*, 1996)	Survey; high-tech firms (biotechnology, EDP, medical equipment microelectronics and sensor technology)	Product (new & improvements) Process	Product improvements (+) related to suppliers & customers New products (+) related to universities Process (+) related to universities & consultants
(Freel, 2003); (Freel and Harrison, 2006)	Survey; manufacturing SMEs	Product (new to industry) Process (new to industry)	Product (+) related to customers & public (and quasi-public) sector agencies Process (+) related to suppliers & universities
(Amara and Landry, 2005)	Survey; manufacturing firms	Product & process (world first or not)	World first innovation (+) related to research sources (i.e. universities & research laboratories) & (-) related to market sources (i.e. suppliers, clients, peers, competitors & consultants)
(Nieto and Santamaría, 2007)	Survey; manufacturing firms	Product (degree of novelty)	Degree of product novelty (+) related to suppliers, clients and research organizations, and (-) related to competitors
(Tödtling et al., 2009)	Survey; manufacturing and service firms	Product (radical & incremental)	Radical products (+) related to with universities and research organizations Incremental products (+) related to providers of business services
(Tomlinson and Fai, 2013)	Survey; manufacturing SMEs (aero- space, ceramics, information technology and software, textiles and healthcare)	Product Process	Product (+) related to buyers and suppliers Process (+) related to buyers and suppliers No relation between innovation & competitors

Source: *Own compilation*

1.2.3 Network management

While the study of networks and relationships has a long history in the business context, it is only recently that network research has started to focus on the management of networks (Möller and Svahn, 2006; Knight and Harland, 2005; Ritter *et al.*, 2004; Lorenzoni and Lipparini, 1999); this is particularly valid when networks of more than two partners, as opposed to dyads, are concerned (Partanen

and Möller, 2012). Similarly to the study of networks, network management has attracted efforts from researchers among several fields (Järvensivu and Möller, 2009). It has been studied for example in industrial and business networks (e.g. Heikkinen *et al.*, 2007; Ritter and Gemünden, 2004), strategic networks (e.g. Möller and Rajala, 2007; Gulati *et al.*, 2000), public sector networks (e.g. Turrini *et al.*, 2010; Agranoff and McGuire, 2001), and learning and innovation networks (e.g. Batterink *et al.*, 2010; Dhanaraj and Parkhe, 2006).

In the network management literature, different approaches are followed by scholars based on the underlying assumptions they make about the nature of networks (Järvensivu and Möller, 2009). Some scholars (e.g. Håkansson and Ford, 2002; Wilkinson and Young, 2002) adopt what is called the 'network of organizations' view by Achrol (1997) and Möller *et al.* (2005). They see networks as a group of actors interconnected in exchange relationships and emphasize the self-organizing aspects of networks which they believe cannot be managed (Möller and Rajala, 2007; Ritter *et al.*, 2004). Other scholars (e.g. Heikkinen *et al.*, 2007; Park, 1996) adopt the 'network organization' view, which is embraced in this dissertation. They look at networks as deliberately created structures and argue that they are to be managed in order to be succesfull (Möller and Rajala, 2007; Möller *et al.*, 2005).

In this section, a review of the recent literature on network management is provided. The review mainly encompasses studies of network management in the context of learning and innovation networks as this PhD dissertation aims at contributing to this field of research. Nevertheless, studies on network management in other contexts are also referred to when they add complementary insights into the issue of network management. Extant studies that have investigated network management in the context of learning and innovation networks can be divided into two broad categories: (1) literature on hub-driven innovation networks, which examine the process of network management from the perspective of a central firm i.e. the 'hub', and (2) literature on network brokers and intermediaries, which investigate the process of network management from the perspective of a third-party i.e. the network broker or intermediary. These are reviewed here.

1.2.3.1 Hub-driven networks

In the hub approach, network management can be viewed as the attempt of the hub firm to facilitate inter-organizational cooperation in order to reach its own goals (Corsaro *et al.*, 2012a). There are only a handful of studies that have examined the phenomenon of management in the context of innovation and learning networks. An interesting study is the one of Dhanaraj and Parkhe (2006) where they develop a framework that offers a rather holistic view of the management process in innovation networks. The framework focuses on how hub firms 'orchestrate' network activities in order to create and extract value from the network. It identify three tasks of orchestration. In the case of innovation networks, where knowledge is the chief resource that firms seek to access, the first task involves ensuring knowledge mobility. Knowledge mobility is defined as '*the ease with which*

knowledge is shared, acquired, and deployed within the network' (Dhanaraj and Parkhe, 2006: 660). The hub firm can improve it by focusing on three processes: knowledge absorption, network identification and inter-organizational socialization. The second task of orchestration involves managing innovation appropriability in order that the value created is distributed equitably between the network members. The hub firm can ensure such equitable distribution but also mitigate appropriability concerns through trust, procedural justice and joint asset ownership. The third task of orchestration concerns network stability as a network in erosion may significantly harm innovation outputs. The hub firm can increase the network stability by enhancing network reputation, managing expectations and building multiplexicity. In addition to these orchestration tasks, the framework also points to the task of network design. Through its recruitement activities, the hub firm can also influence the network design (i.e. network membership, network structure, position) which has been shown to impact innovation outcomes as well (e.g. Corsaro *et al.*, 2012b; Rodan and Galunic, 2004; Gemünden *et al.*, 1996).

A few empiricial studies have explored the nature, importance and/or effects of the orchestration processes underpinned in the framework of Dhanaraj and Parkhe (2006) for the success of innovation and learning networks. Nambisan and Mohanbir (2011)'s qualitative study suggests that in order to be successful, orchestration processes should carefull be crafted and reflect the interplay between elements of the innovation to be developed and elements of network design. Hurmelinna-Laukkanen *et al.* (2012) investigate how the orchestration of innovation networks by improving absorptive capacity, network stability, and innovation appropriability contribute to the success of both the network and the individual firm. Their results indicate that stability and absorptive capacity are most relevant for the success of the network, and absorptive capacity and appropriability for the success of the firm. Ritala *et al.* (2009) utilize qualitative evidence to show that the orchestration of innovation networks relies on both organizational and individual level skills.

Outside the framework of Dhanaraj and Parkhe (2006), other empirical studies have sought to investigate the essence and/or impact of network management, or some aspects of it, in innovation and learning networks. Dyer and Nobeoka (2000) examine how Toyota has managed to create and manage a high-performance knowledge sharing network. They show that Toyota has succeeded to solve three fundamental dilemnas with regard to knowledge sharing by having devised methods to motivate participation and knowledge sharing, prevent free-riding and reduce the costs associated with finding and accessing knowledge. In particular, Toyota has managed to develop a highly interconnected and cohesive networks by creating a strong network identity with rules for participation and entry to the network.

In their analysis of two case companies' approaches to network management, Ojasalo (2008) identify several aspects of management of innovation networks. They find that planning, control (through e.g. written contracts) and trust are important elements in innovation management networks both for coordinating the activities and protecting the intellectual properties of innovations. Their results also suggest

that to operate efficiently, an innovation network requires a 'manager' or 'coordinator'. This central actor is expected to establish effective and efficient coordination of activities in the network without taking too detailed control of the network members and their activities.

The importance of planning, control, trust and coordination for the success of innovation networks is also underpinned by other studies. Using a longitudinal in-depth case study approach, Gardet and Fraiha (2012) shows that for assuring the success of its innovation network, the hub-firm changes the tools it uses for coordinating it (i.e. communication, trust, division of benefits, guarentees of cooperation and conflict resolution) in function of its dependence towards the other network members and the collaborative phase they are in. In their study about the influence of network management on the effectiveness of innovation networks, Rampersad *et al.* (2010) find that harmony, defined as the development of mutual interests among network actors, is positively influence by trust, control, and coordination. Harmony, in turn, positively impacts network efficiency which leads to network effectiveness. The results of Landsperger *et al.* (2012) demonstrate the positive impact that a network manager endowed with the appropriate social and technical skills has on the development of harmony, trust and members' commitment in innovation networks. They also point to the importance of three network management functions (i.e. member selection, planning, and control) for reaching such a relational network performance.

1.2.3.2 Intermediary-driven networks

In intermediary-driven networks, network management can be seen as the effort of the intermediary to plan and coordinate the activities of a network as a whole in order create value for all network members (Paquin and Howard-Grenville, 2013). Intermediaries, also called third-parties, bridgers, and network brokers, entail a wide range of agents such as technology transfer centres (e.g. Alexander and Martin, 2013; Comacchio *et al.*, 2012), business incubators (e.g. Soetanto and Jack, 2013), science parks and development agencies (e.g. Lee *et al.*, 2010), business promotion entities (e.g. Cantner *et al.*, 2011), and cluster organizations (e.g. Garbade *et al.*, 2012). Many of them are created through government initiatives as a way to overcome market and system failures (Klerkx and Leeuwis, 2009; Edler and Georghiou, 2007). Intermediaries are described to perform a wide variety of activities in the innovation process (for a review of intermediaries' tasks, see Howells, 2006). Some of them have for main task to act as brokers in the formation and maintenance of innovation and learning networks (Klerkx and Leeuwis, 2009). In other words, the chief function of certain intermediaries is to manage networks. Such intermediaries have been coined 'innovation brokers' by Winch and Courtney (2007).

As mentioned in the general introduction, firms and especially SMEs are confronted to a variety of challenges when it comes to establish and derive benefits from inter-organizational networks. Overcoming these challenges is the function of innovation

brokers, and researchers have started to investigate whether and how these intermediaries can effectively fullfil their purpose.

Keast and Hampson's (2007) case study examines the formation and operation of an innovation network in the construction sector to provide insights into the governance modes and management strategies employed. The findings indicate that a mix of governance modes can co-exist in the same networks, and is often preferred. In the network under study, a combination of governance mechanisms based on mutual relationships, contracts, and formalized hierarchical structures (i.e. presence of a governance board and a management team acting as innovation broker) was used as a key integrating process. In addition, the results emphasize four key relational management tasks in innovation networks, which represent, to a certain extent, an alternative way of managing, and therefore require specific strategies to be put in place. The first task, i.e. 'activating', is similar to the network design task of Dhanaraj and Parkhe (2006). It refers to the correct identification of necessary participants for the network as well as to the process of tapping into their skills, knowledge and resources. The task of framing involves establishing and influencing the operating rules, values, and norms of the network and altering the perceptions of the members to make them realize that more can be achieved by working together than singularly. The task of mobilizing describes the process of securing members' commitment to the joint undertaking. It requires building a set of common objectives and achieving these objectives through convincing members that by working to a shared outcome they can also achieve individual goals. Finally, the task of synthesizing relates to the process of creating an environment for favourable, productive interaction among members. It needs preventing or removing blockages to cooperation, developing effective communication systems and establishing incentives, rules or procedures to enhance cooperation.

Both the qualitative (2000) and quantitative (2001) studies of Huggins provide interesting insights about the role that innovation brokers can play in the success of innovation and learning networks. In his qualitative study on the success and failure of policy-implanted inter-firm networks, Huggins (2000) finds that innovation brokers can stimulate, or on the contray impede, the creation of network environments conducive to sustained cooperation. He finds that networks characterized by certain features are more likely to succeed as sustained and valued forms of business activity for their members. In particular, a relatively low number of network participants, a degree of spatial proximity and informality, and communality with regards to the nature of the businesses involved, increase the chance of collaboration. As these features mainly result from the actions of the innovation brokers, it is crucial that networks are managed in an effective way. The results of Huggins' (2001) quantitative study on the strengths and weaknesses of inter-firm networks confirms these findings. In inter-firm networks facilitated by policy-agents, it is primarily the innovation brokers, rather than the firms participating in the networks, who will trigger the production of interactions among network members. The success of these networks will therefore highly depend on the innovation broker's competence in fostering such interactions.

The study of Olsen *et al.* (2012) confirms the importance of having a competent innovation broker within the network, that is a neutral third-party who can facilitate and manage the network. Based on their review of 101 policy-implanted food SMEs networks, the authors argue that a good innovation broker must clarify the expectations of network members beforehand, administer the network meetings in a flexible and interactive way, monitor the participants, and attempt to facilitate and stimulate involvement and knowledge transfer.

The role of innovation brokers in the success of inter-firm networks is also examined in the qualitative studies of Hanna and Walsh (2002) and Hanna and Walsh (2008). The results suggest that, in order to facilitate successful networks, innovation brokers must encourage the development of trust among network participants. '*The process of networking is prone to suspicions of opportunism […] and intermediaries organize the networks to preclude it*' by e.g. excluding competitors and finding trustworthy partners (Hanna and Walsh, 2008: 310). Besides, innovation brokers must also ensure that network members have similar goals.

Drawing on the framework of Dhanaraj and Parkhe (2006), Batterink *et al.* (2010) investigate how innovation brokers successfully orchestrate innovation networks of SMEs. The results of their case study indicate that innovation brokers operate properly when they engage in a number of orchestration processes. They must orchestrate 'innovation initiation' by incorporating the needs of SMEs in the collaborative initiative and by being strongly connected to SMEs' networks. They orchestrate well the 'innovation network composition' when they possess a large and diverse network and when they are able to connect SMEs with actors endowed with complementary resources. Finally, they need to 'manage the innovation process' by taking the lead in handling potential conflicts, enhancing transparency, and facilitating interactions between network members.

Bessant *et al.* (2012) examine the factors affecting the setting-up, operation and sustainability of peer-to-peer learning networks. Their analysis of a series of networks suggests that trust is an important factor for the success of learning networks and that it can be fostered by a neutral, third-party. It also highlights the importance of coordination in order to obtain a group of high closure, i.e. '*a cohesive and trusted group able to go through repeated interactions and share in-depth knowledge' (Bessant et al., 2012: 1106)*. The study reports that two coordination modes may exist in networks. High closure can be achieved through power and hierarchy, or through neutral, external, intermediaries '*acting as facilitators overcoming internal conflicts, jealousies, and mistrust*' *(Bessant et al., 2012: 1106)*.

1.2.3.3 Summary of network management literature

Even though the literature review on network management in learning and innovation networks above did not aim at being comprehensive, it shows that

aspects of network management are manifold. Prior studies have been concerned with different aspects of management practices in networks, such as hierarchy, control, trust, coordination, and communication. Besides, the review also highlights the challenging nature of network management. Although a series of scholars talk against more controlled and structured management and are in favour of more freedom in innovation and learning networks (Ojasalo, 2008), the studies reviewed suggest that the key for successfully managing networks lies in the art of balancing both controlled and relational management approaches while reflecting on the network goal, stage of development, and design such as the type of participants.

Although the number of studies on network management is not negligible, the literature on network management in general is still in its infancy (Partanen and Möller, 2012; McGuire, 2006; Möller and Svahn, 2006), and a series of knowledge gaps were identified. These are summarized now.

A notable aspect of prior studies on network management in learning and innovation networks is that the majority of them are case studies or conceptual papers. Many researchers therefore call for identifying aspects characterizing network management approaches in quantitative studies (Hurmelinna-Laukkanen *et al.*, 2012; Olsen *et al.*, 2012; Nambisan and Mohanbir, 2011; Batterink *et al.*, 2010; Ojasalo, 2008).

Besides, there is a plea for more research on the role of innovation brokers in learning and innovation networks (Ojasalo, 2008; Sapsed *et al.*, 2007; Winch and Courtney, 2007; Pittaway *et al.*, 2004). In particular, more research are needed on the precise role of innovation brokers in the development of proximity in -, and success of collaborative innovation initiatives (Crespin-Mazet *et al.*, 2013; Lee *et al.*, 2010; Johnson, 2008).

Furthermore, there is little reported on the antecedents of network management mechanisms in literature. Researchers are therefore encouraged to investigate such antecedents which may lie in the network design (Gardet and Fraiha, 2012). For example, Hurmelinna-Laukkanen *et al.* (2012) argue that the number of partners and the extent to which they are familiar with one another will impact the type of network management mechanisms to be put in place.

1.3 Theoretical perspectives

In this PhD dissertation, two theoretical perspectives are used to shed light on the nature of the factors that may constrain, or on the contrary foster, the success of networks for learning and innovation in food SMEs. Section 3.1 introduces the resource-based view of the firm which proposes that networking is driven by a logic of resource needs. Section 3.2 presents the social capital theory which suggests that having an inter-organizational network is a pre- but not sufficient condition to access strategic resources. According to this theory, the structure and social

content of the inter-organizational network influence the extent to which resources can effectively be acquired in the network.

1.3.1 Resource-based view

The resource-based view of the firm (RBV) is certainly one of the most commonly used frameworks to understand the sources of sustained competitive advantage for firms. It emerged at a time where environmental models of competitive advantage predominated (see e.g. Porter's five forces model) and where little emphasis was placed on the role of firm characteristics on a firm's competitive position (Barney, 1991).

The resource-based view is rooted in the early contribution of Penrose (1959) and her 'theory of the growth of the firm'. Since then, it has been further developed by a series of authors in the strategic management literature, notably Wenerfelt (1984), Dierickx and Cool (1989), Barney (1991), Peteraf (1993) and Lavie (2006), but has also been critized (for a review of the critiques of the RBV see Kraaijenbrink *et al.*, 2010).

The RBV is based on the notion that the resources used by the firm have the potential to provide sustainable competitive advantage. It assumes that firms are characterized by a combination of strategic resources that may be significantly different across firms (Peteraf, 1993; Barney, 1991; Wenerfelt, 1984; Penrose, 1959). In addition, it holds that these resources may not be perfectly mobile across firms; heterogeneity can thus be preserved throughout time (Peteraf, 1993; Barney, 1991; Dierickx and Cool, 1989). The firm resources include '*all assets, capabilities, organizational processes, firm attribute, information, knowledge, etc. controlled by a firm*' (Barney, 1991: 101). Not all are relevant strategic resources, however. Following Barney (1991), a firm resource holds the potential to lead to sustained competitive advantage if it possesses the four following attributes:

- Valuable: The firm resource enables the firm to conceive or implement strategies that either exploit opportunities or neutralize threats present in the environment

- Rare: The firm resource is not possessed by large numbers of competitors or potentially competing firms

- Imperfectly imitable: The firm resource cannot be obtained or imitated by other firms because it is socially complex, depended upon unique historical conditions, or/and is related ambiguously to the firm's sustained competitive advantage

- *Non* – Substitutability: The firm resource cannot be replaced by another resource that enables the firm to conceive and/or implement the same strategies.

Along with these four resource characteristics, referred to as the VRIS framework (Nilsson, 2008), additional elements and/or perspectives are brought forward by other scholars in order to explain the sources of sustained competitive advantage. Peteraf (1993: 182) emphasizes the importance of preserving heterogeneity in order to maintain competitive advantage over time: '*If the heterogeneity is a short-lived phenomenon, the rents will likewise be fleeting*'. As such, she argues that 'forces' or 'isolating mechanisms' (e.g. property rights, reputation) must be put in place in order to protect individual firm from imitation and limit competition. She also highlights that, to have competitive advantage, a firm must establish a superior resource position only when there is limited competition for that position. Hoopes *et al.* (2003) claim that, out of the four resource characteristics identified by Barney (1991), only value and inimitability are at the heart of the RBV, the others being only their 'derivatives' (Vermeire, 2009).

Some authors advocate or support a 'knowledge-based view' of the firm where knowledge is seen as the most important strategic resource of the firm (Decarolis and Deeds, 1999; Bierly and Chakrabarti, 1996; Grant, 1996). The knowledge-based view of the firm argues that the primary rationale of the firm is the creation and application of knowledge. According to this view, the heterogeneous knowledge bases and capabilities in creating and transferring knowledge among firms are the main determinants of performance differences (Grant, 1996; Spender, 1994).

In the 1980s, the concept of 'competence' was put forward by many strategic theorists who advocated that the study of the resource bases of firms would not properly explain how competitive success can be achieved (Sanchez, 2004). A new perspective, the 'competence perspective', is developed which suggests that competitive advantage results from the superior ability of firms to coordinate flows and resources in and outside of their boundaries (Sanchez and Heene, 1997).

Teece *et al.* (1997) introduce the 'dynamic capability approach', also as a reaction to the lack of efforts that are made in order to understand how and why certain firms are able to build competitive advantage. The authors define dynamic capabilities as '*the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments*' (Teece et al., 1997: 516), where competences refer to the operational routines that are necessary to perform the basic functional activities of the firm (Ambrosini and Bowman, 2009; Helfat and Peteraf, 2003). They argue that the competitive advantage of a firm lies with its 'distinctive' dynamic capabilities; that is dynamic capabilities that are '*based on a collection of routines, skills, and complementary assets that are difficult to imitate*' (Teece et al., 1997: 524). Eisenhardt and Martin (2000) extend the understanding of dynamic capabilities. They advance that '*dynamic capabilities are necessary, but not sufficient, conditions for competitive advantage*' (Eisenhardt and Martin, 2000: 1106). They argue that although dynamic capabilities (e.g. alliancing and product development) are based on idiosyncratic processes that emerge from path-dependent histories of individual firms, they also entail common features across firms. As such, dynamic capabilities are substitutable and therefore cannot be a

source of sustained competitive advantage. Their value for sustained competitive advantage rather lies in the resource configurations that they create.

The 'relational view' (Dyer and Singh, 1998) and 'network resource perspective' (Lavie, 2006; Zaheer and Bell, 2005; Gulati et al., 2000; Gulati, 1999) also complement the RBV. Similarly to the 'dynamic capability approach', they answer to the lack of attention that the traditional RBV has given on the process by which firms create value-generating resources (Gulati et al., 2000). They extend the traditional RBV by moving from its sole focus on the internal resources of firms to the discussion of the importance of the firm external resources for performance. Following these perspectives, sustained competitive advantage derives not only from firm-level resources but also from difficult-to-imitate capabilities and resources embedded in dyadic and network relationships (Gulati, 1999; Dyer and Singh, 1998).

In the frame of this dissertation, the RBV and its related approaches (e.g. relational view) help to understand why a firm participates in networks on the one hand, and why it may be more or less successful in retrieving benefits from networks on the other hand. Following the RBV, the formation of relationships and participation in networks can be seen as an attempt of the firm to access to the ressources it lacks in order to stay abreast of competitors. Accessing and deriving benefits from these ressources, which refer here to anything tangible (e.g. specialized production facilities) or intangible (e.g. expertise in chemistry) the firm can use in its process for creating, producing or offering its products to the market (Sanchez, 2004; Eisenhardt and Martin, 2000; Teece *et al.*, 1997), is not straighforward, however. Firms must possess the adequate dynamic capabilities so that new, relevant ressources can be acquired and integrated to and/or combined with the firm's current ressources in order to generate a more valuable resource base (Ambrosini and Bowman, 2009; Eisenhardt and Martin, 2000). Past studies have for example emphasized the importance of 'network capability', which refers to the firm's ability to establish and use relationships with other organizations (Ritter and Gemünden, 2004), in order to develop and benefit from networks (e.g. Walter *et al.*, 2006; Ritter and Gemünden, 2003; Lorenzoni and Lipparini, 1999). Other studies point to the crucial role of 'absorptive capacity', which is defined as '*a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge*' (Zahra and George, 2002: 186), in efficiently managing external flows of knowledge and enhancing the firm's resource base and innovations (e.g. Escribano *et al.*, 2009; Lane *et al.*, 2001; Tsai, 2001).

1.3.2 Social capital theory

Despite the existence of different definitions of social capital, the consensus is in literature that social capital represents the resources or benefits an individual or social entity gain through its network of relationships (Payne *et al.*, 2011; Portes, 1998). The concept of social capital originated in sociology where it was used to describe the relational assets of communities (Putnam, 1993; Coleman, 1988) and

individuals (Bourdieux, 1980; Granovetter, 1973). Since that time, it has been examined by researchers in a wide variety of social science disciplines including economics, political science, mental health and business and management (Lee, 2009). It has also been studied at different levels, crossing over individuals, teams, organizations, communities, regions and nations (Zheng, 2010).

Several scholars such as Paldam (2000) and Adler and Kwon (2002) have suggested that social capital is a paradigm capable of creating bridges and encouraging dialogue across disciplines. Still, its adoption by scholars across a variety of fields of research has resulted in a multitude of definitions, maintaining it as an '*elusive*' concept (Durlauf, 2002: 460). In their essay on the nature of social capital, Robison *et al.* (2002) suggest that the different definitions of social capital lack precision because they include expressions of what social capital is but also of where it resides and of what it can be used to achieve. In their conceptual paper, Adler and Kwon (2002) argue that the definitions are actually relatively similar but vary in terms of focus. Following the authors, the definitions differ in the attention they give to the relations an actor maintains with other actors, the structure of these relations in a collectivity, or both. In general, scholars have either adopted what they call an 'external' or 'internal' approach on social capital. Payne *et al.* (2011) supports this argument with their review on the application of social capital at multiple levels of analysis. They show that articles often base their definition on Burt's (2000, 1997) or Coleman's (1990, 1988) theoretical foundations of social capital. Burt's 'brokering view' (1997) is one of external linkages and is concerned with the information and control advantages that actors can retrieve when embedded in networks rich in 'structural holes'. Coleman (1990) follows an internal linkage perspective on social capital by defining it as '*some aspects of social structure that facilitates certain actions of individual within the structure*'. He holds that actors in a close network can trust one another thereby reducing the uncertainty of exchange and enhancing cooperation (Coleman, 1988). Unlike other types of capital that can be possessed individually (i.e. human and financial capital), this internal or 'bonding' form of social capital is a 'collective good' as it resides in the relationships among actors (Portes, 1998; Coleman, 1988).

It is worth noting that although scholars have traditionally differentiated between the internal – and external view on social capital, a number of studies (e.g. Yu *et al.*, 2013; Zhang and Wu, 2013; Eklinder-Frick *et al.*, 2012; Soda *et al.*, 2004; Rowley *et al.*, 2000) combine actually both perspectives (Payne *et al.*, 2011). Adler and Kwon's (2002) conceptualization of social capital for example encompasses both the brokering and bonding form of social capital. They define social capital as '*the goodwill available to individuals or groups'*, and propose that '*its source lies in the structure and content of the actor's social relations*' and '*its effects flow from the information, influence, and solidarity it makes available to the actor*' (Adler and Kwon, 2002: 23). Nahapiet and Ghoshal's (1998: 243) definition of social capital also comprises an internal and external perspective. They define social capital as '*the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit*'. Drawing on Granovetter's (1992) discussion of structural and relational

embeddedness, they distinguish between the 'structural dimension' of social capital that refers to the overall pattern of connection between actors and the 'relational dimension' that refers to the assets created and leveraged through relationships such as trust. Based on the strategic literature, they also propose a third dimension of social capital i.e. the 'cognitive dimension' that involves the resources providing shared representations and systems of meaning among network members.

The central proposition of social capital theory is that networks of relationships are a valuable resource for the individual or social entity (Nahapiet and Ghoshal, 1998). Social capital helps access to broader sources of information, and increase information's quality, relevance and timeliness. It can also enhance one's influence, control or power and improve solidarity within a group (Adler and Kwon, 2002). In the field of business and management, the bonding form of social capital has been found to increase organizational commitment (Watson and Papamarcos, 2002), knowledge acquisition (Martínez-Cañas *et al.*, 2012; Yli-Renko *et al.*, 2001), resource exchange and knowledge sharing (Hung *et al.*, 2014; Yu *et al.*, 2013; Yang and Farn, 2009; Chow and Chan, 2008; Tsai and Ghoshal, 1998), innovativeness and innovation (Martínez-Cañas *et al.*, 2012; Pérez-Luño *et al.*, 2011; Luk *et al.*, 2008), and performance (Batjargal, 2003) at the individual, unit, and organizational levels. Studies have also showed that the brokering form of social capital can encourage knowledge transfer between team members (Wei *et al.*, 2011), and enhance the firm's absorptive capacity (Chiu and Ting-Lin, 2012), innovation and business performance (Chiu and Ting-Lin, 2012; Koka and Prescott, 2008; Zaheer and Bell, 2005; Rodan and Galunic, 2004) and market share (Castro and Roldán, 2013).

In the majority of studies, the accumulation of social capital is seen as positive. '*More is better*' (Edelman *et al.*, 2004: 61). Still, a growing stream of research is providing evidence that social capital, especially its bonding form, has also a downside (Laursen *et al.*, 2012; Edelman *et al.*, 2004; Adler and Kwon, 2002; Gargiulo and Benassi, 2000). The ties from which flows a variety of benefits can also serve as '*lock-ins that isolate the organization from the outside world*' (Eklinder-Frick *et al.*, 2012: 800). Following Gargiulo and Benassi (2000: 185), strong ties amplify the pressure to reciprocate past favours which '*may lock the players into endless mutual exchanges, even though both see no further benefits from the exchange*'. Uzzi (1997), and Molina-Morales and Martínez-Fernández (2009) argue that firms are exposed to the risk of becoming 'overembedded' when networks become too dense. In these networks, the flow of new ideas is reduced as there are few or no links to outside members from whom new ideas can flow. Under these conditions, the network members slowly become isolated from the environment and decline (Uzzi, 1997). Andersen (2013) also claims that high level of embeddedness in networks lead to the accumulation of homogeneous knowledge which reduce creativity and performance.

In this dissertation, the social capital theory adds to the traditional RBV by putting forward the importance of the dynamics of social forces in explaining the success of networks. Following this theory, the manner in which firms participate in networks

is likely to be not only influenced by business considerations (e.g. access to new resources), but also by social factors such as existing relationships, trust and cultural compatibilities (Bond III *et al.*, 2008; de Wever *et al.*, 2005; Huggins, 2000).

1.4 Conceptual framework

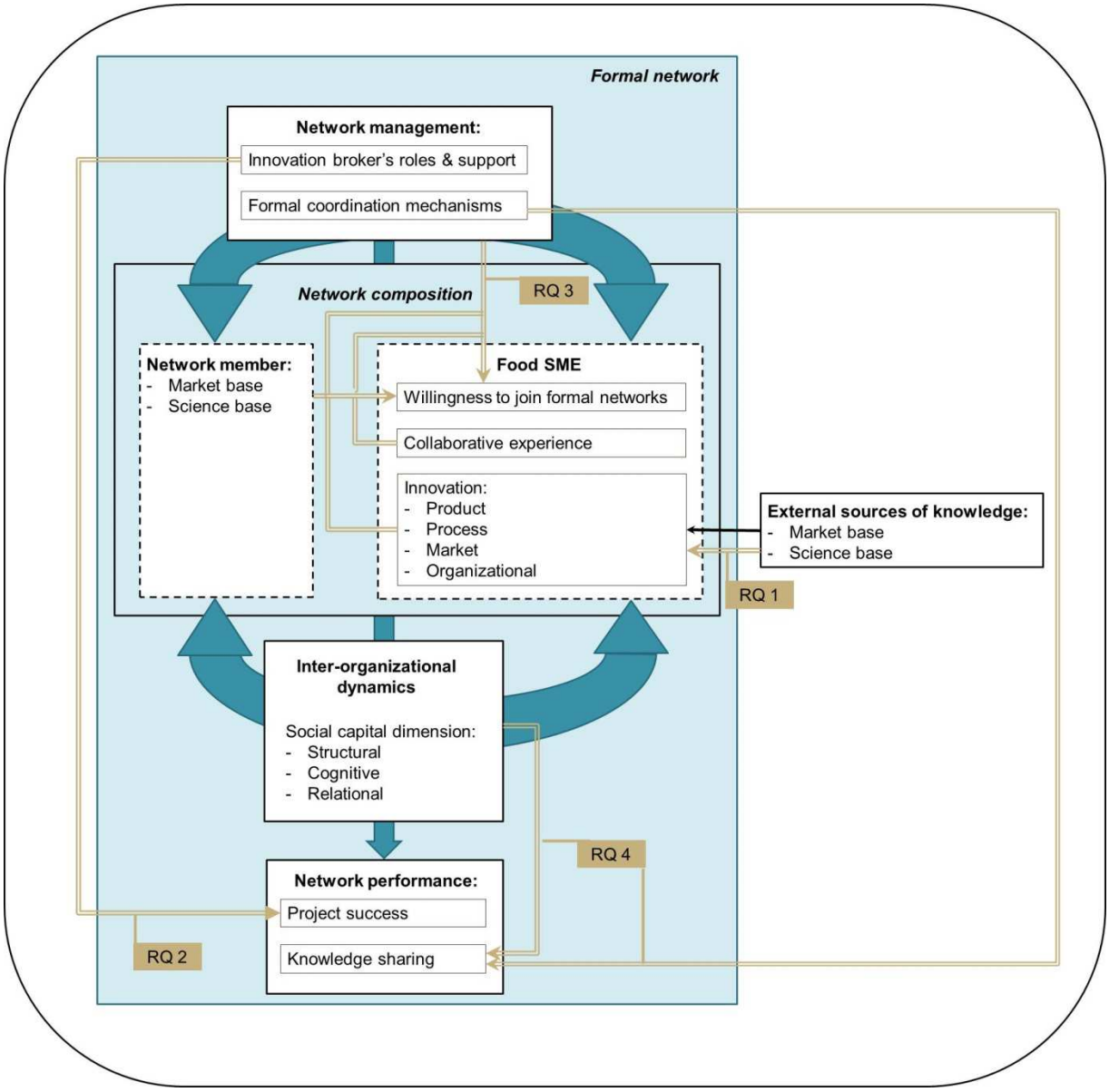
This section summarizes the main concepts of this PhD dissertation into a conceptual framework. Based on the literature review on network composition and management and the theoretical perspectives previously described, a few key concepts were selected and are clarified here (see Figure 1.1). These concepts constitute the core of the empirical work that was carried out in order to fulfil the main objective of this dissertation.

As mentioned above, the main focus of this PhD dissertation is on '*formal networks*', and more specifically on learning and innovation networks. A '*learning network*' is viewed as a defined group of three or more legally autonomous organizations, formally set up and operated in order to support knowledge sharing among members and generate learning that is useful for business purposes (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001). So described, they encompass a variety of forms of organizations such as innovation networks. '*Innovation networks*' are thus a particular type of learning networks where the focus lies not only on learning but also on innovation. In innovation networks, organizations collaborate in one or more steps of the innovation cycle (i.e. idea generation, innovation investments, research and development, and commercialization) in order to develop and/or market their products or services (Chen and Guan, 2011; Landsperger and Spieth, 2011; Batterink *et al.*, 2010).

The core elements of any network are certainly the network actors (Brass *et al.*, 2004; Borgatti and Foster, 2003; Håkansson and Ford, 2002), which together form the '*network composition*'. '*Food SMEs*', that is food manufacturing firms with less than 250 employees (CIAA, 2009), are '*willing to join formal networks*' in order to access ressources (e.g. assets, capabilities, organizational processes, information and knowledge) from other actors, which are referred to as '*network member*s' (Barney, 1991). Network members can be of different types and are either classified as market base or science base actors (Lasagni, 2012; Amara and Landry, 2005). '*Market base actors*' comprise suppliers, customers, competitors, and firms from other sectors. '*Science base actors*' include universities and public research institutes, private research institutes, and training institutes and consultants.

In order to access ressources from the network members, food SMEs must necessarily interact with them. By doing so, interactive '*inter-organizational dynamics*' develop within the network (Easterby-Smith *et al.*, 2008). Such dynamics are described in terms of the three social capital dimensions proposed by Nahapiet and Ghoshal (1998), that is the structural, cognitive and relational dimensions. The '*structural dimension*' refers to the overall pattern of connection between actors. It has been analysed from different perspectives (e.g. tie strength, centrality and

network stability) (Zheng, 2010) but in this dissertation, it focuses on social interaction between network members (Lee, 2009; Yli-Renko *et al.*, 2001). The '*cognitive dimension*' involves the resources providing shared representations and systems of meaning among network members. Originally, Nahapiet and Ghoshal (1998) had related it to shared language and shared narratives, but other authors



Source: *Own compilation*

Figure 1.1 Conceptual framework

have later described it through shared goals or vision, and shared culture (Inkpen and Tsang, 2005; Tsai and Ghoshal, 1998). In this dissertation, the cognitive dimension entails shared language and shared vision. Finally, the '*relational dimension*' refers to the kind of personal relationships people develops with each

other through a history of interactions (Nahapiet and Ghoshal, 1998). Among the facets of this dimension, this dissertation focuses on trust.

The literature suggests that inter-organizational dynamics are influenced by a variety of factors related to the characteristics of the actors involved, such as their collaborative experience. It is argued that prior experience with a specific partner or prior failure experience with collaborative initiatives such as alliances facilitate the development of trust and cooperation (Ruitenburg *et al.*, 2014; Chen *et al.*, 2011a; Zollo *et al.*, 2002). In this dissertation, '*collaborative experience*' refers to the food SMEs' past involvement with horizontal or science base actors in order to source knowledge and information with the aim to innovate.

Besides, inter-organizational dynamics are likely to be influenced by '*network management*'. In the literature review above, it was shown that aspects of network management are manifold. In this dissertation, two perspectives on network management are taken. A first key element appeared to be the presence of a central actor or '*innovation broker*' who is expected to manage the formal network, that is to plan and coordinate the activities of the formal network in order to facilitate inter-organizational cooperation and create value for all network members (Paquin and Howard-Grenville, 2013; Corsaro *et al.*, 2012a; Ojasalo, 2008). Because management research has for a long time approached managerial work through the identification and description of managerial roles (Heikkinen *et al.*, 2007), this dissertation focuses on the '*roles*' and types of '*support*' that can be played or provided by innovation brokers within the context of formal networks. In addition, network management is looked at from the perspective of the '*formal coordination mechanisms*' put in place within the networks. These entail formal processes of vetting potential members (e.g. screening, probationary period), contracts, law and regulations governing member behaviour in the network (e.g. confidentiality agreements), sanctions for non-compliant, non-active, or dormant members, and dispute resolution procedures (Parker, 2008; Kale *et al.*, 2002; Dyer and Singh, 1998).

The '*performance of the network*' is thought to be influenced by all the network dimensions described so far, i.e. the network management and composition and the nature of inter-organizational dynamics. In this dissertation, the performance of the network either refers to the '*success of the collaborative research projects*' occurring among the food SMEs and the network members, or to the ability of the network to enhance knowledge sharing among food SMEs and network members, where '*knowledge sharing*' is understood as the process of exchanging knowledge between the network actors (Chow and Chan, 2008).

In turn, the network performance is assumed to impact the food SMEs' capacity to develop innovations. '*Innovation*' is defined as the succesful exploitation of new ideas into either new '*products*', '*processes*', '*markets*' and '*ways of organizing*' (Pittaway *et al.*, 2004; Lundvall, 1995).

In addition, the food SMEs' capacity to develop innovations is likely to depend upon the collaborative relationships they have developed with external sources of

knowledge. Like the network members, '*external sources of knowledge*' also include a variety of actors that are classified as either '*market base*' or '*science base actors*'. As such, external sources of knowledge and network members are similar concepts. Different wordings were nevertheless used as these concepts are examined in different contexts. The network members are investigated in the context of formal networks, while the external sources of knowledge are not.

1.5 Research questions

The main objective of this PhD dissertation is to investigate the impact of a series of factors related to network composition and management on the success of networks for learning and innovation in food SMEs. This section specifies the main research questions of the present work, which were developed in line with the conceptual framework described above. Each of these questions is addressed and answered in the subsequent empirical chapters (Chapter 2 to 5).

RQ1: How do different external sources of knowledge relate to different types of innovations in food SMEs?

It is more and more acknowledged that firms rely on specific knowledge sources and partners for different types of innovations. A growing number of studies show that different types of innovations are associated with different types of partners (e.g. Tödtling *et al.*, 2009; Freel, 2003). Nonetheless, studies that investigate the type of partners upon which firms rely for different types of innovations remain scarce (Chen *et al.*, 2011b; Nieto and Santamaría, 2007). Furthermore, the studies reviewed in Section 2.2 have all focused on technological innovations (i.e. product and process innovations). The role of different types of partners for non-technological innovations such as market and organizational innovations has yet to be investigated. Likewise, and although a rich literature on innovation in traditional, low-tech sectors including the food industry has emerged in the last few years, few studies have investigated the diverse sources of knowledge that firms in such sectors rely upon for their innovation activities (Trippl, 2011). Regarding the food industry in particular, previous studies emphasize the need for a better understanding of the 'open innovation strategies' in the food industry (e.g. types of partners, strategy for sourcing external ideas) as these have appeared to be various and associated with different outcomes (Sarkar and Costa, 2008). In addition, most of the empirical studies on innovation in the food industry have mainly focused on large firms. Empirical evidence about innovation processes in SMEs in general and in the food sector in particular are still scarce (Edwards *et al.*, 2005; Avermaete *et al.*, 2004).

This research question is addressed in Chapter 2.

RQ2: In an innovation network such as an innovation cluster, what are the factors that influence the success of collaborative research projects for food SMEs? What role does the cluster organization (i.e. the innovation broker) play?

Firms, and especially SMEs, are confronted to a variety of challenges when they pursue inter-organizational collaborative innovation processes (Columbo *et al.*, 2012). As a result, many SMEs rely on intermediaries to drive their networks of relationships (Katzy *et al.*, 2014; Sherer, 2003). As discussed in Section 2.3.2, intermediaries entail a wide range of agents and are known to perform a broad variety of functions. In this dissertation, the focus is on cluster organizations, a particular type of intermediary, that has for function to coordinate a formal innovation cluster and organizes cluster activities to create synergies between the cluster members (Provan and Kenis, 2008; Benneworth et al., 2003). So described, a cluster organization can be regarded as an 'innovation broker' (Winch and Courtney, 2007).

Cluster organizations, and innovation brokers in general, have started to received attention in literature (e.g. Levén et al., 2014; Calamel et al., 2012; Johnson, 2008; Carpinetti et al., 2007). Nevertheless, there is still little reported on how they operate in order to facilitate learning and innovation (Bessant *et al.*, 2012; Sapsed *et al.*, 2007; Winch and Courtney, 2007). There is a need for more detail on what happens within the clusters they are responsible for and the 'cluster activities' they organize (Benneworth et al., 2003), e.g. collaborative R&D projects (Calamel et al., 2012). In particular, there is a plea for more research on how the actions of the cluster organization impact the development of proximity in -, and success of collaborative projects (Crespin-Mazet *et al.*, 2013; Lee *et al.*, 2010; Johnson, 2008).

This research question is dealt with in Chapter 3.

RQ3: Do network features, such as the type of members, support and formal coordination mechanisms, explain the food SMEs' willingness to join innovation networks; and if so, in what way?

There are many different designs for networks and an even broader variety of approaches when implementing them (Bek *et al.*, 2012; Nauwelaers, 2001). Networks differ for example in terms of configuration (e.g. structure and position), composition (e.g. type of participants) and operation or management (e.g. use of brokers or intermediaries to coordinate the network) (Turrini *et al.*, 2010; Pittaway *et al.*, 2004; Bessant and Tsekouras, 2001). Despite the fact that much research has been conducted on the nature and form of networks, no consensus has been reached about the optimal design for networks to foster learning and innovation (Corsaro *et al.*, 2012b; Thorpe *et al.*, 2005; Pittaway *et al.*, 2004). What actually

constitutes the success of networks is still open to debate (Hanna and Walsh, 2008; Huggins, 2001).

Scholars suggest that the success of innovation networks lies in the understanding of the local context, in particular the needs and expectations of the direct beneficiaries i.e. the food SMEs (Ebbekink and Lagendijk, 2013; van der Borgh *et al.*, 2012). It is assumed that innovation networks that meet food SMEs' needs and expectations about benefits will survive longer than networks that fail to do so (Miller *et al.*, 2007). A fundamental consideration is perhaps to first reflect on the key factors and influences affecting food SMEs' commitment to join innovation networks. Past literature has highlighted a few factors concerning both SMEs and the networks themselves. Yet, while there is an abundance of studies that explore the underlying motives for firms to engage in dyadic relationships and inter-firm alliances (Ozman, 2009; Ireland *et al.*, 2002), there is still a paucity of empirical research that focus on understanding the motives for firms to join innovation networks.

This research question is covered in Chapter 4.

RQ4: How do the development of social capital among network members and formal coordination mechanisms impact the knowledge sharing performance of learning networks?

Successful knowledge transfer within the firm is argued to be difficult (Argote and Ingram, 2000; Szulanski, 1996), but successfully sharing knowledge between organizations is seen as even more challenging (Easterby-Smith *et al.*, 2008; Inkpen and Tsang, 2005). 'Learning' or 'knowledge transfer' networks are established to act as a channel of knowledge distribution (Bond III *et al.*, 2008; Bessant and Tsekouras, 2001). Learning networks have already been proven useful for facilitating knowledge transfer (e.g. Bond III *et al.*, 2008). However, studies that investigate the factors that influence their outcomes and success are scarce (Bessant *et al.*, 2012; Kenis and Provan, 2009). In particular, previous studies have predominantly focused on factors that influence firm level performance, which negates the importance of how collective entities perform (e.g. van Geenhuizen and Soetanto, 2013; Samarra and Biggierro, 2008).

This research question is addressed in Chapter 5.

1.6 Intended research contribution

1.6.1 Intended theoretical contribution

This PhD dissertation mainly aims at contributing to the emerging theory of network management. It sheds light on the process of managing networks as deliberately created structures in order to foster learning and innovation

performance in firms, in this particular case food SMEs. Specifically, it contributes to 'theory building' by examining (Colquitt and Zapata-Phelan, 2007):

- the unexplored relationship between the roles played by innovation brokers and the success of collaborative projects for SMEs in the context of a formal innovation network (see Chapter 3)

- the interactions between the food SME's willingness to join a particular innovation network and its profile (see Chapter 4).

It also contributes to 'theory testing' by investigating on the one hand, the interrelations between the different dimensions of social capital and on the other hand, the relationships between these dimensions and the formal coordination mechanisms put in place within learning networks (see Chapter 5) (Colquitt and Zapata-Phelan, 2007).

1.6.2 Intended methodological and empirical contribution

The methodological contribution of this PhD dissertation lies in the use of a stated preference approach for the investigation of firms' networks (see Chapter 3). This approach is particularly suitable for studying such object as it enables the estimation of the relative importance of the different components in a setting close to real-life (Hess and Daly, 2010; Louvière and Woodworth, 1983). Nevertheless, and despite its advantages, it has not yet been used to investigate firms' networks.

This dissertation also contributes to empirical research by first of all, studying issues related to networking and innovation in SMEs in a low-tech sector, i.e. the food sector. Most innovation studies, including studies on networking for innovation, have paid attention to large, high-tech, and multinational enterprises. Few have focused on SMEs and low-tech sectors (Gassmann *et al.*, 2010; van de Vrande *et al.*, 2009a; Hirsch-Kreinsen *et al.*, 2005; Barnett and Storey, 2000). The empirical research contribution of this dissertation also lies in the types of innovations investigated. Hitherto, the studies that have investigated the role of networking for innovation have mainly focused on technological innovations (i.e. product and process innovations) thereby neglecting the non-technological innovations such as market and organizational innovations. In addition, this PhD dissertation makes an empirical contribution for conducting quantitative empirical research at the network level of analysis (see Chapter 5) (Provan *et al.*, 2007).

1.6.3 Intended managerial and policy contribution

This PhD dissertation also seeks to be of practical relevance for policy-makers and network managers.

The novel perspectives that this dissertation brings on network management will benefit policy-makers, network managers and other stakeholders that aim at fostering collective efforts through building learning and innovation networks. Nowadays, 'innovation' is at the core of many regional, national and European policy actions aimed at enhancing competitiveness. It has been placed at the center of the 'Europe 2020 strategy for smart, sustainable and inclusive growth' under the flagship initiative 'Innovation Union' (European Commission, 2014b). Within this initiative, a series of actions are taken by both the EU and national authorities in order to support and encourage excellence in innovation. Among these actions can be found the use of networks and alike as mechanisms to foster innovation (European Commission, 2014a).

Nevertheless, and despite these efforts, there is still a long way to go in developing successful policy-implemented networks. Many network initiatives have failed or have been subject to extremely high 'drop-out' rates. Some can even be considered as a drain of resources (Rampersad et al., 2010; Huggins, 2001). As a consequence, exploring the factors for managing learning and innovation networks successfully is important, especially in light of the current public budget austerity.

1.7 Research design and structure of the dissertation

1.7.1 Research design

As mentioned in the preface, this PhD dissertation consists of several articles where different research methods and analyses were used. The research methods employed were the case study and survey method (see Table 1.2).

Table 1.2 Research method and data source

Research method	Data source (primary)	Research field	Chapter
Case study (in-depth interviews)	Actors involved in a collaborative project of an innovation cluster (n=13)	-Innovation -Intermediary organizations -Cluster organizations	3
Survey 'food SMEs'	Food manufacturing SMEs (n=909)	-Innovation -External sources -Design of innovation networks	2 & 4
Survey 'network'	Network managers (n=16) Network members (n=155)	-Performance of networks -Social capital	5

The case study method was used to explore the factors that influence the success of collaborative projects for food SMEs (research question 2, see Chapter 3). The method was chosen as it is useful for researching contemporary events that are difficult to separate from their environment (Yin, 2009). The case study consisted of a collaborative research project that took place within the context of a Belgian innovation cluster called 'Wagralim'. Primary data were derived from 13 semi-

structured interviews that were conducted with different actors involved in the project. In addition, complementary documents such as project reports and information from the website of Wagralim (i.e. secondary data) were collected in order to increase construct validity (Yin, 2009). For the analysis, an inductive, open coding approach was used.

The survey method was used to serve conclusive goals. It was applied in order to investigate the research questions 1, 3 and 4 (see Chapter 2, 4 and 5). In this dissertation, two surveys were conducted.

The first survey (see Appendix 1) aimed at investigating the relationships entailed in research question 1 ("*How do different external sources of knowledge relate to different types of innovations in food SMEs*"; see Chapter 2) and research question 3 ("*Do network features explain the food SMEs' willingness to join innovation networks; and if so, in what way";* see Chapter 4). The survey was conducted using an online structured questionnaire targeting the owner-manager of food and drink manufacturing SMEs in six European countries (i.e. Belgium, France, Hungary, Ireland, Italy and Sweden).

In total, 8,175 food and drink firms were surveyed and 909 questionnaires were recovered, resulting in an initial response rate of 11.12%. In Chapter 2, the removal of cases with missing values in any of the variables used in the analysis resulted in a sample of 258 questionnaires. Based on the firm's activities (e.g. exclusion of feed and food packaging companies) and size (exclusion of firms with 250 employees or more), an extra 44 questionnaires were removed, resulting in a final sample of 214 food and drink SMEs (i.e. an effective response rate of 2.61%). In Chapter 4, the exclusion of missing data resulted in a reduced sample of 286 questionnaires. After data cleaning based on the firm's activity and size, the number of usable questionnaires for data analysis added up to 231 (i.e. an effective response rate of 2.825%). Descriptive statistics of the sample used in Chapter 2 are provided in Table 1.3. In both Chapter 1 and Chapter 4, logistic regression models were used to analyse the data.

The second survey aimed at investigating the relationships put forward in research question 4 ("*How do the development of social capital among network members and formal coordination mechanisms impact the knowledge sharing performance of learning networks*"; see Chapter 5). It was conducted using two structured questionnaires. The first questionnaire (see Appendix 2) was administrated to the network managers of a series of Belgian, Danish, Hungarian and Irish learning networks that were identified through the use of a snowball and purpose sampling technique. It was administrated by means of a telephone or face-to-face interview and collected data on the structural and management characteristics of each network. The second questionnaire (see Appendix 3) was administrated online to the members of each selected network. It gathered information on the network performance and perceived level of social capital prevailing in each network. Out of a population of 1,324 members across 16 learning networks, 155 completed questionnaires were returned (i.e. an initial response rate of 11.7%). Listwise deletion of respondents with missing data reduced the number of valid responses to

Table 1.3 Descriptive statistics of the sample used in Chapter 2 (n = 214 food and drink SMEs)

	Country													
	Belgium (n = 50)		France (n = 64)		Hungary (n = 15)		Ireland (n =22)		Italy (n = 31)		Sweden (n = 32)		TOTAL (n = 214)	
NACE codes	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
C10 - Manufacture of food products														
C10.1.1 Processing and preserving of meat	4	8.0	6	9.4	0	0.0	5	22.7	2	6.5	2	6.3	19	8.9
C10.1.2 Processing and preserving of poultry meat	0	0.0	3	4.7	0	0.0	0	0.0	0	0.0	0	0.0	3	1.4
C10.1.3 Production of meat and poultry meat products	6	12.0	3	4.7	0	0.0	2	9.1	0	0.0	4	12.5	15	7.0
C10.2.0 Processing and preserving of fish, crustaceans and molluscs	2	4.0	4	6.3	0	0.0	1	4.5	0	0.0	0	0.0	7	3.3
C10.3.1 Processing and preserving of potatoes	0	0.0	0	0.0	0	0.0	1	4.5	0	0.0	1	3.1	2	0.9
C10.3.2 Manufacture of fruit and vegetable juice	0	0.0	1	1.6	1	6.7	1	4.5	1	3.2	1	3.1	5	2.3
C10.3.9 Other processing and preserving of fruit and vegetables	0	0.0	8	12.5	6	40.0	0	0.0	0	0.0	2	6.3	16	7.5
C10.4.1 Manufacture of oils and fats	1	2.0	1	1.6	0	0.0	0	0.0	2	6.5	0	0.0	4	1.9
C10.4.2 Manufacture of margarine and similar edible fats	1	2.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
C10.5.1 Operation of dairies and cheese making	2	4.0	4	6.3	3	20.0	3	13.6	2	6.5	2	6.3	16	7.5
C10.5.2 Manufacture of ice cream	2	4.0	1	1.6	0	0.0	0	0.0	0	0.0	2	6.3	5	2.3
C10.6.1 Manufacture of grain mill products	1	2.0	3	4.7	0	0.0	2	9.1	3	9.7	2	6.3	11	5.1
C10.6.2 Manufacture of starches and starch products	0	0.0	1	1.6	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
C10.7.1 Manufacture of bread; manufacture of fresh pastry goods and cakes	3	6.0	4	6.3	0	0.0	1	4.5	1	3.2	7	21.9	16	7.5
C10.7.2 Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cake	2	4.0	5	7.8	0	0.0	0	0.0	4	12.9	1	3.1	12	5.6

C10.7.3 Manufacture of macaroni, noodles, couscous and similar farinaceous product	0	0.0	1	1.6	2	13.3	0	0.0	2	6.5	0	0.0	5	2.3
C10.8.1 Manufacture of sugar	0	0.0	1	1.6	0	0.0	0	0.0	1	3.2	0	0.0	2	0.9
C10.8.2 Manufacture of cocoa, chocolate and sugar confectionery	9	18.0	1	1.6	0	0.0	1	4.5	0	0.0	3	9.4	14	6.5
C10.8.3 Processing of tea and coffee	0	0.0	2	3.1	0	0.0	0	0.0	1	3.2	1	3.1	4	1.9
C10.8.4 Manufacture of condiments and seasonings	2	4.0	1	1.6	0	0.0	0	0.0	0	0.0	0	0.0	3	1.4
C10.8.5 Manufacture of prepared meals and dishes	1	2.0	2	3.1	0	0.0	2	9.1	2	6.5	1	3.1	8	3.7
C10.8.6 Manufacture of homogenised food preparations and dietetic food	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
C10.8.9 Manufacture of other food products	4	8.0	5	7.8	0	0.0	3	13.6	0	0.0	1	3.1	13	6.1
C11 - Manufacture of beverages														
C11.0.1 Distilling, rectifying and blending of spirits	1	2.0	2	3.1	1	6.7	0	0.0	0	0.0	0	0.0	4	1.9
C11.0.2 Manufacture of wine from grape	0	0.0	1	1.6	0	0.0	0	0.0	6	19.4	0	0.0	7	3.3
C11.0.3 Manufacture of cider and other fruit wines	0	0.0	1	1.6	0	0.0	0	0.0	0	0.0	1	3.1	2	0.9
C11.0.4 Manufacture of other non-distilled fermented beverage	1	2.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.1	2	0.9
C11.0.5 Manufacture of beer	6	12.0	2	3.1	0	0.0	0	0.0	2	6.5	0	0.0	10	4.7
C11.0.6 Manufacture of malt	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
C11.0.7 Manufacture of soft drinks; production of mineral waters and other bottled waters	2	4.0	1	1.6	2	13.3	0	0.0	2	6.5	0	0.0	7	3.3

150. Details concerning the composition of the sample are provided in Table 1.4. Hierarchical linear modelling and structural equation modelling were used to analyse the data.

A more detailed description of the different methods and analyses used is provided in the relevant chapters.

Table 1.4 Descriptive statistics of the sample used in Chapter 5 (n = 150 network members)

	Country									
	Belgium (n = 23)		**Denmark (n = 35)**		**Hungary (n = 43)**		**Ireland (n = 49)**		**Total (n = 150)**	
Respondent type	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Food industry	16	69.6	19	54.3	31	72.1	22	44.9	88	58.7
Supply Chain Actors	6	26.1	10	28.6	4	9.3	2	4.1	22	14.7
Universities and public research institutes	0	0.0	0	0.0	4	9.3	4	8.2	8	5.3
Other (non-food) industries	1	4.3	6	17.1	4	9.3	21	42.9	32	21.3

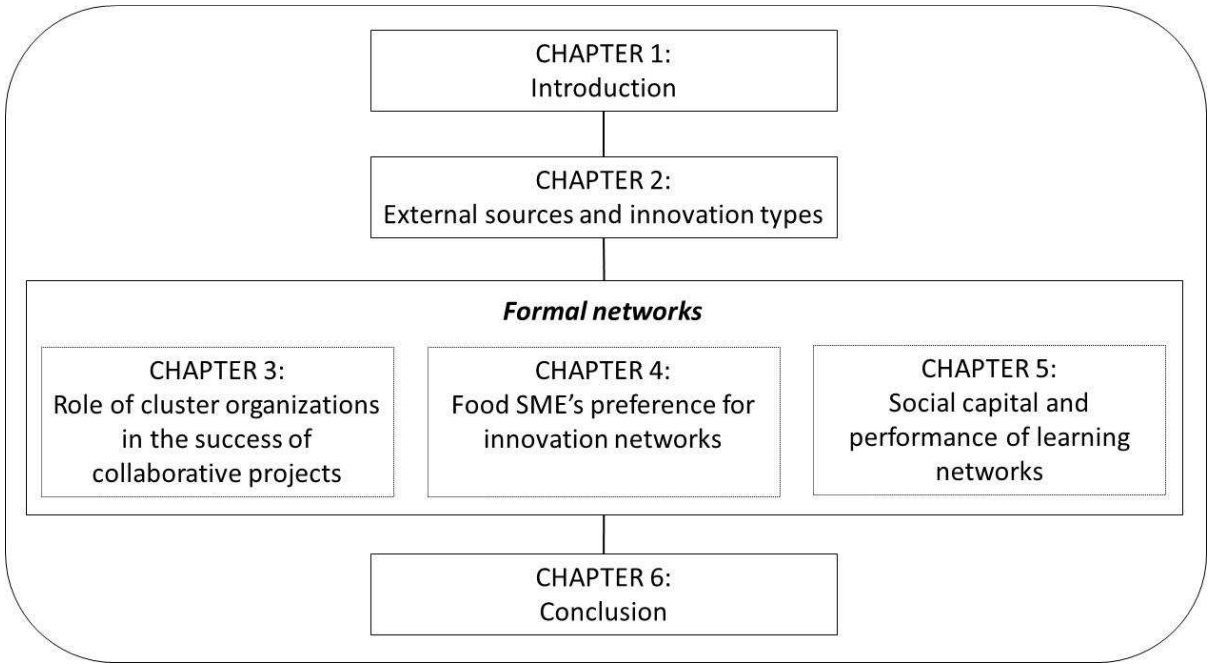
It should be noted that three out of the four results Chapters are based on data collected through web surveys. Although web surveys certainly offer advantages compared to traditional modes of collecting survey data, such as low administration costs and speed (Evans and Mathur, 2005), they may be associated with a series of biases that reduce research accuracy and validity. One source of error that is particularly relevant for web surveys relates to coverage. Coverage error occurs when there is a mismatch between the target population, i.e. the population one wants to study, and the frame population, i.e. the elements of the target population for whom, in the case of web survey, e-mail addresses can be retrieved and from which the sample will be drawn (Couper, 2000). In this PhD dissertation, this type of error probably occurred when collecting the data from food SMEs (see Chapter 2 and 4) as the firms for which the e-mail address of the owner-manager could not be recovered were systematically excluded from the sample.

Non-response is another source of error in web surveys. "*Non-response error arises through the fact that not all people included in the sample are willing or able to complete the survey*" (Couper, 2000: 473). It is a function of both the rate of non-response and the differences between respondents and non-respondents on the variables of interest (Groves and Couper, 1998 in Couper, 2000). A variety of factors affect the respondents' decision of whether they will participate in a survey or not (Sauermann and Roach, 2013; Manfreda *et al.*, 2008). Among them, and of relevance for this PhD dissertation, is the topic of the survey. Potential respondents are more likely to participate in the survey when the topic is highly relevant for them (Fan and Yan, 2010). Also, the respondents' personality impacts the response rate. In their systematic review of the factors that influence the response rate of the web survey, Fan and Yan (2010) find that respondents who are more likely to participate in web surveys are conscientiousness, agreeable, and open to experience. This suggests that the samples used to conduct the quantitative

analyses in this PhD dissertation are likely to not be representative of the target populations. They are likely to be overrepresented by food SMEs' owner-managers (see Chapter 2 and 4) and network members (see Chapter 6) who are open, and genuinely interested in innovations and networks. The generalization of the findings should therefore be treated with caution.

1.7.2 Structure

This PhD dissertation comprises 6 chapters, as outlined in Figure 1.2. In Chapter 1, the objective, conceptual framework, research questions and intended contributions were presented. The overall aim was to provide the reader with a broader understanding of the rationale of the present work and a justification for the subsequent chapters (Chapter 1 to 6).



Source: *Own compilation*

Figure 1.2 Structure of the dissertation

The research questions are addressed in Chapter 2 to 5. Chapter 2 investigates the type of partners upon which firms rely for different types of innovations. Chapter 3 to 5 delves into the complex reality of formal networks. Chapter 3 explores the impact of the cluster organizations' actions on the success of research collaborative projects for food SMEs. Chapter 4 evaluates the importance of selected network features on the food SMEs' willingness to join innovation networks. Chapter 5 examines the relationship between the social capital accumulated among network members and the performance of learning networks in terms of their ability to enhance knowledge sharing among network members.

The final chapter, Chapter 6, draws conclusions and highlights the main contributions of the PhD dissertation. It ends by presenting the limitations and by providing avenues for future research.

Chapter 2

External sources and innovation types

Based on: *Virginie Marie Lefebvre, Hans De Steur, Xavier Gellynck (forthcoming). External sources for innovation in food SMEs. British Food Journal, vol. 117 (1)*[1]

Abstract: *The purpose of this chapter is to examine the role that different external sources of knowledge play in product, process, market and organizational innovations in food SMEs. Primary data on the use of external sources of knowledge for innovation were gathered in 2012-2013 through an online survey targeting European food SMEs (n=214). Binary logistic regression models were used for data analysis. The results support the recent studies that advocate that the introduction of different types of innovations is associated with different types of sources of knowledge. They indicate that collaboration with customers matter for product innovations in food SMEs while they suggest that collaboration with competitors is more important for the development of organizational innovations in this type of firm. In addition, and in line with previous works, collaboration with science base actors (e.g. universities) does not appear relevant for innovation in food SMEs.*

Keywords: *Food and Drink, Small and medium-sized enterprises, Innovation, Collaboration*

[1] *Contribution of the co-authors to the paper: Review and suggestions for improvement*

2.1 Introduction

The food industry is the largest manufacturing sector and leading employer in the EU (Kühne, 2011; Menrad, 2004). In recent years, the food industry has undergone important changes in the nature of both food demand and supply; it faces stringent legal requirements, a growing pressure from both retailers and consumers, and is offered with new opportunities for added-value applications caused by new developments in Science (Sarkar and Costa, 2008; van der Valk and Wynstra, 2005; Menrad, 2004). In light of these changes and an increasing level of competitiveness (Sarkar and Costa, 2008), innovation has become a crucial activity for the food firm for enhancing its profitability and thus its survival (Capitanio *et al.*, 2010; Sarkar and Costa, 2008).

Many studies on innovation accentuate that innovation is an interactive process in which firms interact and collaborate with a variety of other actors such as other firms, universities, and consultants (among others Chesbrough, 2012; Pittaway *et al.*, 2004; Gemünden *et al.*, 1996). Firms engage in inter-organizational networks in order to spread the risk and uncertainty involved in innovation processes, shorten innovation time, reduce costs, and access external resources on which innovations may potentially be built upon (Cantner *et al.*, 2011; Lee *et al.*, 2010; Hoffmann and Schlosser, 2001). Networks become especially important for small and medium-sized firms (SMEs) – which compose more than 99% of the European food firms (Kühne, 2011) – in that they can help them to supplement their limited internal resources with external ones (Narula, 2004; Szarka, 1990).

Although a rich literature on innovation in traditional, low-tech sectors including the food industry has emerged in the last few years, few studies have investigated the diverse sources of knowledge that firms in such sectors rely upon for their innovation activities (Trippl, 2011). Regarding the food industry in particular, previous studies emphasize the need for a better understanding of the 'open innovation strategies' in the food industry (e.g. types of partners, strategy for sourcing external ideas) as these have appeared to be various and associated with different outcomes (Sarkar and Costa, 2008). Moreover, while a number of studies have investigated the role of certain inter-organizational relationships for product and process innovations in the food industry (e.g. Knudsen, 2007; van der Valk and Wynstra, 2005; Avermaete *et al.*, 2004), more research on the relation between inter-organizational relationships and innovation types other than product and process innovations are called for (Baregheh *et al.*, 2012). Besides, most of the empirical studies on innovation in the food industry have mainly focused on large firms. Empirical evidence about innovation processes in SMEs in general and in the food sector in particular are still scarce (Edwards *et al.*, 2005; Avermaete *et al.*, 2004). With this chapter, we aim to add to previous research on inter-organizational relationships for innovation in SMEs and in the food industry by investigating the following research question:

RQ: How do different external sources of knowledge relate to different types of innovations in food SMEs?

The chapter is organized as follows. It begins with a literature review on innovation, collaboration for innovation in SMEs, and innovation in the food industry. The study methodology is then explained and is followed by the results section. The chapter ends with the discussion and conclusions.

2.2 Literature review

2.2.1 Innovation – An interactive process

Innovation is about the successful exploitation of ideas (Pittaway *et al.*, 2004). It is recognized to be the result of several functionally distinct but interacting and interdependent processes whereby ideas are transformed into innovation outputs from which the firm derives economic profits (Chen and Guan, 2011; Roper *et al.*, 2008). These innovation outputs vary considerably in their nature. For example, Pittaway, Robertson *et al.* (2004) relate them to product, process and organizational innovations, Damanpour and Evan (1984) to technical and administrative innovations, Johne (1999) to product/service, process and market innovations, while Lundvall (1995) and Caraça *et al.* (2009) connect them to product, process, market and organizational innovations. Besides varying in terms of forms, innovation outputs also vary based upon their radical or incremental nature. Radical innovations produce fundamental changes in the activities of a firm and therefore correspond to a clear existing departure from existing practices. On the contrary, incremental innovations introduce relatively minor changes resulting in little departure from existing practices (Dewar and Dutton, 1986; Ettlie *et al.*, 1984).

Regardless of the type of innovation, there is now a considerable amount of studies that support the 'interactive' nature of innovation (e.g. Chesbrough, 2012; Pittaway *et al.*, 2004; Tether, 2002). In today business world where fields of practice are rapidly evolving and knowledge is increasingly getting specialized and distributed across organizations (Powell *et al.*, 1996), fewer firms are able to '*go it alone*' in innovation development (Tether, 2002: 947). A growing number of studies show that firms must develop linkages with a variety of market base actors (e.g. customers, suppliers and competitors) or science base actors (e.g. universities and consultants) in order to innovate (e.g. Knudsen, 2007; Nieto and Santamaría, 2007; Amara and Landry, 2005; Miotti and Sachwald, 2003). External relationships are founded to serve diverse objectives such as accessing the necessary value-generating resources (e.g. capabilities and knowledge) the firm is currently lacking (Wittmann *et al.*, 2009; Street and Cameron, 2007; Lechner and Dowling, 2003; Miotti and Sachwald, 2003). Interacting with chain members for example may provide the firm with crucial information on technologies, process improvements, users' needs, and markets (Miotti and Sachwald, 2003; Whitley, 2002). Collaborating with competitors may also be attractive to reduce the costs and risks for large projects or to work on common problem especially when these fall outside of the sphere of competition (Miotti and Sachwald, 2003; Tether, 2002). Besides, linkages with science base actors such as universities, consultants and research organizations can provide the firm with access to new scientific and technical knowledge (Lundvall, 1995).

Moreover, there is growing evidence that different types of innovation are associated with different types of sources of knowledge (Capitanio *et al.*, 2010; Varis and Littunen, 2010; Tödtling *et al.*, 2009; Freel, 2003; Gemünden *et al.*, 1996). Tödtling et al. (2009) for example show that firms introducing more radical product innovations are cooperating more often with universities and research organizations, while firms introducing more incremental product innovations are developing more links with providers of business services. Still, studies that investigate the external sources upon which firms rely for different types of innovation are scarce (Chen *et al.*, 2011b; Nieto and Santamaría, 2007), hence the relevance of this study.

2.2.2 Collaboration for innovation in SMEs – challenges and types of external source

The requirement of SMEs to draw on their networks as a mean to complement their limited internal resources has dominated much of the academic debate (Zeng *et al.*, 2010; Freel, 2000). Cumbers *et al.* (2003) have claimed that SMEs can offset the size-related advantages of larger firms through the benefits they derive from localized networks and learning. Similarly, Rammer *et al.* (2009) have demonstrated that SMEs without in-house R&D can yield similar innovation success as R&D performers if e.g. they source for external knowledge while also effectively applying human resource management or team work to facilitate innovation processes. Nevertheless, serious concerns are raised in literature about the ability of SMEs to derive innovation related benefits from external linkages (Hoffman *et al.*, 1998). SMEs are usually characterized by a specialized knowledge base associated with their core business (Bianchi *et al.*, 2010; Huggins and Johnston, 2009). They therefore face barriers when they encounter new knowledge in unfamiliar areas. Moreover, the often limited number and qualification of the employees in SMEs result in low absorptive capacity (Spithoven *et al.*, 2010). In addition, insufficient knowledge or dissimilarities in cultures or modes of organization may lead to potential cognitive, organizational, cultural and institutional differences between collaboration partners, and hence potential problems (van de Vrande *et al.*, 2009a). Research on academia-industry collaboration has for example identified organization and culture as one of the most influencing constraints on collaboration negotiations (Melese et al., 2009 in Saguy, 2011).

The review of the literature on the relationship between networks and innovation in SMEs has uncovered a number of empirical studies that shed light on the types of external sources SMEs may use for innovation. Nevertheless, these empirical studies are still scarce and neglect to focus on other types of innovations than the technological ones (i.e. product and process); thus highlighting the relevance of our study. Many of the empirical studies reviewed emphasize the importance of relationships with chain members as an essential source of innovation-related inputs for SMEs (e.g. Tomlinson and Fai, 2013; Lasagni, 2012; Parida *et al.*, 2012; Varis and Littunen, 2010; Zeng *et al.*, 2010; Nieto and Santamaría, 2007; Doloreux, 2004; Freel, 2003). Besides, some studies have analysed the role that other market base actors (e.g. competitors) play regarding innovation in SMEs, but these studies

are scarce and their results are mixed. For example, a number of them indicate that cooperation with competitors is negatively related to product innovation (Fitjar and Rodríguez-Pose, 2013; Nieto and Santamaría, 2007) while others do not find any significant relation between product innovation and interaction with competitors (Tomlinson and Fai, 2013; Freel, 2003). Finally, several studies have also sought to investigate the impact of science base actors on innovation in SMEs, but some mixed results here also make it difficult to draw conclusions on this topic. Some studies emphasize the relevance for SMEs to develop linkages with science base actors (i.e. universities, laboratories, and public and private research institutes) in order to innovate (e.g. van Hemert *et al.*, 2013; Lasagni, 2012; Parida *et al.*, 2012; Fukugawa, 2006; Freel, 2003). Still other studies claim that that it is the relationships with market base actors rather than the relationships with science base actors that matter for innovation in SMEs (e.g. Bigliardi *et al.*, 2011; Zeng *et al.*, 2010; Doloreux, 2004).

2.2.3 Innovation in the food industry – Nature and role of collaboration

Previous research on innovation in the food industry illustrate the engagement of food firms with various types of innovations. For example, Menrad (2004) find that two-thirds of the firms they surveyed are engaged with both product and process innovations. Baregheh *et al.* (2012) demonstrate that food SMEs innovate not only in terms of products, and processes but also in terms of marketing (e.g. launch of a new website) and business strategies (e.g. establishment of a constant search for innovative ideas). Similarly, with her case study on the Vienna food sector, Trippl (2011) shows that food firms engage in new product development as well as in process and marketing innovations. In addition, the literature also points to the incremental nature of innovation in the food industry. Based on 21 in-depth interviews with food firms representatives in Sweden, Beckeman *et al.* (2013) find that very few innovations on the Swedish market are radical. In a similar vein, the study of Trippl (2011) highlights that the different forms of innovation in which Viennese food firms engage are often incremental in nature, while the study of Martinez and Briz (2000) shows how Spanish food firms concentrate their product-oriented innovations towards incremental innovations.

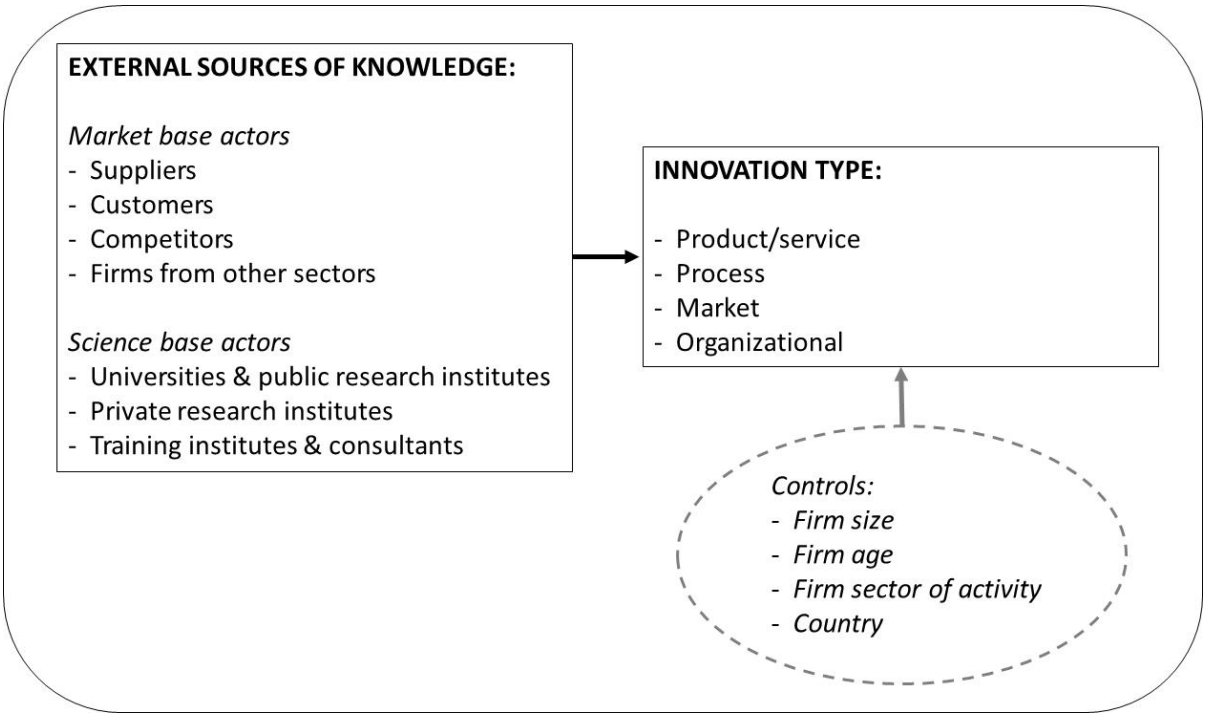
The use of inter-organizational relationships for innovation is common practice in many industries, e.g. pharmaceutical (e.g. Bianchi *et al.*, 2011), chemicals (e.g. Berchicci, 2013), IT (e.g. Parida *et al.*, 2012), and the food industry is no exception. Previous studies have demonstrated that food firms do open up for innovation (e.g. Fortuin and Omta, 2009; Sarkar and Costa, 2008; Knudsen, 2007), even though this is probably at a lower extent compared to firms in other, high-tech sectors (Gassmann *et al.*, 2010). Food firms develop inter-organizational relationships for innovation purposes especially with suppliers (Beckeman *et al.*, 2013; Trippl, 2011; Knudsen, 2007; Menrad, 2004), but support is also found in literature regarding the importance of relationships with customers for innovation (Menrad, 2004; Thomke and von Hippel, 2002). Besides, some studies also points to the relevance of relationships with science base actors for innovation processes in food firms

(Baregheh *et al.*, 2012; Trippl, 2011). Still these types of relationship seem to be used less frequently than those with chain members (Knudsen, 2007; Menrad, 2004). In addition, a few studies have sought to understand the role that external sources play in innovation processes in food SMEs (Gellynck and Kühne, 2010; Avermaete *et al.*, 2004). Still their scarcity and the mixed results they provide call for more empirical research on how these particular firms use external relationships for innovation.

2.3 Methodology

2.3.1 Conceptual model and questionnaire construction

This chapter aims at investigating the research question 'how do different external sources of knowledge relate to different types of innovations in food SMEs?' Our approach to address this question is visualized in our conceptual model presented in Figure 2.1.



Source: *Own compilation*

Figure 2.1 Conceptual model

2.3.1.1 External sources of knowledge

By reviewing the literature on the relationship between networks and innovation in SMEs and in the food sector (see previous section), a number of external sources that food SMEs may use for gaining knowledge for innovation were identified. For the present study, a distinction is made between seven external sources which are either categorized as market base actors or science base actors (Lasagni, 2012; Amara and Landry, 2005). Market base actors comprise (1) the suppliers, (2) customers, (3) competitors, and (4) firms from other sectors. Science base actors include (5) universities and public research institutes, (6) private research institutes, and (7) training institutes and consultants. These seven sources were coded as seven dummy coded variables and form our independent variables. These variables take the value of '1' when respondents indicated that their firm had collaborated with this type of partner in order to source knowledge for the purpose of innovation in the last two years, and '0' otherwise (see Table 2.1).

2.3.1.2 Innovation type

In this work, and similarly to other studies (e.g. Varis and Littunen, 2010), we adopt the categorization of Lundvall (1995) and distinguish between product/service, process, market, and organizational innovations. The concept of innovation is therefore rather broad but still provides an overall picture of the innovation activities conducted by the firm. Respondents were asked whether, in the last two years, their firm had introduced 'none', 'one', 'two', 'three, four, or five', or 'six or more' of each of these types of innovation (for more details see Appendix 4). For each type of innovation, a dummy coded dichotomous variable was then created where firms were given a '1' if they had introduced at least one innovation and a '0' otherwise.

2.3.1.3 Controls

Two factors related to innovation are included as control variables in the model. These include the firm size (log value of the number of employees) and the firm age (log value of the number of years since the establishment of the firm). We expect the firm size to be positively related to innovation and the firm age to be negatively related to innovation. The firm size – which is in fact an indicator of the firm's resources (Plambeck, 2012) – may allow the firm to invest more resources in the development of innovations. We also include the firm age as literature points that younger firms tend to be more innovative even when they possess a limited set of resources and capabilities (Huergo and Jaumandreu, 2004). In addition, we also include the firm sector of activity (one dummy variable referring to two-digits NACE codes) and country (five dummy variables, with Belgium selected as the baseline variable) as control variables in the model in order to limit the omitted variables bias (Lasagni, 2012).

Table 2.1 Variables used in logit equations

Variables	Description	Scale of measurement	Frequencies
INNOProd	Binary dummy variable measuring the introduction of product (including service) innovations 'during the last 2 years'	1 = Introduction of at least one innovation	170
		0 = Otherwise	40
INNOProc	Binary dummy variable measuring the introduction of process innovations 'during the last 2 years'	1 = Introduction of at least one innovation	112
		0 = Otherwise	87
INNOMark	Binary dummy variable measuring the introduction of market innovations 'during the last 2 years'	1 = Introduction of at least one innovation	126
		0 = Otherwise	73
INNOOrg	Binary dummy variable measuring the introduction of organizational innovations 'during the last 2 years'	1 = Introduction of at least one innovation	57
		0 = Otherwise	124
SUPP	Binary dummy variable measuring the use of suppliers as a source of knowledge for innovation 'during the last 2 years'	1 = Used	152
		0 = Otherwise	62
CUST	Binary dummy variable measuring the use of customers as a source of knowledge for innovation 'during the last 2 years'	1 = Used	128
		0 = Otherwise	86
COMP	Binary dummy variable measuring the use of competitors as a source of knowledge for innovation 'during the last 2 years'	1 = Used	67
		0 = Otherwise	147
OFIRM	Binary dummy variable measuring the use of other firms in other sector as a source of knowledge for innovation 'during the last 2 years'	1 = Used	94
		0 = Otherwise	120
UNI	Binary dummy variable measuring the use of universities and public research institutes as a source of knowledge for innovation 'during the last 2 years'	1 = Used	82
		0 = Otherwise	132
PRI	Binary dummy variable measuring the use of private research institutes as a source of knowledge for innovation 'during the last 2 years'	1 = Used	51
		0 = Otherwise	163
CONS	Binary dummy variable measuring the use of training institutes and consultants as a source of knowledge for innovation 'during the last 2 years'	1 = Used	94
		0 = Otherwise	120
size	Log value of the number of employees	*Continuous variable*	
age	Log value of the number of years since the establishment of the firm	*Continuous variable*	
sector	Binary dummy variable referring to the type of sector the firm belong	1 = Drink industry (NACE-C11)	32
		0 = Food industry (NACE-C10)	182
country	Categorical variable 'country' transformed into five dummy variables which denoted the country of survey administration (with Belgium selected as the baseline variable)	BE = Belgium	50
		FR = France	64
		HU = Hungary	15
		IR = Ireland	22
		IT = Italy	31
		SWE = Sweden	32

2.3.2 Sample and data collection

A survey targeting food and drink manufacturing SMEs was conducted in six European countries: Belgium, France, Hungary, Ireland, Italy and Sweden. Regarding the SMEs – which we define following the European Commission as firms with less than 250 employees (CIAA, 2009) –, the targeted respondents were the SME's owner-managers, known to be a reliable key informant (Kumar *et al.*, 1993). The primary data were gathered via an online questionnaire. The questionnaire was first pilot tested (sixteen pilot tests in total, half with SMEs and half with academics) in order to verify its validity. It was subsequently revised based on the pilot test results, and translated in the national language(s) of each participating country.

The data were collected between October 2012 and April 2013. In order to draw our sample, we exploited available national databases. We first needed to check whether the firms listed were still active and whether the contact details of the SME's owner-managers could be found, when they were not readily accessible from the databases. This required considerable work in terms of time and effort. Once the respondents were identified, country specific approaches were used to send them the online questionnaire. In France, Sweden, and Italy, e-mails were sent directly to the respondents with the link to the online questionnaire and a personalized covered letter that explained the purpose of the study and proposed to provide a summary of the results to the respondents if they wished to. In Belgium, respondents were first contacted by telephone in order to explain them the purpose of the study and what they would gain from it. Those who agreed to participate received another e-mail with a link to the questionnaire and a personalized cover letter. In Ireland and Hungary, a combination of both approaches was used. In all approaches, up to two reminders were sent via e-mail for those who had not completed the survey.

In total, 8,175 food and drink firms were surveyed and 258 completed questionnaires were returned (i.e. a 3.15% response rate). From the 258 returned questionnaires, 44 were removed because of their activities (e.g. exclusion of feed and food packaging companies) or size (i.e. 250 employees or more). Therefore, 214 questionnaires were used for the analysis. The response rate was expected to be rather low due to the selected data collection method, i.e. web-survey (Sauermann and Roach, 2013; Manfreda *et al.*, 2008; Evans and Mathur, 2005), and due to the time constraints of SME's owner-managers who were targeted as participants (Avermaete *et al.*, 2004; Baruch, 1999). Nevertheless, the low response rate is likely to affect the representativeness of our sample and, thus, our findings. Although the presence of this potential bias could not be assessed, our sample is expected to be overrepresented by firms that are active in networking because non-participation in networking surveys is seen as an indicator of a lack of participation in networks (Gellynck *et al.*, 2007).

As Table 2.2 illustrates, the percentage of SMEs located in Belgium, Ireland and Sweden is relatively higher than expected, whereas Italian SMEs are rather underrepresented. At the same time, the sample is composed of a larger share of

SMEs for the manufacture of food products (85%) as compared to the manufacture of beverages (15%). It thus reasonably represents the population of food and drink SMEs of the six participating countries in terms of sectoral distribution with respect to the official European figures of 2009 (i.e. 93.7% SMEs are manufacturers of food products and 6.3% of beverages) (Eurostat, 2009).

Table 2.2 Proportion of SMEs manufacture of food products and beverages by country in the sample and official Eurostat Data

	Food products				**Beverages**			
	Sample		**Eurostat**		**Sample**		**Eurostat**	
Country	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Belgium	40	22.0	7,238	5.7	10	31.3	331	3.9
France	57	31.3	56,878	44.8	7	21.9	2,878	34.0
Hungary	12	6.6	4,162	3.3	3	9.4	2,361	27.9
Ireland	22	12.1	535	0.4	0	0.0	22	0.3
Italy	21	11.5	54,887	43.2	10	31.3	2,741	32.4
Sweden	30	16.5	3,216	2.5	2	6.3	131	1.5
TOTAL	182	100	126,916	100	32	100	8,464	100

Source: *Elaboration on data from 214 SMEs and Eurostat (year 2009) – structural business statistics databases.*

Regarding the size distribution, the sample is stratified in such a way that micro-sized firms are underrepresented and that bigger firms are overrepresented (see Table 2.3). The under-representation of micro-firms is not surprising as innovation surveys with micro firms tend to report lower response rates (e.g. Tomlinson and Fai, 2013; Lasagni, 2012; Freel, 2003). Most likely, the main consequence of this under-representation is an overestimate of population levels of innovation and use of external sources as bigger firms tend to innovate and network more than smaller ones (Tomlinson and Fai, 2013; Drechsler and Natter, 2012). It should therefore be taken into account in the data analysis. Nevertheless, we attempted to address these representativeness issues by introducing several control variables (i.e. firm size and country) in the empirical analysis in order to detect specific patterns in the responses to the questionnaire (Lasagni, 2012).

Table 2.3 Proportion of SMEs manufacture of food products and beverages by size in the sample and official Eurostat Data

	Food products				**Beverages**			
	Sample		**Eurostat**		**Sample**		**Eurostat**	
Number of employees	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Micro firm (1-9)	62	34.1	111,375	87.8	14	43.8	7,070	83.5
Small firm (10-49)	84	46.2	13,228	10.4	16	50.0	1,163	13.7
Medium firm (50-249)	36	19.8	2,313	1.8	2	6.3	231	2.7
TOTAL	182	100	126,916	100	32	100	8,464	100

Source: *Elaboration on data from 214 SMEs and Eurostat (year 2009) – structural business statistics databases.*

2.3.3 Modelling innovation

In order to address our research question, we fit two logistic regression models for each of the four types of innovations (i.e. product, process, market, and organizational innovations). The first model (i.e. the baseline model) includes only the independent variables described above, while the second model (i.e. the full model) also includes the control variables. In this way, in the full model, the basic regression equation used to estimate the probability that a firm i introduces an innovation is:

$$P\,(INNO_i = 1) = \frac{1}{1 + exp^{(-y)}},$$

where

$$y_i = \beta_0 + \beta_1 SUPP_i + \beta_2 CUST_i + \beta_3 COMP_i + \beta_4 OFIRM_i + \beta_5 UNI_i + \beta_6 PRI_i + \beta_7 CONS_i + \beta_8 size_i + \beta_9 age_i + \beta_{10} sector_i + \beta_{11} country_i + \varepsilon\,.$$

β_1, β_2,..., β_n are the coefficients corresponding to the independent and control variables. β_1 is the constant and ε a disturbance term.

2.4 Results

Before estimating the regression models, we first assessed the correlations between the independent variables. Although there were significant correlations between all pairs of variables, these were sufficient distinct to be used in the analysis. Spearman rank correlation coefficients were all below 0.6, the commonly used threshold above which multicollinearity is more likely (see Table 2.4). In addition, the computed mean variation factor (VIF) values never exceeded 2. They were thus far away from the recommended cut-off threshold value of 10 (Hair *et al.*, 2010).

Table 2.4 Correlation between independent variables

	SUPP	CUST	COMP	OFIRM	UNI	PRI	CONS
SUPP	1						
CUST	.522*	1					
COMP	.267*	.368*	1				
OFIRM	.395*	.412*	.307*	1			
UNI	.407*	.432*	.373*	.372*	1		
PRI	.314*	.345*	.195*	.405*	.404*	1	
CONS	.319*	.335*	.211*	.439*	.356*	.386*	1

Notes: *Spearman rank correlation coefficients. An asterisk denotes correlations significant at the 0.01 level*

The results of the binary logistic regression models are presented in Table 2.5 (i.e. product and process innovations) and Table 2.6 (market and organizational innovations). For each type of innovation, both the results of the baseline model and the full model – by which the robustness of the results of the baseline model are tested through the use of the controls (Lasagni, 2012) – are reported. Based on the fit statistics, all models appear to fit well with the data. The model Chi-square indicates a strong significant contribution of our predictors ($p < 0.01$) in three of our models (i.e. product, market, and organizational innovations). Regarding the models with process innovation, the model Chi-square indicates a weaker but still significant contribution of our predictors ($p = 0.010$). The value of the Nagelkerke pseudo R square ranges from 0.118 for the base line model with process innovations to 0.370 for the full model with product innovations; suggesting that the predictors together explain a reasonable amount of the variation between firms having or having not introduced innovations recently. Besides, the different estimated models show an acceptable predictive power, with more than 60% of predictions correct.

In two of the models (i.e. product and organizational innovations), a set of external sources of knowledge appear to be correlated with the introduction of innovations. Examining first the results for product innovations, the variable CUST was significant with a positive sign in both the baseline ($p = 0.002$) and full model ($p = 0.001$). This suggests that collaborating with customers is positively associated with the introduction of product innovations in food SMEs. These findings are consistent with previous work that demonstrates the importance of relationships with chain members for product innovation in both SMEs (Tomlinson and Fai, 2013; Lasagni, 2012; Zeng *et al.*, 2010; Freel, 2003) and food firms (Knudsen, 2007; Menrad, 2004). Besides, the absence of significant relation for science base actors underpins the general finding of previous studies that emphasize the more important role of market base actors than science base actors for innovation in SMEs (Zeng *et al.*, 2010; Doloreux, 2004).

Table 2.5 Logit models of the probability of introducing product and process innovations

	Product innovation				**Process innovation**			
	Baseline model		**Full Model**		**Baseline model**		**Full Model**	
	β	**SE**	**β**	**SE**	**β**	**SE**	**β**	**SE**
Sources of knowledge:								
SUPP	0.891*	0.470	0.761	0.513	0.313	0.391	0.346	0.414
CUST	1.695***	0.55	1.944***	0.609	0.721*	0.383	0.655	0.403
COMP	-0.508	0.546	-0.218	0.593	0.013	0.362	0.128	0.384
OFIRM	0.627	0.538	0.517	0.568	0.076	0.361	-0.005	0.375
UNI	0.219	0.532	0.006	0.573	0.396	0.357	0.328	0.377
PRI	-0.693	0.603	-0.877	0.665	0.074	0.408	0.106	0.442
CONS	0.102	0.455	-0.347	0.498	0.165	0.344	-0.061	0.370
Constant	0.095	0.296	-0.627	0.90	-0.654**	0.288	-0.458	0.707
Controls:								
Size			0.546	0.396			0.489	0.306
Age			0.105	0.507			-0.603	0.396
Sector			0.414	0.605			0.373	0.466
Country								
FR			0.977	0.635			0.423	0.426
HU			-0.194	0.863			0.695	0.758
IR			1.155	1.169			0.410	0.629
IT			0.031	0.682			-0.311	0.531
SWE			-0.822	0.634			-0.248	0.533
Model fit:								
N	210		210		199		199	
-2 log-likelihood	166.06		152.572		254.449		245.099	
Chi-square	38.444***		51.932***		18.274**		27.625**	
Nagelkerke R^2	0.269		0.352		0.118		0.174	
Percentage correctly classified	81.40		83.8		67.3		63.8	

Notes: *The dependent variables are the INNO dummy variables that assume the value 1 when the firm has introduced at least one innovation and 0 otherwise. For the binary variables, we report the discrete change from 0 to 1. For the binary variable 'sector', the category 'food industry' is taken as the reference category. SE = Standard error, * p ≤ 0.1, ** p < 0.05, *** p < 0.01.*

Turning to the models with organizational innovation, the data in Table 2.6 indicate that one external source of knowledge appeared to be significantly and positively associated with the introduction of organizational innovations in food SMEs: the relationships with competitors (p = 0.022 in base line model and p = 0.000 in full model). This finding can clearly find support in literature. Previous research have emphasized the positive role that competitors may play in innovation processes especially when their contribution is required in order to solve common problems that fall outside of the sphere of competition (Miotti and Sachwald, 2003; Tether, 2002).

Regarding the other two types of innovation i.e. process and market innovations, the comparison of the results across the base line and full model indicates that none of the external sources of knowledge are significantly related to the introduction of any type of innovation.

Table 2.6 Logit models of the probability of introducing market and organizational innovations

	Market innovation				**Organizational innovation**			
	Baseline model		**Full Model**		**Baseline model**		**Full Model**	
	β	**SE**	**β**	**SE**	**β**	**SE**	**β**	**SE**
Sources of knowledge:								
SUPP	0.507	0.397	0.508	0.430	0.416	0.503	-0.386	0.569
CUST	0.605	0.390	0.763*	0.422	0.135	0.458	0.427	0.536
COMP	0.264	0.376	0.437	0.406	0.875**	0.383	1.816***	0.498
OFIRM	0.369	0.379	0.417	0.398	0.174	0.408	0.032	0.455
UNI	0.314	0.370	0.108	0.395	0.075	0.403	-0.212	0.461
PRI	0.122	0.431	0.069	0.467	-0.203	0.427	-0.214	0.507
CONS	-0.481	0.360	-0.535	0.400	0.854**	0.381	0.492	0.436
Constant	0.406	0.291	0.160	0.765	-1.991***	0.410	0.524	0.979
Controls:								
Size			0.305	0.321			0.031	0.416
Age			-0.914**	0.427			-1.634***	0.575
Sector			1.143**	0.534			1.627***	0.416
Country							***	***
FR			0.334	0.452			0.119	0.513
HU			-0.403	0.776			-2.602**	1.123
IR			0.394	0.639			1.507**	0.704
IT			1.231	0.605			0.153	0.636
SWE			-0.326	0.548			-2.989***	0.990
Model fit:								
N	199		199		181		181	
-2 log-likelihood	241.698		225.641		203.052		170.132	
Chi-square	19.887***		35.945***		22.467***		55.386***	
Nagelkerke R^2	0.130		0.226		0.164		0.370	
Percentage correctly classified	69.8		71.4		72.4		77.3	

Notes: *The dependent variables are the INNO dummy variables that assume the value 1 when the firm has introduced at least one innovation and 0 otherwise. For the binary variables, we report the discrete change from 0 to 1. For the binary variable 'sector', the category 'food industry' is taken as the reference category. * p ≤ 0.1, ** p < 0.05, *** p < 0.01.*

Finally, regarding the control variables, firm age is significantly and negatively related to the introduction of two types of innovation i.e. market (p = 0.032) and organizational innovations (p = 0.004). These findings are in line with Huergo and Jaumandreu (2004) who found that oldest firms have a lower probability of being innovative. In the same models (i.e. market and organizational innovations), the firm sector is significant also but with a positive sign (p = 0.032 in full model for market innovation and p = 0.003 in full model for organizational innovation). Previous studies have already provided support that innovativeness is affected by industry-specific factors (Amara and Landry, 2005; Hausman, 2005). Our results suggest that even within an industry sector, the level of innovation may be different. For example, beverage manufacturing firms are more likely to introduce market and organizational innovations than food manufacturing firms. Finally, the variable country shows a strong significant association with the probability of introducing organizational innovation (p = 0.002). In comparison to Belgian food SMEs, Irish food firms are significantly more likely to introduce organizational innovations while Hungarian and Swedish firms are significantly less likely to do it. These findings suggest a potential role for national-factors (e.g. quality of governance, governmental support for innovation, national culture) in explaining this particular type of innovation.

2.5 Discussion and conclusions

With this chapter, we aimed to add to previous research on inter-organizational relationships for innovation in SMEs and in the food industry by investigating the research question: How do different external sources of knowledge relate to different types of innovations in food SMEs?

Our findings support the recent studies that suggest that the introduction of different types of innovation is associated with different types of sources of knowledge (Capitanio *et al.*, 2010; Varis and Littunen, 2010; Tödtling *et al.*, 2009; Freel, 2003). Our results indicate a positive significant relation between the introduction of product innovations and collaboration with customers while they suggest that the introduction of organizational innovations is positively and significantly related to collaboration with competitors.

Our results also support previous works that highlight that market base actors play a more distinct role in innovation for both SMEs and food firms than science base actors (Bigliardi *et al.*, 2011; Zeng *et al.*, 2010; Knudsen, 2007; Doloreux, 2004; Menrad, 2004). Following our study, science base actors are not associated with the introduction of innovation in food SMEs. On the contrary, our study provides evidence that linkages with market base actors matter for innovation in food SMEs. Our results show that food SMEs are more likely to introduce innovations when they develop relationships with actors that belong to their chain or that are active in the same industry, probably because they share a high degree of proximity (e.g. cognitive, cultural) with these types of actors. Also, in the perspective where the development of innovations in SMEs is seen as a result of external stakeholder

pressure, the more distinct role played by market base actors in comparison with science base actors may be attributed to their greater ability to 'push' innovations on SMEs (Sawang and Unsworth, 2011).

Our study thus reveals that the significance of cooperation with science base actors is less than it could be expected. It therefore casts doubt on the usefulness of the many current policy initiatives that strive to connect food SMEs with science base actors in order to foster innovation. Nevertheless, this deduction should be taken with caution. Science base actors have often been associated with radical innovation rather than with incremental ones (Tödtling *et al.*, 2009). As such, science base actors may still play a crucial role for innovation in food SMEs at least when it concerns radical innovations. In future research, one may thus want to add to our results by distinguishing radical innovations from incremental ones when assessing the role of science base actors in innovation processes in food SMEs.

In addition, our results suggest that there must be some national aspects that influence the probability of food SME's to introduce organizational innovations as the control variable country is significantly associated with this type of innovation. A few studies have provided evidence that aspects such as the quality of governance, innovation friendly climate, education but also characteristics of the national culture, like individualism and masculinity, influence the motivation to innovate in general (e.g. Efrat, 2014; Kash, 2010; Fagerberg and Srholec, 2008), and to develop organizational innovations in particular (e.g. Fernandes *et al.*, 2013). Previous research has shown for example that the innovative and supportive orientations are more pronounced in most West European countries than in Eastern and Central European countries (Susanj, 2000). This difference could potentially explain the lower levels of organizational innovation found in the Hungarian food SMEs as compared to the Belgian ones. This calls for future research on the underlying reasons behind cross-country differences in innovation in order to adapt innovation policy initiatives to the local context and thus increase their success.

As it is the case for all research, our study has a few limitations that should be taken into account when considering the reliability of the results obtained. First, although our sample is composed of an acceptable amount of data from food SMEs in six European countries, the relatively low response rate as well as the difficulty to collect innovation data from micro-firms has an important impact on the representativeness of our sample. The generalization of our findings to all European food SMEs may thus be limited, by which they should be interpreted with caution. Nevertheless, the sample does represent a broad range of food SMEs (including micro-firms) that, - to our knowledge -, goes beyond the scope of previous innovation studies in the food industry. As the low response rate is most likely due to the online survey method as well as a low interest in participating in surveys due to time constraints, there is clearly a need to develop, adapt or, at least, evaluate survey tools that would result in higher response rates, especially for micro-firms. Also, further identifying the reasons behind the refusal of these particular firms to participate in surveys would help to reach them more effectively. Such a 'tailored'

surveying approach is of utmost importance for studies focusing on sectors where the majority of firms are micro-firms like the European food sector.

Second, the data used in this study were gathered from single informants (i.e. targeted respondents were the SME's owner-manager) which may have resulted in self-report bias (Podsakoff *et al.*, 2003). The decision to rely solely on the SME's owner-managers is supported by prior evidence that they possess the most complete information about the firm's innovation decision and outcomes (Branzei and Vertinsky, 2006). Nevertheless, future research should attempt to control for this bias by collecting data through several in-company sources.

Another limitation is that the data employed are cross-sectional. We were therefore not able to draw any causal inferences. Future studies may want to use longitudinal data in order to understand the dynamics between the use of external sources of knowledge and innovation outputs.

Finally, similarly to other studies (e.g. Varis and Littunen, 2010; Nieto and Santamaría, 2007), the measurement of our main concepts (i.e. external sources of knowledge and innovation type) was broad. Notwithstanding the significant effects reported in this study, future work may especially benefit from the use of more refined indicators. As mentioned above, distinguishing between radical and incremental innovations may clarify the role of science base actors for innovation in food SMEs. The use of external sources of knowledge could be defined in a more detailed way also by for example distinguishing formal from informal networking behaviours (van de Vrande *et al.*, 2009a). In addition, relating innovation outputs to firm performance may be of particular interest as it would give an indication about how successful the innovations introduced are. Finally, forthcoming research should try to include other explanatory variables in order to develop more effective models on innovation in food SMEs. Disaggregating the variable firm size into detailed firm internal resources may for example be particularly interesting to enhance our understanding of innovation processes in these firms.

Chapter 3

Role of cluster organizations in the success of collaborative projects

Based on: *Virginie Marie Lefebvre, Xavier Gellynck (in review). Successful collaborative projects for SMEs in innovation clusters*

Abstract: *This chapter focuses on cluster organizations, a particular type of intermediary organization that has for function to coordinate a formal innovation cluster and organize cluster activities in order to create synergies between the cluster members. Cluster organizations have started to receive attention in literature, but little has been reported on what happens within the clusters they are responsible for and the cluster activities they organize such as collaborative R&D projects. This chapter aims to investigate the factors that influence the success of collaborative projects for food SMEs, including the potential role of the cluster organization. It comprises one in-depth case study of a collaborative research project that took place in a Belgian food innovation cluster. The case findings indicate that cluster organizations can play a number of roles to enhance the success of collaborative projects for food SMEs. They emphasize in particular the roles of regulator, boundary-spanner, mediator and match-making.*

Keywords: *Collaborative projects, Innovation clusters, Cluster organizations, Small firms, Innovation*

3.1 Introduction

Innovation is progressively seen as a cooperative phenomenon, a result of relationships, alliances, networks and other types of interaction (Lasagni, 2012; Freel, 2003). In today business world where fields of practice are swiftly evolving and knowledge is progressively getting specialized and distributed across organizations (Powell et al., 1996), fewer firms are able to '*go it alone*' in innovation development processes (Tether, 2002: 947). A growing number of studies show that firms, including small and medium sized firms (SMEs), must develop relationships with a variety actors in order to create in-house innovations (e.g. Purcarea *et al.*, 2013; Köhler *et al.*, 2012; Chen *et al.*, 2011b; Zeng *et al.*, 2010; Tödtling *et al.*, 2009; Knudsen, 2007; Nieto and Santamaría, 2007; Amara and Landry, 2005). Indeed, inter-organizational cooperation helps firms to spread the risk and uncertainty related to innovation and provides firms access to new resources and learning opportunities (Cantner et al., 2011; Bayona et al., 2001; Hoffmann and Schlosser, 2001).

Nevertheless, several challenges impede firms, and especially SMEs, to pursue inter-organizational collaborative innovation processes. Among them, are the limited capacity of SMEs to find appropriate partners, and the organizational problems and cultural differences that arise when interacting with an increased number of external actors (Lee *et al.*, 2010; van de Vrande *et al.*, 2009a). As a result, many networks of SMEs are driven by intermediary organizations (Katzy et al., 2014; Sherer, 2003). Intermediary organizations, also called third parties, bridgers, and brokers, are described to perform a variety of activities in the innovation process (Howells, 2006). They entail a wide range of agents (Katzy et al., 2014; Edquist, 2006), of which many are created through government initiatives (Klerkx and Leeuwis, 2009). Intermediary organizations have received a wide attention in literature, especially regarding their different innovation brokerage functions (e.g. Winch and Courtney, 2007; Howells, 2006), their diversity of forms (e.g. Klerkx and Leeuwis, 2008) and their embeddedness within the innovation system (e.g. Sapsed et al., 2007; Huggins, 2000). Still, whether and how these organizations contribute to the innovation process remain poorly investigated (Gassmann et al., 2011; Batterink et al., 2010; Johnson, 2008; Klerkx and Leeuwis, 2008).

This chapter focuses on cluster organizations, a particular type of intermediary organization that has for function to coordinate a formal innovation cluster and organize cluster activities to create synergies between the cluster members (Provan and Kenis, 2008; Benneworth et al., 2003). Cluster organizations may only consist of a single individual or they may be a formal organization, consisting of an executive director and staff addressing the operational decisions and a board addressing strategic-level cluster concerns. Moreover, they may either be established by the members themselves or through mandate; and in that case, are often set up when the cluster first forms, to stimulate its growth through targeted funding and/or cluster facilitation and to ensure that cluster goals are met (Provan and Kenis, 2008). Cluster organizations have been widely used as a policy tool for

regional and sectorial development by governments across the globe (Bessant et al., 2012; Kingsley and Malecki, 2004). They have been implemented to promote innovation in low and high-tech sectors (e.g. Garbade et al., 2012), and utilized to assist both small and big firms with innovation (e.g. Bocquet and Mothe, 2009). Cluster organizations have started to receive attention in literature (e.g. Levén et al., 2014; Calamel et al., 2012; Johnson, 2008; Carpinetti et al., 2007), but there is still little reported on how they operate in order to facilitate learning and innovation (Bessant et al., 2012). There is a need for more detail on what happens within the clusters they are responsible for and the 'cluster activities' they organize (Benneworth et al., 2003), e.g. collaborative R&D projects (Calamel et al., 2012). In particular, there is a plea for more research on how the actions of the cluster organization impact the success of collaborative projects (Johnson, 2008). This chapter makes a contribution in this direction by investigating the factors that influence the success of collaborative projects for SMEs, including the potential role that the cluster organization might play.

This chapter presents the findings of one in-depth case study of a collaborative research project which took place within the Belgian food innovation cluster 'Wagralim'. The choice to focus on the food sector is motivated by the lack of research on intermediation in low-tech sectors such as the food sector (Spithoven and Knockaert, 2012). Moreover, the food sector is an interesting ground for studying cluster organizations as previous studies have shown the importance that these actors can have in the innovation processes of food firms and food SMEs in particular (e.g. Garbade et al., 2012).

The chapter begins with a literature review on the collaborative innovation process in SMEs and on the role of clusters organizations in the innovation process. It then presents the methodology of the empirical research. Next, based on the analysis of the case study, the paper highlights the success factors of the collaborative research project, including the role of the cluster organization. In particular, it summarizes the challenges that occurred in the collaborative project and how they were or could have been overcome. The chapter concludes by reflecting on the theoretical and practical implications of the findings, acknowledging the limitations of the study and proposing avenues for future research.

3.2 Literature review

3.2.1 Collaborating for innovation and SMEs

It is acknowledged that networking is crucial for SMEs to innovate as it helps them to compensate their liability of smallness. Still, it poses key managerial and organizational challenges to them (Columbo et al., 2012). SMEs, and especially the ones operating in traditional, low-tech sectors such as the food industry (Kirner et al., 2009), are known to have difficulties in establishing inter-organizational networks for a number of reasons. SMEs are usually characterized by a specialized knowledge base associated with their core business (Bianchi et al., 2010; Huggins

and Johnston, 2009). They therefore face barriers when they encounter and need to exploit new knowledge in unfamiliar areas. Also, the often limited number and qualification of the employees in SMEs result in low absorptive capacity (Spithoven et al., 2010). Furthermore, SMEs have limited financial resources which reduce the amount of efforts they can deploy to scan the external environment to identify strategic partners for knowledge sharing and innovation (Bianchi et al., 2010; Hausman, 2005). Besides, SME managers or owners – who are at the core of the decision-making process within the firm – are often risk-averse and conservative (Hausman, 2005). Since external relationships for knowledge sharing and innovation entails risks (e.g. unintended information and knowledge leakages) (Easterby-Smith et al., 2008), risk aversion reduces the propensity of the firm to establish such relationships. Finally, potential cultural and organizational differences between collaboration partners may lead to eventual misunderstandings and contentious situations (van de Vrande et al., 2009). In academia-industry collaboration, differences in organization and culture have been identified as very influencing constraints on collaboration negotiations (Melese et al., 2009 in Saguy, 2011).

3.2.2 The role of innovation clusters in the innovation process

There is now little doubt that the management of innovation depends on human factors (Fichter, 2009). New products or process ideas result from the efforts of persons who commit themselves with enthusiasm to the innovation project and help to overcome certain barriers that emerge in innovation processes, such as lack of resources, missing linkages and limited coordination between actors (Klerkx and Aarts, 2013; Fichter, 2009; Gemünden et al., 2007).

Following Howells (2006: 720), an intermediary organization is "*an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties*." A series of studies have investigated the specific roles or functions of intermediary organizations including innovation brokers, technology transfer centres, consultants, business incubators, collective research centres and cluster organizations. A wide range of roles exist and Dalziel (2010) proposes to classify them into three categories: (a) inter-organizational networking supporting roles, (b) technology development supporting roles, and (c) other supporting roles.

Intermediary organizations can play several kinds of inter-organizational networking supporting roles (see Table 3.1). First, they can play the role of network formation or marriage broker/match-making, and connect organizations that were not previously aware of one another's existence and/or of the potential synergies that could arise if they would combine one another's knowledge (Crespin-Mazet et al., 2013; Hakanson et al., 2011; Howells, 2006; Bessant and Rush, 1995). Important to this role is the ability to maintain linkages across a diverse set of actors (Hakanson *et al.*, 2011; Batterink *et al.*, 2010; Lee *et al.*, 2010) and to possess a deep understanding of the needs of the organizations to be served (Hakanson *et al.*, 2011; Batterink *et al.*, 2010).

Second is the role of boundary spanner which implies the activation of direct contact among unrelated organizations but also the translation of one body of language (e.g. scientific language) into another (e.g. business language) (Comacchio *et al.*, 2012).

A third role is that of network regulator or coordinator, whereby a formal structure is given to the interactions between organizations (Crespin-Mazet *et al.*, 2013; Howells, 2006). Intermediary organizations can for example set up partnerships rules and principles of conduct of action that can favour the cooperation and knowledge transfer between parties (Crespin-Mazet *et al.*, 2013).

Intermediary organizations can also act as resource/management provider in order to help the organizations to structure their interactions and collaboration. For example, they can provide firms with management models and project management systems that can be helpful in collaborative R&D settings (Johnson, 2008). They can also give contractual advice to firms (Howells, 2006). In some cases, they can even play a more direct role and take the lead in setting up the appropriate collaborative arrangements and contracts (Batterink *et al.*, 2010).

There is also the role of mediator or moderator/arbitrator. Here, the intermediary organization's task is to help solving disputes and conflicts among parties (Hakanson *et al.*, 2011; Batterink *et al.*, 2010; Johnson, 2008). Especially important to this role is the neutrality of the intermediary organization (Hakanson *et al.*, 2011; Batterink *et al.*, 2010).

Besides inter-organizational networking supporting roles, intermediary organizations often also play a number of technology development supporting roles. First, they can play the role of developer of technology and innovation by actively conducting technology development and related activities either on their own or together with firms (Spithoven and Knockaert, 2012; Dalziel, 2010). By playing such a role, intermediary organizations are better able to engage in technology transfer activities (Spithoven and Knockaert, 2012) and assist firms in finding new uses for their existing technological applications (Gassmann *et al.*, 2011).

Intermediary organizations can also play the role of facilitator of technology and innovation by providing firms with support in order to enhance their innovation capacity. They play such a role by offering technological counselling, technical assessment, access to facilities and equipment, intellectual property (IP) rights advice and management, and commercialization support (e.g. support for market research and fund raising) (Soetanto and Jack, 2013; Spithoven and Knockaert, 2012; Winch and Courtney, 2007; Howells, 2006).

A further role is the diagnostic role which intermediary organizations play in helping firms to identify their needs in innovations and/or collaboration (Klerkx and Leeuwis, 2008; Howells, 2006; Bessant and Rush, 1995).

Another role is the filter role of potential technological developments. An intermediary organization can act as a filter for example when it decides which technological projects are worthy of support and which are not (Johnson, 2008).

Finally, intermediary organizations can also play other roles which can be seen as complementary to their networking and technology related supporting roles (Dalziel, 2010). They can for example act as fund (Johnson, 2008) and training provider (Alexander and Martin, 2013; Howells, 2006). They can also play an internationalization role, thereby providing an international exposure to their clients or members (Omta and Fortuin, 2013).

Table 3.1 Roles of intermediary organizations

Type of supporting roles	
Inter-organizational networking	Network formation/marriage broker/match-making
	Boundary spanner
	Regulator/coordinator
	Resource/management provider
	Mediator/moderator/arbitrator
Technology development	Developer of technology and innovation
	Facilitator of technology and innovation
	Diagnostic
	Filter
Others	Fund provider
	Training provider
	Internationalization

Source: *Own compilation*

To summarize, the roles that an intermediary organization, such as a cluster organization, can play are numerous. In the next sections, we will seek to understand how the specific roles played by the Belgian food innovation cluster Wagralim impact the success of its collaborative projects.

3.3 Research methodology

3.3.1 The case study

A case study approach was employed in this research to explore the factors that influence the success of collaborative projects for SMEs, including the potential role that the cluster organization might play. The case study approach was chosen as it is useful for researching a 'how' or 'why' question about a contemporary event which is difficult to separate from its context and its dynamics (Yin, 2009; Eisenhardt, 1989). It gives the opportunity to study the many-sided view of a certain phenomenon and its context, and therefore offer depth and comprehensiveness for understanding such a phenomenon (Halinen and Törnroos, 2005).

3.3.1.1 Wagralim

In this study, we investigated a collaborative research project that took place in a Belgian innovation cluster called Wagralim. Wagralim can be compared to the French innovation clusters, the so-called 'Pôles de compétitivité', which are characterized by a government certification and are defined as '*a combination, in a given geographic space, of companies, training centers and public and private research institutes working in partnership in order to create synergies around joint projects of an innovative nature*' (Retour, 2009: 93).

Wagralim is a public-private funded regional innovation cluster which was developed in 2006 through the initiative of the Walloon regional Government. It was created with the aim to foster the competitiveness of Walloon food firms by bringing enterprises together, developing the spirit of innovation, improving the profitability of food chains and encouraging the positioning of enterprises in growing market. To achieve this goal, the cluster organization of Wagralim offers and/or manages a variety of activities among which collaborative R&D projects that are to be framed in one the four priority development areas selected by the cluster (i.e. healthy foods, innovative production and conservation technology, bio-packaging, and durable food industry networks). In particular, the Board of Directors takes the strategic decisions concerning the network, for example regarding the priority development areas, while the Operations Unit implements the decisions taken by the Board and takes care of the structural organization of the cluster as well as of monitoring projects. Two types of R&D projects can be distinguished. First are the core projects which come at a pre-competitive stage and are intended to develop useful skills and technological tools for the members interested in one of the four priority development areas. Second are the applied projects. These projects are more targeted industrial projects which focus on the development of specific products or markets. They generally involve more restricted partnerships. Today, the cluster counts 159 members that include university laboratories, research centres, public services providers and food manufacturers – in majority SMEs. Since its establishment, it has helped to launch and fund 20 collaborative research projects.

Any research project conducted within the frame of Wagralim is mandated to include at least two firms (of which one at least is an SME) and two knowledge institutions (e.g. university laboratory). It must be led compulsorily by a firm (i.e. 'the coordinator') who will have the responsibility of writing and submitting a project proposal and of appointing a 'project manager' in case the project proposal receives funding. As it is the case for the intermediary organization 'Precarn' (Johnson, 2008), the cluster organization of Wagralim does not technically manage the projects it helps to fund. Rather, it provides them general support and guidance, but can step in when required.

The funding for the projects comes from both the Walloon Government and the firms themselves. Every year, the cluster organization informs Wagralim's members about the call for project proposals that the Walloon Government releases annually to the members of the certified Walloon innovation clusters. The cluster organization shares with them the procedure to be followed to access to the funding

and offer them support when needed. In order to get funded, the project proposals need to go through two selection phases. The first is internal. Together with an independent jury of scientific experts, the cluster organization makes a first selection based on six criteria: (1) the scientific quality, (2) innovativeness, and (3) potential economic impact of the project proposal, (4) the adequacy between the work plan and research objectives, (5) the quality of the consortium and (6), and quality of the intellectual property (IP) agreements. The second selection phase is external to the cluster and conducted by an international panel established by the Walloon Government. The ultimate decision is made by the Walloon Government, who gives its approval and allocates grants to the selected projects.

3.3.1.2 The project

The collaborative research project we investigated was developed in the frame of the priority development area 'healthy foods'. It was a core project and therefore was essentially focused on bringing together an extended knowledge base around a certain theme related to healthy food. The idea of the project was triggered by the launch of a new Regulation of the European Parliament on nutrition and health claims made on food (Regulation (EC) 1924/2006). With the new regulation, any claim made on food had to be based on scientific evidence. Walloon food firms interested in nutrition needed therefore to get prepared for this new regulation. The coordinator of the project was a large firm (i.e. a firm with more than 250 employees) who collaborated intensively with a university laboratory in order to develop the project proposal.

The objective of the project was twofold. On the one hand, it aimed at developing, validating or improving scientific tools to allow detecting and showing the function of bioactive compounds (i.e. food ingredients). On the other hand, it aimed at identifying new bioactive compounds or new combinations of bioactive compounds with the help of these scientific tools in order to develop new products exhibiting health benefits that could be underpinned scientifically. The novelty of the project was to combine, where feasible, bioactive compounds that originated from three different groups of food constituents (i.e. poly-unsaturated fatty acids, fibres, and poly-phenols) in order to create complementary effects or synergies. A budget of 6.1 million of euros was allocated to the project. The project started in November 2006 and finished in October 2010. It was one of the first projects supported by Wagralim as it was launched soon after the creation of the cluster. The project included nineteen partners, among which nine business partners (including 6 SMEs) and ten research partners, and involved more than a hundred persons.

3.3.2 Data gathering and analysis

Data were derived through 13 semi-structured interviews that were conducted with different actors who were directly or indirectly involved in the project (5 firms

among which the project manager, 4 research institutes, 1 staff member of the cluster organization, 2 observers from the Walloon regional Government). Informants were selected for having different positions within and different perspectives on the project in order to limit the possible bias resulting from convergent retrospective sense making and/or impression management (Eisenhardt and Graebner, 2007). The interviews were conducted face-to-face, between January and June 2011. The interviews were carried out on the basis of a pre-tested semi-structured interview guide that assured a basic comparison between them, and thus addressing the problem of reliability (Yin, 2009). The questions included in the guide focused on the initial launch of the project, the dynamic of collaboration developed, the obstacles and success factors encountered in the project, and the evolution of the project towards its objectives. All interviews were recorded and entirely transcribed. In addition to the interviews, complementary documents such as project reports and information from the website of Wagralim, were collected in order to increase construct validity (Yin, 2009).

For the analysis, we followed a grounded theory approach and repeatedly compared the concepts and relations emerging from the data with existing literature (Glaser and Strauss, 1967). An inductive, open coding approach was used whereby the data were systematically coded into first-level codes emerging during the analysis. These first-level codes were subsequently categorized into pattern-codes in order to reduce the number of initial codes (Miles and Huberman, 1994).

3.4 Results

The case analysis reveals that collaborating for innovation in the frame of innovation clusters is far from being easy for SMEs. A series of challenges were identified in the collaborative project and are discussed here. From the analysis, it appears that these challenges were overcome, at least partially, by the presence of a competent project manager and coordinator, and maintenance of confidentiality.

3.4.1 Lack of contract design capabilities

The first challenge identified was at the level of the planning and formulation stage of the collaborative work. In inter-organizational arrangements like the projects of Wagralim, agreements or contracts must often be designed so that the goals of the collaborative work are defined, the roles and responsibilities of each clarified, the communication procedures discussed and the rights over intellectual property settled (Argyres and Mayer, 2007). As it is shown from the verbatim statements collected, designing such agreements requires both sufficient human resources and experience in project proposal:

"*Firms must invest resources in order to set up the project. They must put the consortium in place, write the project proposal (…) It requires time and men*" (cluster staff);

"If we expect a firm to write the project that is scientifically sound, it's very complicated and very difficult (…) it's a problem linked to the size of the enterprise. We have worked with firm x, which is a rather big firm with a R&D centre, and them, they knew how to write a research project" (scientific partner).

Because SMEs often lack knowledge and experience in designing contracts and managing partnerships (Batterink et al., 2010; Hoffmann and Schlosser, 2001), they are often not willing to play the coordinating role in the project:

"*Submitting a project on our own seems to be beyond our capability as we are too small.*" (Business partner)

"*If an SME could coordinate, it would be great. The problem is SMEs do not have sufficient time and resources to write the project proposal.*" (Project manager)

As such, the fact that the coordinating task was taken on by a large firm appeared to be a key success factor for the project. It allowed that the necessary resources were allocated to set up the project successfully:

"*X was really the motor. They really dedicated human resources for writing the project (…). It's almost like a European project in terms of administration. It's something very heavy. Nothing will happen if there is not someone who really wants to pull up things.*" (Project manager)

3.4.2 Lack of shared cognition

Another challenge related to the lack of 'shared cognition' between the business and scientific partners present in the consortium (Nooteboom et al., 2007; Nahapiet and Ghoshal, 1998). At the beginning of the project especially, a series of misunderstandings and contentious situations had arisen because of the partners' different objectives, culture, and language which needed to be smoothed out in order to achieve a satisfying level of cooperation. As one business partner highlighted:

"*We certainly had difficulties to go along at the beginning, because we didn't speak the same language, hadn't the same objectives (…) we needed to oil the machine*". Indeed, as the project manager pointed out, "*the deadlines for the scientific and business partners are different. A business partners must develop something very fast (…) Research needs more time (…) There was also the notion of time which is different (…) It is important to know that at the university during Easter, All saints, the summer holidays (…) everything goes slower. The enterprises can't bear that.*"

The business partners needed to go beyond these differences and learn to understand and work with scientific partners. This was especially true for the business partners lacking research competencies. As with Belso-Martinez *et al.* (2013) and Tödtling *et al.* (2009), the business partners lacking research competencies were less able to successfully engage in the collaborative work with the scientific partners, especially at the outset of the project.

> "*Some enterprises were more research oriented. They understood right away the dynamic of the project and thus took the work packages in order. Others were not at all accustomed to do research (…). They didn't understand the aim of the project.*" (Project manager)

> "*The results arrived late for us because we took a certain time to work with the universities*" admitted a business partner who was not experienced in scientific research.

Besides, certain scientific partners, lacking former collaborative experiences with small firms, also needed to learn to work with SMEs.

> "*At the beginning, working together was not easy (…) we were not used to work with small firms, we work more with big enterprises (...).*" (Scientific partner)

The project manager played a crucial role in helping the project's members to overcome the obstacles encountered. As a business emphasized:

> "*I think that the project manager contributed to a big part of this 'oiling process' by doing a very good coordinating work.*"

First, the project manager acted as a boundary spanner when he translated and relayed the information between the scientific and business partners. One scientific partner explained that:

> "*The project manager helped to make the firms understand the necessity to work with scientific partners. The project manager came to us saying 'I need to understand everything in order to be able to explain to the firms what you are doing'. It was well done*".

By doing so, he helped to deal with the difficulties of communicating across organizational boundaries due to the existence of different idiosyncratic norms, time frame and values and therefore facilitated cooperation (Fleming and Waguespack, 2007; Tushman, 1977).

In addition, he also acted as a mediator. He actively assisted project partners to solve contentious situations, thereby fostering the development of trust and hence cooperation (Mesquita, 2007). The project manager was especially focused on the business partners whom he was meeting twice per week but also on demand. He saw it as his duty to "*visit the business partners and really see what is going well, not well*". Whenever a problem arose, the project manager "*was right away going to see what was wrong (…) to have a good discussion with the partner in order to really*

smooth down misunderstandings". He was then "*going back to the eventual scientific partner concerned, and in general things were getting better*" (project manager). The project manager assured also that the project didn't deviate from its initial objectives:

> "*The objectives didn't change. X was a very good project manager, and we didn't observe any deviation.*" (Business partner)

The focus of the project was therefore kept on the shared goals rather than on the individual ones, thereby enhancing the willingness of network members to cooperate and share knowledge with each other (Chow and Chan, 2008).

Although the value of the project manager was regularly emphasized by the respondents, one may wonder whether the performance of the project could have been improved if the problems related to the lack of shared cognition would have been better anticipated by e.g. the cluster organization. As a business partner mentioned:

> "*The kick-off of the project should be better supervised in order to have a shorter responsiveness (…). In the future, it would be good that the smaller enterprises are better supervised when it's about projects with universities. A preliminary coaching would have helped us winning time and thus doing extra things*".

This echoes a conclusion of Calamel *et al.* (2012) on the need to take 'offensive measures' in order to ensure that the lack of shared cognition does not pose any problems.

3.4.3 Presence of competitors

Another challenge that would have seriously jeopardized the success of the project if not properly tackled was the presence of direct competitors within the business partners. A few project partners mentioned that at the outset of the project, the firms "*stressed*", "*had fear*". A scientific partner mentioned:

> "*They were very fearful with regard to the fact that we would disclose the results".*

Indeed, the presence of direct competitors combined with the necessary need to preserve confidentiality and minimize information disclosure within the consortium *"probably limited the progresses made*" (Scientific partner). As one of the objectives of the project was to combine different bioactive compounds to create new products, cooperation between business partners was also required by the project. The project consortium did not provide the ideal ground for stimulating such type of cooperation. Because it included direct competitors, certain firms never collaborated with each other. As one business partner mentioned:

"*We didn't develop links with this firm [a competitor] (…) It was not the ideal to have a direct competitor in the consortium*".

Still, some inter-firm interactions took place within the project, but only among indirect competitors. As the same business partner remarked:

"*We had more links with firm x who is not a direct competitor.*"

Nonetheless, it seems to us that the presence of competitors could have led to worse consequences in the absence of confidentiality and IP agreements and a competent project manager. Indeed, the presence of confidentiality agreements, and in particular the maintenance of confidentiality during the project, helped to develop a minimum feeling of trust, and hence cooperation among the project participants. As one scientific partner mentioned:

"*Maybe the project was successful thanks to the preservation of confidentiality. The business partners were confident; they knew that not everything would be shared on the public place*".

The importance of confidentiality and clear property rights for the success of the project was also highlighted by a business partner:

"*The presence of this firm [a competitor] didn't really bring problem because it was agreed that the results obtained on one ingredient of a firm was the property of that firm (…) so all the business partners didn't have access necessarily to the results obtained on the ingredients of the other partners (…) This confidentiality regarding the results allowed the project to function well*".

Besides, the project manager fostered the development of interactions between specific partners when he saw that opportunities for synergies appeared:

"*I pushed them to work with another business partner. I told them that there was an opportunity to develop something (…) and then things started up.*" (Project manager)

"*The project manager did very well his work. He was trying to prompt meetings from which he thought that interesting synergies could develop.*" (Scientific partner)

This 'match-making role' was certainly crucial for the success of the project (Hakanson *et al.*, 2011; Howells, 2006). Because of the presence of competitors, little of the information concerning the advancements and findings of the project was shared between the project partners which prevented the network members to keep an overview of the progresses made as the following quote illustrates:

"*We had a plenary meeting every 6 months, but I had difficulties to have a global view and to know what everybody was doing (…). It's a bit linked to the industrial secrecy.*" (Scientific partner)

Fortunately, the project manager had access to the 'big picture' thanks to his central position. He was therefore able to scan and connect information and ideas between members to create synergies (Jepsen, 2013).

3.4.4 Focus on research and development rather than on commercialization

A final challenge identified related to the fact that the project focused essentially on research and development activities and did not include any commercialization activities such as marketing, business planning, manufacturing and operations (Chen and Guan, 2011). All the verbatim statements we collected suggest that the project was a success for the participating firms as it provided them with interesting results. One business partner for example said that:

> "*The project really helped us to discover the effects of our ingredient.*"

Another mentioned:

> "*We (…) acquired results that are useful to us.*"

Still, the project didn't allow the firms to directly exploit the results of the project commercially.

> "*The project helped us to valorise scientifically our extract, but we cannot say that it helped us to exploit commercially our product*".

As a scientific partner stressed:

> "*For us, it stops with the studies and the delivery of the results, but for the firms not.*"

The valorisation task was thus left for the firms, after the project ended. This would not necessarily have been a downside if some of the firms had not been ill-equipped to valorise the project results. At the time of data collection, the firms were only starting to deploy efforts to valorise the project results, but we could already see that the firms would not be on equal terms regarding valorisation.

The exploitation of the project results into commercial outputs had appeared unfeasible or at least rather challenging for the firms with a smaller internal capacity. A business partner mentioned:

> "*The principal reason [for which we do not use the results of the project] is because we are an SME with 10 persons and that we can't have many irons in the fire*".

Another said:

> "*It would have been nice if the commercial aspect would have been included in the project (…). In our case, we have an innovation centre in our SME, but*

sometimes we lack resources and competences at the level of valorisation, marketing and communication (…). It's difficult for us to communicate, to valorise this information".

For these firms, and as scientific partner suggested it, it would have been better to provide support "*until the end*" including "*the communication aspect and the development of marketing strategies*". For the firms with higher internal capacity, to valorise the project results had not appeared to be an obstacle, expect perhaps for the extra time and investments it required. These firms knew that the project was part of "*a long-term undertaking*", and had already started to engage in the next steps of the 'innovation production process' (e.g. development of a marketing plan, efficient production process) at the time we collected the data (Chen and Guan, 2011).

These findings raise the question about whether the cluster organization actually organizes the 'project activities' properly so that they can bring benefits to firms, and especially to SMEs. Following a staff member of Wagralim, one factor that contributes to the success of research projects, in terms of their potential to create benefits for the participating firms, is that:

"*The enterprises have the control over the projects, so that the project objectives can be kept in line with their market*".

The rules that must be followed to be able to submit a research project and the criteria that must be fulfilled to get it selected are designed with the purpose to give such control to the firms: the leadership and project coordination tasks must be carried out by a firm, and the project proposal must emphasize the potential economic impact of the project in order to get selected.

Although the project under study was led by a firm, the difficulties that certain participating firms faced at the outset as well as in the end of the project leave some doubt about whether the project was really designed by and for the firms. This doubt is supported by one respondent from the Walloon government:

"*One difficulty that we got in Wallonia (…) is that the academic world played an essential role in the construction of the Cluster (…). They took the projects they already had in their closet thinking that these were good for the enterprises. However, the original idea was that the project ideas come from the enterprises. It was not really the case*".

As mentioned in section 3.1.2, the project proposal resulted from the combined efforts of the coordinator, a large firm, and a university laboratory. In particular, it was written by the scientific and nutritional adviser of the coordinating firm, and a researcher from the research laboratory. This early academia-business collaboration was seen by many as positive:

"*It was really a positive Ping-Pong game between the two (scientific member).*"

"*Both assembled the project, coordinated it, united the different actors, and of course participated in writing the project. It's almost like a European project in terms of administration. It's something very heavy. If you don't have somebody who really wants to pull up things, nothing will happen.*" (Project manager)

"*What was interesting and thus positive, is how the project had been tied together. I think it had been tied together in a very coherent way regarding both the firms and academics. There was a lot of coherence, and it ensured that it could evolve properly.*" (Scientific partner)

Still, the active involvement of scientific partners in the proposal might have caused the scientific rather than the economic interests to be prioritized, and the valorisation aspects to be put on the back burner.

3.5 Discussion

3.5.1 Role of cluster organizations in the success of collaborative projects

The case findings raise interesting issues with respect to the factors that influence the success of collaborative projects for SMEs in innovation clusters. They first show that a series of challenges can arise in collaborative projects, which must be tackled in order to assure the success of the collaborative work. They also point out that certain roles need to be fulfilled in order to overcome some of these challenges (see Table 3.2). Interestingly, while following the literature (see section 3.2.2) these key roles can be played by the cluster organization, they were for the majority played by another actor (i.e. the project manager) in the investigated case.

Looking first at the roles played by the cluster organization, the findings point to the role of regulator which entails giving a formal structure to the interactions between the project members (Crespin-Mazet *et al.*, 2013; Howells, 2006). The cluster organization of Wagralim performed the role of regulator by having articulated the compulsory structure of the collaborative projects it helps to fund. Through the forced design of its research projects, the cluster organization could assure the presence of certain mechanisms that allowed effective cooperation among project members, and SMEs to retrieve benefits from the project. The mechanisms that positively impacted the success of the project were the obligatory presence of a project manager and confidentiality and intellectual property agreements.

The results also emphasize the benefice of having a competent project manager for the project. More specifically, they highlight the roles of boundary spanner, mediator and facilitator that were played by the project manager; roles that also might have been played by the cluster organization (see e.g. Comacchio et al., 2012; Hakanson et al., 2011; Batterink et al., 2010; Johnson, 2008). By having played these roles in the project, the project manager facilitated the creation of ties and positive interactions between the project partners.

Table 3.2 Summary of case study results - Challenges and coping strategies

Challenge		**Coping strategy**	
Source	**Impact on project**	**Strategy**	**Outcome on project**
Lack of contract design capabilities of SMEs: - Lack of human resources - Lack of experience in designing project proposals	- Weak willingness of SMEs to take the lead in setting up collaborative projects	Project coordinating task played by a large firm that was able to dedicate the required resources to set up the project	Project proposal finalized and submitted for approval
Lack of shared cognition between business and scientific partners: - Misunderstandings and contentious situations	- Period of 'adaptation' required which slows down the collaborative work - Present especially for business partners lacking research competencies, and for scientific partners lacking former experience with SMEs	**Boundary spanner** and **mediator roles** played by the project manager	Improvement of communication and development of cooperation
Presence of (direct) competitors: -Lack of trust	- Weak cooperation and knowledge exchange	- Presence of confidentiality and property rights agreements **(regulator role** of the cluster organization) - Maintenance of confidentiality - **Match-making role** played by the project manager	Development of trust and a higher level of cooperation
Focus on R&D rather than on commercialization: - Valorisation of the project results in the hands of the firms, after the end of the project	- Difficulties to exploit the project's results commercially - Present especially for firms lacking resources and competences in marketing	*Absent*	

Our case findings confirm the results of previous studies that indicate a joint impact of formal coordination mechanisms and the aptitudes of the network manager on network performance (e.g. Cristofoli *et al.*, 2014). In particular, they point to the influence of the ability of the network manager, in this case the project manager, to play the role of boundary spanner, mediator, and match-maker on the success of the collaborative project.

The findings also suggest that trust acts as a mediator between formal coordination mechanisms and the success of collaborative projects. They are thus in line with the recent study of Ruitenburg *et al.* (2014) where a positive impact of IP protection on trust and via trust on innovation performance in alliances was found. Still, we have to be careful with this interpretation as other factors may as well have

impacted the development of trust among the project partners. Perhaps it is not the coordination mechanisms themselves but rather them being respected over time by the project members which lead to the development of trust. We therefore encourage other researchers to conduct both qualitative and quantitative longitudinal studies in order to reveal the exact nature of the relationship between formal coordination mechanisms and trust.

3.5.2 Practical implications

The chapter provides valuable inputs for policy-makers and innovation practitioners who wish to use and improve inter-organizational networks as innovation and regional development tool. It brings new insights into how cluster organizations, but also network managers in general, should operate in order to facilitate research related cooperative work. It reveals several approaches and practices that can be employed by cluster organizations and network managers to increase the benefits that SMEs can retrieve from collaborative research projects.

Besides, the results also indicate that many challenges in collaborative projects are due to a lack of competencies or experiences of the project partners. As such, and as suggested by the study of Calamel *et al.* (2012), it is important that cluster organizations and network managers anticipate these challenges in order to improve the performance of the collaborative projects they help to fund. They could for example carefully vet the capabilities of each network member, and act as a resource/management provider and/or facilitator of technology and innovation if required. In particular, they could verify that the firms, and especially SMEs, do not lack resources and capabilities in contract design, research, manufacturing, distribution and marketing as these appeared from our case results to be crucial for successfully engaging and deriving benefits from collaborative projects.

3.5.3 Suggestions for future research

This study highlights a number of factors that influence the success of collaborative research projects for SMEs, among which a series of roles that can be played by cluster organizations. In this respect, it constitutes a welcome contribution to the literature on intermediary organizations and cluster organizations in particular, as it addresses a research gap on the role of cluster organizations in the success of collaborative projects (Johnson, 2008). Still, future research will be needed to understand the exact influence on collaborative work of the success factors identified in this study. In particular, how do the interactions between formal coordination mechanisms and network management impact network performance? What kinds of personal skills possess those individuals who manage research collaborative projects effectively? How does the composition of the project consortium in terms of the partners' capabilities and past collaborative experience influence the success of collaborative work, but also the way it is managed? Further

research of this nature will help to develop a more complete picture of the functioning of effective cluster organizations and innovation networks.

Chapter 4

Food SMEs' preference for innovation networks

Based on: *Virginie Marie Lefebvre, Meri Raggi, Davide Viaggi, Clarissa Sia-Ljungström, Francesca Minarelli, Bianka Kühne, Xavier Gellynck (2014). SME's Preference for Innovation Networks – a Choice Experimental Approach. Creativity and Innovation Management Journal, vol. 23 (4), pp. 415-435* [2]

Abstract: *The objective of this chapter is to assess whether and how network characteristics, such as the type of members, support and formal coordination mechanisms, influence the food SMEs' willingness to join innovation networks. A number of hypotheses were developed and tested through a choice experiment exercise ran on a sample of 231 European food SMEs. The results suggest that the willingness of a food SME to join a particular innovation network depends on the innovation network and its characteristics but also on the fit between these characteristics and the characteristics of the firm. They show that food SMEs prefer networks that are composed of manufacturers and supply chain members, where information is shared confidentially among network partners, and that provides the firms with support for building their network of partners for innovation. In addition, the SMEs' choice of the network is also affected by the interaction between specific network characteristics and two firm characteristics i.e. the firm collaborative experience and innovation objective.*

Keywords: *Innovation networks, Choice experiment, Small and medium-sized enterprises, Food industry*

[2] *Contribution of the co-authors to the paper: Support for the design of the choice experiment and for the analysis of the results; results section, limitations and concluding remarks; review and suggestions for improvement*

4.1 Introduction and objective

In today's business world, '*partner or perish is the new mantra*' when it comes to innovation (Traitler *et al.*, 2011: 66). Several studies have highlighted that innovation is increasingly generated in networks rather than within the individual firm (Pittaway *et al.*, 2004). Networking helps firms distribute the risk and uncertainty during the innovation process, shorten innovation time, reduce costs, and provide access to external knowledge and competences that may be necessary for new idea generations and successful innovation development (Cantner *et al.*, 2011; Lee *et al.*, 2010; Hoffmann and Schlosser, 2001). Networking for innovation is perceived especially useful to Small and Medium-sized Enterprises (SMEs) in that it can help to offset their inherent fragility due to their size by providing a supportive environment (Szarka, 1990). SMEs often lack the necessary resources and capabilities to successfully innovate solely by means of in-house activities (Narula, 2004 and Nooteboom, 1994 in Batterink *et al.*, 2010). By joining networks, SMEs can supplement their limited internal resources and knowledge base through access to external sources. This can help them overcome the challenges they would face if they would rely entirely on their internal capacity to innovate.

Despite the advantages of networking, not all SMEs operating in traditional sectors, such as the food industry, utilize these external sources for innovation due to the challenges and costs it brings (Traitler *et al.*, 2011; Fortuin and Omta, 2009). This is likely due to the fact that networking for innovation still requires investments in human resources such as for assessing, selecting, and negotiating with external innovation contributors (Traitler *et al.*, 2011). Networking can also create potential problems to SMEs owing to cognitive, organizational, cultural and institutional differences between collaboration partners (Boschma, 2005). Moreover, it exposes the SME to the risk that network partners may act opportunistically (Dahlander and Gann, 2010) or that unintended knowledge leakage occurs (Ozman, 2009) during the development process that can jeopardize the final innovation outcome.

As there is increasing evidence that the economic impact contributed by SMEs is comparable to those of large businesses (Hausman, 2005), governments around the world have been increasingly interested in nurturing innovation development in SMEs (Kolodny *et al.*, 2001). Numerous policy tools aimed at promoting innovation were developed (Edler and Georghiou, 2007). Many focus on fostering collective efforts, rather than providing direct financial assistance (Bougrain and Haudeville, 2002), such as establishing innovation networks to foster collaborations. There are many different designs for co-operative innovation networks and an even broader variety of approaches when implementing them (Bek *et al.*, 2012). They differ in terms of objectives (e.g. regional or national growth), geographical scale, scale of financial intervention, the extent of networking (e.g. agglomeration of firms, supply chain linkages, horizontal networking), and use of brokers or intermediaries to coordinate the network (Burfitt and MacNeill, 2008; Kingsley and Malecki, 2004; Martin and Sunley, 2003). These approaches and the innovation networks established have had varying degrees of success (Burfitt and MacNeill, 2008; Huggins, 2001). This prompted questions over the extent to which they fulfil their

primary goals of supporting SMEs' innovation development (Burfitt and MacNeill, 2008; Kolodny *et al.*, 2001).

Scholars suggest that the success of these policy approaches and innovation networks lies in the understanding of the local context, in particular the needs and expectations of the direct beneficiaries i.e. the SMEs (Ebbekink and Lagendijk, 2013; van der Borgh *et al.*, 2012). It is assumed that innovation networks that meet SMEs' needs and expectations about benefits will survive longer than networks that fail to do so (Miller *et al.*, 2007). A fundamental consideration is perhaps to first reflect on the key factors and influences affecting SMEs' commitment to join innovation networks. Past literature has highlighted a few factors concerning both SMEs and the networks themselves. While there is an abundance of studies that explore the underlying motives for firms to engage in dyadic relationships and inter-firm alliances (Ozman, 2009; Ireland *et al.*, 2002), there is still a paucity of empirical research that focus on understanding the motives for firms to join innovation networks.

The objective of this chapter is to contribute to fill this gap by evaluating the importance of selected characteristics of innovation networks and how they affect the decisions of food SMEs when joining the networks. Using stated preferences from a choice experiment exercise, we analyse the effect of the differences in the type of actors engaged in the network, the level of information sharing and the type of support offered to the network members on the decision to join an innovation network. As previous studies have suggested that actors may act differently towards networks depending on their own specific characteristics (e.g. Miotti and Sachwald, 2003), we also examine the interaction between specific firm characteristics and the innovation network's characteristics when they decide to join a network.

The main novelty of the chapter rests on the following: first, we contribute to the literature on partner selection and the study on innovation networks in general. Our results help to develop a better understanding of the underlying motives for firms to join certain innovation networks, suggesting that the firm's preference for a network is driven by resource considerations. Second, from a methodological point of view, we use a stated preference approach to the investigation of firms' network. This approach is particularly suitable for studying such object as it enables the estimation of the relative importance of the different components in a setting close to real-life (Hess and Daly, 2010; Louvière and Woodworth, 1983). To the best knowledge of the authors, it has not yet been used in investigating firms' networks, despite its advantages. Finally, we answer the call for more research on innovation networks in SMEs and low-tech sectors, such as food. Most innovation studies, including studies on networking for innovation, have paid attention to large, high-tech, and multinational enterprises. Few have focused on SMEs and traditional or low-tech industries (Gassmann *et al.*, 2010; van de Vrande *et al.*, 2009a; Hirsch-Kreinsen *et al.*, 2005; Barnett and Storey, 2000).

The remainder of this chapter is organized as follows: we start with the introduction of the resource-based view of the firm based on which we construct a series of hypotheses. Next, the chapter continues with the empirical approach where the

experiment design, sample composition, variables used and choice modelling approach are summarized. The results are then presented, followed by a discussion of the limitations, implications, and some reflections on future research.

4.2 Theoretical background

Innovation networks in this chapter belong to the category of networks that are purposively constructed or orchestrated by an organizational actor for the primary purpose of fostering innovation. They are characterized by boundaries defining participation and have a clear strategy and ground operations to support valuable learning and innovation for their members (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001).

In this chapter, and similarly to previous studies that have sought to understand the reasons behind the firm's choice for specific partners (e.g. Miotti and Sachwald, 2003; Hitt *et al.*, 2000), we draw on the resource-based view (RBV) of the firm developed in the context of strategic management to explain why SMEs join specific innovation networks. We propose that the SME's choice to join an innovation network with specific characteristics depends on the type of resources it seeks to access, which is in turn dependent on its own profile.

The RBV provides a useful theoretical lens to explain why firms join particular innovation networks. The RBV, developed in the seminal work of Penrose in 1959, holds that firms are characterized by a combination of resources (i.e. physical assets, knowledge and/or capabilities) that are significantly different across firms. Each firm's resources set is in some way unique, and could lead to competitive advantage especially if it contains resources that are not easily copied or acquired (Hunt and Davis, 2008). Following the RBV, firms thus have specific resource endowments but may require extra resources in order to stay abreast of competitors (Hitt *et al.*, 2000). We believe that these resource requirements are the driving force behind the firms' choice both to join innovation networks in general and certain specific innovation networks. Past research has shown that firms join innovation networks in order to learn and share experience, gain novel ideas and information, find potential partners for exchange and innovation, and access to shared resources and facilities (Paquin and Howard-Grenville, 2013; Bessant *et al.*, 2012; van der Borgh *et al.*, 2012; Perry, 2007). Still, to our knowledge, no studies have sought to explore the relation between the firm's decision to join a particular innovation network and its own profile.

In the next section, we examine the relation between network preference and the profile of both the networks and SMEs, and develop two sets of hypotheses.

4.3 Hypotheses development

In this chapter, innovation networks are described according to three network characteristics that were identified through a literature review and qualitative data (see section 4): 1) the type of actors engaged in the network (supply chain members or research institutions), 2) the level of information sharing (open or confidential information sharing) and 3) the type of support offered to the network members (support to either develop innovations, build networks or manage networks). These network characteristics constitute the core of the hypotheses developed in this chapter.

This section contains two parts. In the first part, we review the literature on innovation in the food sector and on innovation in SMEs, and develop hypotheses that relate preference to the specificities of both the food sector and SMEs. In the second part, we shift the perspective of viewing SMEs as an homogeneous category of firms, to develop the hypothesis that the preference of certain networks by SMEs is related to specific internal firm characteristics. Indeed, studies on innovation collaboration identify several firm characteristics that influence firms' networking behaviour for innovation. These include the firm's business strategy (Koka and Prescott, 2008; Gemünden and Heydebreck, 1995), intellectual property mechanisms, knowledge and financial resources (Drechsler and Natter, 2012), R&D and absorptive capacities (Bayona *et al.*, 2001; Schartinger *et al.*, 2001), and networking capabilities (Tether and Abdelouahid, 2008). In our analysis, we focus on two firm characteristics: the collaborative experience and innovation objectives of the firm in terms of product, process or market innovations. We expect them to significantly interact with certain network characteristics as explained below.

4.3.1 Network preference in relation to the specificities of the food sector and SMEs

4.3.1.1 Types of actors

According to the RBV perspective, firms are endowed with unique sets of resources that can become a source of competitive advantage when they are valuable, rare, inimitable and non-substitutable (Hunt and Davis, 2008; Barney, 1991). As such, the process by which firms create this type of resources is essential. Firms can develop them in-house, acquire them through e.g. mergers and acquisitions, or gain access to them through networking (Wittmann *et al.*, 2009). There are many types of external sources from which firms may derive valuable resources (Pittaway *et al.*, 2004; Gemünden *et al.*, 1996). Interacting with chain members (i.e. suppliers and customers) for example may provide firms with crucial information on technologies, process improvements, users' needs and markets (Miotti and Sachwald, 2003; Whitley, 2002), while linkages with science-based actors such as research institutions can provide firms with access to new scientific and technical knowledge (Lundvall, 1995). In this chapter, we distinguish between two types of members that firms can often be found in innovation networks: supply chain members and research institutions.

In the food sector, firms develop inter-organizational relationships for learning purposes especially with suppliers (Beckeman *et al.*, 2013; Trippl, 2011; Knudsen, 2007), but support is also found in literature regarding the importance of relationships with customers for learning and innovation (Menrad, 2004; Thomke and von Hippel, 2002). Relationships with science-based actors seem to be less frequently used than those with chain members (Knudsen, 2007; Menrad, 2004). This may be rather surprising in the light of the recent changes in the nature of both food demand and supply. Consumers now demand unique flavors and singular foods that are healthy and convenient to cook and eat. Such demand requires novel technological solutions which could stem from, among others, advances made in areas such as biotechnology, nanotechnology and preservation technology (Sarkar and Costa, 2008). This places the development of relationships with science-based actors on a different paradigm than before. On the other hand, innovation in the food industry is often incremental as consumers are typically conservative in their food choices and may reject radically novel products (Martinez and Briz, 2000). Thus, the use of scientific inputs, the usual source of radical innovations (Faems *et al.*, 2005) may not be that relevant in this industry. Literature also points to the challenging nature of academia-industry collaboration. Business and academia actors are known to have different cultures and often contradicting goals and needs. These differences can lead to misunderstandings which may jeopardize the quality and therefore outcomes of collaborative efforts (Saguy, 2011). Moreover, SMEs, which constitute the majority of the European food firms (CIAA, 2009), are characterized by a low absorptive capacity due to their limited internal resources and specialized knowledge base (Bianchi *et al.*, 2010; Spithoven *et al.*, 2010). They therefore face difficulties when they encounter new knowledge in unfamiliar areas, such as when developing relationships with science-based actors. Together with the incremental nature of food innovations, these challenges and the extra costs they bring, may explain why food firms do not develop relationships with science-based actors. It may be especially valid when the benefits that can be gained from developing relationships with science-based actors can be found via substitutes such as chain actors at lower costs. This may also explain why food SMEs would prefer networks composed of market-based actors to networks composed of science-based actors. In our study, we therefore expect food SMEs to prefer networks composed of supply chain members than of research institutes, and develop the following hypothesis:

Hypothesis 1a. Food SMEs prefer innovation networks which are composed of supply chain members rather than innovation networks composed of research institutes

4.3.1.2 Level of information sharing

As highlighted by the RBV perspective, strategic resources are central for achieving competitive advantage (Barney, 1991). As a result, firms are not likely to engage in inter-organizational networks and share strategic resources in these networks in any circumstance. While the firms' engagement in inter-organizational relationships may help them to leverage their own resource base, it also exposes them to greater risk of losing some of their core proprietary assets. In these relationships, the risk that other actors act opportunistically is high, especially when the resources present are valuable (Dyer and Singh, 1998). Besides, unintended knowledge leakages may also occur during cooperation (Ozman, 2009). When taking a decision to participate in a certain network, firms thus logically weight the benefits against the risks they may face when participating in such network. The success of a network hence lies in the creation of an environment that can play the dual function of increasing these benefits and reducing these risks.

The literature on alliances and networks identified several factors that may help to reduce risks or at least the uncertainty network actors may have about the motives and conduct of others in inter-organizational settings. These include e.g. third-party enforcements of agreements such as contracts, and self-enforcing agreements such as norms, trust and reputation (Kale *et al.*, 2000; Dyer and Singh, 1998). In our analysis, we distinguish between network environments where information is confidentially or openly shared between members.

In the context of this research, we expect food SMEs to favour networks where information is shared confidentially over networks where information is shared openly. Although networks where information is openly shared among network members are more likely to provide food SMEs with larger amount of new knowledge, and therefore may be perceived as more valuable, they also constitute a more risky option for food SMEs. The value of these networks is only hypothetical and can only be confirmed once the food SMEs participates in them. In addition, uncertainty exists regarding the other network members and how they will behave. When joining a new network, SMEs do not have the benefits of hindsight they would have had in a network where they have had prior experience. They cannot judge whether the other network members can be trusted. While trust would have helped to mitigate the moral hazards concerns originating from the unpredictability of the behaviour of partners (Gulati *et al.*, 2000), its (perceived) absence at the outset of a new network pushes SMEs to behave with more caution, and opt for the innovation network that helps them to better preserve their assets. Besides, unlike firms in other sectors, food firms often cannot rely on formal mechanisms (e.g. patents) to protect their core assets such as recipes (Ruitenburg *et al.*, 2014). They must thus rely on other mechanisms, and as trust is not an option here, confidentiality is the next option. Hence, the following hypothesis:

Hypothesis 1b. Food SMEs prefer innovation networks where information is shared confidentially among network partners rather than innovation networks where information is shared openly among network partners

4.3.1.3 Types of support

The potential benefits that firms can retrieve from innovation networks do not only depend on the type of actors present in these networks but also on the type of support they provide. Similar to the role played by incubators and other intermediary organizations (e.g. Soetanto and Jack, 2013; Vanderstraeten and Matthyssens, 2012), innovation networks can create value for their members by offering access to facilities and services, stimulating new ways of interaction and creating new partnerships (van der Borgh *et al.*, 2012).

The literature identifies several types of support that may be provided by networks (Johnson, 2008; Howells, 2006) with a common denominator among all which is their *raison d'être*. They are all designed as an answer to the problems and shortcomings encountered in the formation and functioning of innovation networks and systems (Spithoven *et al.*, 2010; Klerkx and Leeuwis, 2009). In this chapter, we make a distinction between three types of support provided by the network: 1) support to help the firm to either develop innovations (e.g. market information, pilot facilities), 2) to build its networks of partners for innovation, or 3) to manage its network of partners for innovation.

Each type of these support addresses some form of constraint that SMEs face in their innovation process, for example limited financial and marketing resources, and narrow search and relationship management capacity (Columbo *et al.*, 2012; Bianchi *et al.*, 2010; Narula, 2004). They are therefore likely to be perceived as equally valuable by SMEs. Still, we expect that two of them, i.e. support for helping or managing the firm's network of partners, will be preferred by food SMEs as they are more prone to provide them with valuable resources. Indeed, in innovation networks where innovation development oriented services are provided, the resources that can potentially be gained are not exclusive. They can be easily accessible to others, including competitors, and therefore are less likely, from a RBV perspective, to confer a competitive advantage to its owner (Hoopes *et al.*, 2003; Peteraf, 1993). On the other hand, in innovation networks where network development related services are provided, the resources that can potentially be gained are exclusive. In these networks, SMEs get the opportunity to extent their often limited existing network of partners (Lee *et al.*, 2010; Hausman, 2005). This is an inimitable resource and a source of sustainable competitive advantage if properly built (Gulati *et al.*, 2000). We thus hypothesize the following:

Hypothesis 1c. Food SMEs prefer innovation networks that provide them with support for building their network of partners for innovation rather than innovation networks that provide them with support for developing innovations

Hypothesis 1d. Food SMEs prefer innovation networks that provide them with support for managing their network of partners for innovation rather than innovation networks that provide them with support for developing innovations

4.3.2 Network preference in relation to collaborative experience and innovation objective

4.3.2.1 Collaborative experience

Past literature has shown that the firm's prior collaborative experience plays a key role in the success of collaborative initiatives. Research on strategic alliances for example has shown that past alliances experience matters, especially for the benefits that firms derive from their alliances (Kale *et al.*, 2002; Anand and Khanna, 2000). It is suggested that alliance experience enables firms to accelerate their learning about how to manage alliances successfully. Through the trials and tribulations of past experiences, firms are pushed to learn and are provided with different types of expertise and capabilities to form and manage alliances (Reuer *et al.*, 2002; Anand and Khanna, 2000). They therefore develop stronger alliance capability which helps them to extract higher benefits from their alliances (Kale *et al.*, 2002).

Following this, we expect a significant interaction between the firm's collaborative experience and at least one network characteristic, i.e. the type of network support. Firms that have previously collaborated with other actors have already gained experiences in collaboration. They have probably learned how to extract benefits from external relations and on how to deal with the challenges and risks that such relations involve. As such, firms with past collaborative experience may not see the value of networks that aim to help them build or manage their networks of partners because they are most likely already able to successfully build and use inter-organizational relationships on their own. We therefore expect such firms to exhibit a lower preference for these types of support and develop the following hypothesis:

Hypothesis 2a. Food SMEs with collaborative experience prefer innovation networks that provide them with support for developing innovations rather than innovation networks that provide them with support for building or managing their network of partners for innovation

4.3.2.2 Innovation objectives

The existence of a relation between the firm's innovation objective and its networking behaviour has been suggested in previous studies. It has been shown that the likelihood of a firm engaging in cooperative arrangements is influenced by the type of innovation (e.g. product, process, and market innovations) (e.g. Gooroochurn and Hanley, 2007), the incremental or radical nature of innovation (e.g. Tether, 2002) and the complexity of the innovation (e.g. Oerlemans *et al.*, 2001) the firm is aiming at.

In this study, we expect a significant interaction between the SME's innovation objective and the level of information sharing. We expect food SMEs with high level of product or process innovations to favour networks where information is shared confidentially over networks where information is shared openly. We expect the opposite from food SMEs with high level of market innovations. As mentioned previously, when taking a decision to participate in a certain network, firms are likely to weigh potential benefits against potential risks. For food SMEs with high level of product or process innovations, we believe that the danger is high that their firm-specific inputs (i.e. product or process innovations) will be exploited by other firms when disclosed. Indeed, product innovations, such as new recipes, cannot be protected by formal mechanisms (Ruitenburg *et al.*, 2014). This is also applicable for process innovations as they are mainly derived from new technologies developed by upstream industries (Capitanio *et al.*, 2010; Ettlie and Reza, 1992). Being often of an incremental nature (Martinez and Briz, 2000), both product and process innovations in the food sector are likely to be imitated as they are mainly built on explicit knowledge (Popadiuk and Choo, 2006), a type of knowledge that can be easily acquired (Nonaka *et al.*, 2000). In such perspective, firms with high level of product or process innovations choose the networks where information is confidentially shared in order to protect their specific inputs on which they build their competitive advantage. On the contrary, for food SMEs with high level of market innovations, appropriation concerns are lower as market innovations, by their very nature, are meant to be disclosed and are probably built on tacit knowledge, known to be less imitable (Nonaka *et al.*, 2000). These firms can therefore opt for the networks that can provide them with larger amount of new knowledge, that is the networks where information is openly shared among network members. We thus hypothesize the following:

Hypothesis 2b. Food SMEs with high level of product innovations prefer innovation networks where information is shared confidentially among network partners rather than innovation networks where information is shared openly among network partners

Hypothesis 2c. Food SMEs with high level of process innovations prefer innovation networks where information is shared confidentially among network partners rather than innovation networks where information is shared openly among network partners

Hypothesis 2d. Food SMEs with high level of market innovations prefer innovation networks where information is shared openly among network partners rather than innovation networks where information is shared confidentially among network partners

4.4 Empirical approach

4.4.1 Why a choice experiment

To study the effect of differences in innovation networks on the firms' decision to join these networks, we conducted a choice based conjoint experiment. Our methodological choice was motivated by the following: firstly, as illustrated in section 3, innovation networks can be described by a variety of complex components. Identifying the components that are valued by firms could increase the likelihood of the success of innovation networks when designed according to these components. Choice experiments offer the opportunity to identify these components. In a choice experiment, the respondents are shown multiple alternatives that are described by several attributes (i.e. the network components or characteristics), which can take on different levels. They must then choose the most preferred alternative, and do this in a repeated fashion. The levels of the attributes are varied according to the experimental design, enabling the estimation of the relative importance of the attributes describing the alternatives (Hess and Daly, 2010; Louvière and Woodworth, 1983).

Secondly, although traditionally used to assess the commercial appeal of consumer goods in marketing and business research (Green and Srinivasan, 1990), choice experiments have been proven useful and have provided valuable insights in other fields including entrepreneurial and innovation research (e.g. Fisher and Henkel, 2013; Kanmogne and Eskridge, 2013; Van Rijnsoever *et al.*, 2012).

Thirdly, while there are other methods than choice experiments that would allow identifying the most important components of innovation networks from a firm's perspective, choice experiments offer the opportunity to consider a wide set of potential factors affecting decisions, while remaining close to real-life situations (Louvière and Woodworth, 1983). For example, econometric methods based on actual behaviour may consider only a set of choices restricted to past activities of the firms. Besides, in choice experiments, the level of the independent variables is given by the experimental design, which helps reducing the risk of common method bias (Van Rijnsoever *et al.*, 2012).

Finally, the literature review in section 3 highlights the importance of considering the characteristics of firms when seeking to explain the attractiveness of innovation networks. More specifically, it suggests that it is the interaction between certain firm characteristics and certain network characteristics that determines the firm's decision to join a particular innovation network. Choice experiments permit the examination of such specific interactions explicitly by clearly distinguishing

network attributes and firms characteristics in the primary data collection process and in the analysis.

4.4.2 Design of the choice experiment

4.4.2.1 Identification of attributes and levels

In choice experiments, attributes should be selected based on their likelihood to affect respondents' choice (Alpíraz *et al.*, 2001). Besides, the levels assigned to each attribute selected should reflect the range of situations that respondents might expect to experience (Mangham *et al.*, 2009). As such, qualitative surveys (e.g. verbal protocol, group discussion, actual surveys) are often required in the development of choice experiments in order to select the relevant attributes and levels (Mangham *et al.*, 2009; Alpíraz *et al.*, 2001). In this study, we thus identified the attributes and attribute levels by using the results of a literature review combined with qualitative data obtained from a series of brainstorm sessions and Delphi-rounds in order to ensure that the experiment was tailored to the study setting.

As a first step, the relevant scientific literature was reviewed in order to first compile a list – as comprehensive as possible – of important network characteristics with regards to innovation, including potential levels, variants, and qualifiers related to these characteristics.

In the second step, a series of brainstorm sessions (see Table 4.1 for more details) was conducted. The objective of these sessions was to refine the first list of potential attributes derived from the literature review by developing an understanding of the target population's perspective (i.e. food SMEs) on the importance of network characteristics for learning and innovation. A revised list of 22 attributes and potential levels was obtained.

This revised list was then refined and subsequently narrowed down in the third step, through a 2-rounds Delphi exercise (see Table 4.1 for more details). During the Delphi process, the experts were asked to score each of the listed attributes regarding their importance for the firm to learn and innovate (from 0, unimportant to 7, very important). A definition was provided for each attribute as well as for 'learning' and 'innovation' in order to reduce bias related to item ambiguity (Podsakoff *et al.*, 2003). The analysis of the Delphi results yielded an ordered list of 22 attributes. This list allowed identifying information openness, network's goals, main supports provided and member types as the most relevant network characteristics for the firm to learn and innovate. However, this did not yield ready-to-use attributes for the choice experiment as the identified attributes remained rather generic and potentially suitable for an excessive number of levels. The contents of these attributes were hence further refined by the researchers by eliminating components that were more likely to overlap with each other, or that were conditional to or determined by other listed characteristics. The list and

content of the attributes were also adapted towards more practical and understandable statements of attributes and levels while keeping in mind the required limitation regarding the number of both attributes and levels due to the chosen methodology and type of respondents. Table 4.2 recapitulates the final attributes and attribute levels used in the study.

Table 4.1 Expert Consultation in the Two-Stage Approach for Defining and Refining Network Attributes

Method	Data collection	Participants	Outcome
Brainstorming technique	1 EU-level brainstorm session organized in June 2011	29 participants (representatives from food SMEs, innovation networks, consultancy firms and academia)	Comparison of the results from the sessions with the results of the literature review, selection and definition of the 22 most important network attributes and their potential levels
	6 national brainstorm sessions organized in Belgium, France, Sweden, Ireland, Italy and Hungary between July – September 2011	47 participants (19 food SME representatives, 14 researchers, and 14 policy makers)	
Delphi method	First Delphi-round: Survey by e-mail in December 2011	43 experts (17 food SME representatives, 9 researchers, 5 policy makers, and 12 'others', e.g. standards/certification body, consultancy firm, cooperative) from Belgium, France, Sweden, Ireland, Italy and Hungary	43 returned questionnaires Ordered list of 22 network attributes
	Second Delphi-round: Survey sent by e-mail in February 2012		21 returned questionnaires Confirmation of the results of the first Delphi-round

Table 4.2 Description of the Network Attributes and the According Levels used in the Choice Experiment

Attributes	Definition	Levels
Type of actors	Extent to which the members of the network are actors of the supply chain and research institutions	Manufacturers and supply chain members Manufacturers and research institutions
Level of information sharing	Degree to which information circulates internally within the network	Open information sharing Confidential information sharing
Type of support	Range of supports for innovation the network aims to provide to its members	Help firms to develop innovations (e.g. market info, pilot facilities) Help firms to build their network of partners for innovation Help firms to manage their network of partners for innovation

4.4.2.2 Survey development

A web-based survey was designed using Qualtrics Online Software. Before administrating it, we conducted sixteen pilot tests, split equally between academics and owner-manager or managers of SMEs responsible for R&D. On the basis of the results provided by this fieldwork, the initial survey design was adapted in order to further improve its content and the realism, understandability and practicability of the setup of the choice experiment. This adapted survey was then translated in the national language(s) of each participating country (see next section).

From the pilot-test with the business representatives, it was also found that three choice sets was the optimal number firms were willing to respond to, with each choice set containing two alternatives (i.e. network profiles).

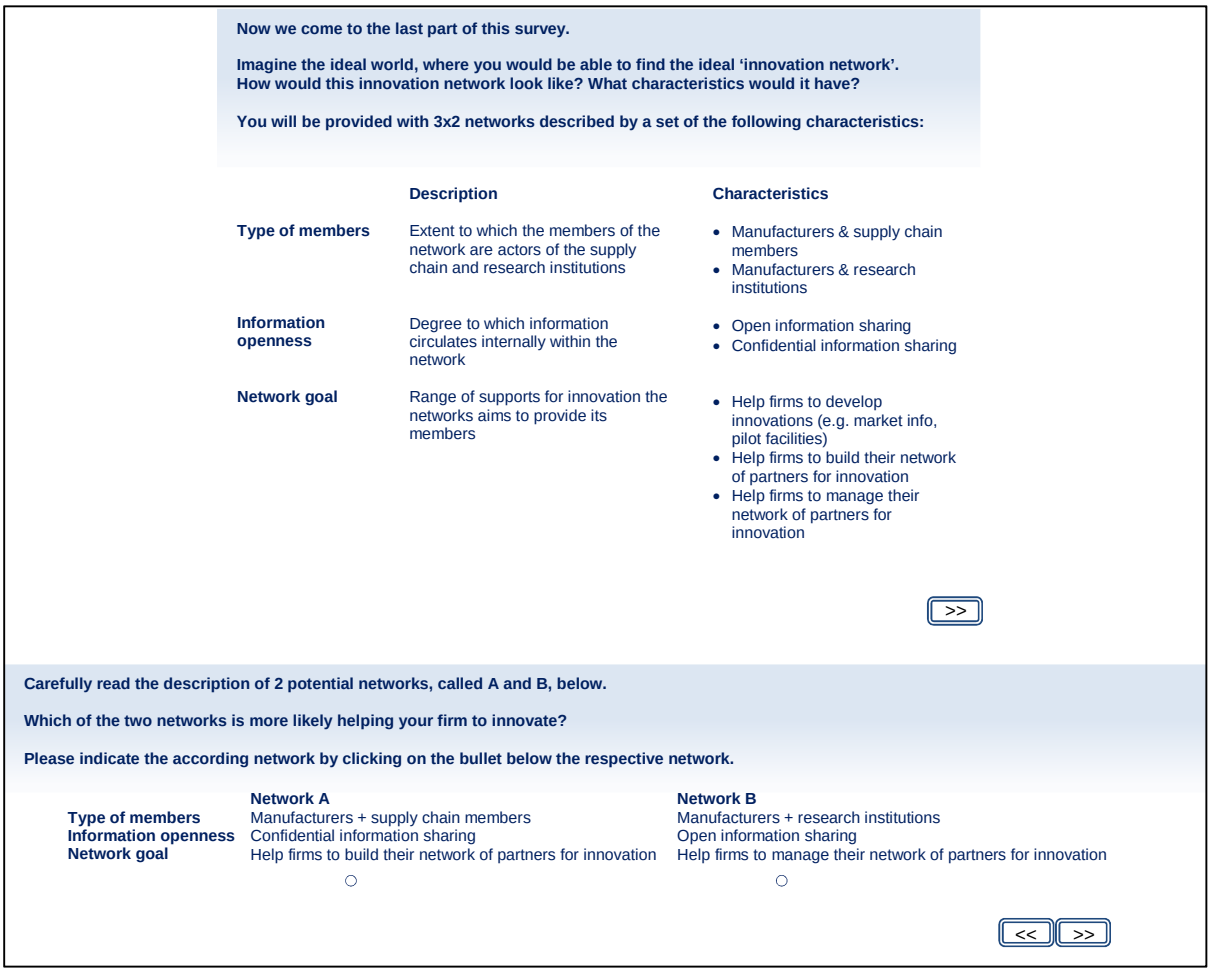
We therefore decided that in the final survey, each respondent would need to indicate his/her choice between two different network profiles in three different choice sets[3]. But, with two attributes at two levels each and one attribute at three levels, 12 possible combinations are possible (2x2x3). As we had opted for presenting only three choice sets to the survey participants, we generated our experimental design as a balanced block design using the statistical software JMP10 (SAS). This means that all twelve network profiles were distributed into three blocks with each block containing three choice sets, and each block was presented to an equal amount of respondents. Figure 4.1 illustrates a choice experiment as presented to the respondents.

4.4.3 Sample and data collection

The sample consisted of food and drink processing firms of six EU countries (Belgium, France, Sweden, Ireland, Italy and Hungary). The sample was composed exclusively of SMEs which are defined according to the European Commission (2009) as firms with less than 250 employees. The choice to focus on the food industry was motivated by the lack of empirical evidence on innovation and networking processes in this industry (Trippl, 2011; Avermaete *et al.*, 2004) despite their importance being highlighted in literature (Sarkar and Costa, 2008). In particular, the focus on SMEs was prompted by innovation literature that highlights the relevance of intermediated networks in fostering successful collaborative experiences in SMEs. Some studies support an intermediated network model for SMEs (Lee *et al.*, 2010) as serious concerns have been raised about the ability of

[3] During the design of the choice experiment, we considered to include also the option "none of the two" in each choice, i.e. the option to choose none of the proposed networks. However, we evaluated that keeping this option would have driven attention to willingness or not to join a network, which was not the main topic of this research. In addition, many firms in the sample were realistically not interested in networking, which could have led to an excessive concentration on the no-choice option. Keeping only the two proposed alternative for each choice helped focusing attention on network attributes and their levels.

SMEs to build and derive benefits from inter-organizational networks on their own due to their limited internal resources (Lee *et al.*, 2010; Hoffman *et al.*, 1998).



Source: *Own compilation*

Figure 4.1 Display of the choice experiment

Respondents were identified through national databases. The targeted respondents were the owner-manager of SMEs. In some countries, the contact details of the owner-managers were readily accessible from the databases. In those cases, contact was directly established with them. When only the general company details were available (for example a generic phone number or email), calls were made to each company to obtain the contacts details of the owner-managers. In some firms, contact details of another type of informants (e.g. R&D managers, marketing managers) were given instead of the owner-managers, as they were deemed more appropriate to answer the survey by the personnel of the SMEs.

Depending on the country, respondents were approached either directly by e-mail or through an initial phone call with a follow-up e-mail. In both cases, the e-mail contained the web-link to the survey and a personalized cover letter explaining the project's aim, the purpose of the survey, and that the respondent could expect a

summary of the results in case they provided their contact details (i.e. e-mail address). In both approaches, either one or two reminders were sent via e-mail for those who had not completed the survey in the given time.

The data were collected between October 2012 and April 2013 using an online questionnaire. In total, 1386 choice responses were used in this study. The number of usable surveys for data analysis added up to 231 (i.e. 231 respondents completed all 3 different choice sets) resulting in a 2.825% response rate of eligible surveys. On average, the firms surveyed have 39 employees and 41 years of existence. Most firms surveyed are situated in Belgium (26.1%) and France (27.0%). Based on the NACE codes, the most common sectors of activity of the firm surveyed are: 'processing and preserving of meat' (9.6%), 'production of meat and poultry meat products' (6.5%), 'other processing and preserving of fruit and vegetables' (6.5%), 'manufacture of cocoa, chocolate and sugar confectionery' (7.0%), and 'manufacture of bread, fresh pastry goods and cakes (6.5%).

4.4.4 Measures of firm characteristics

An overview of the measurement operationalization of the firm characteristics 'collaborative experience' and 'innovation objective' is provided as follows.

4.4.4.1 Collaborative experience

Collaborative experience was coded as a binary variable which indicated whether, in the last two years, the firm had used (1) or had not used (0) at least one of the following actors in order to source knowledge and information with the aim to innovate: (a) competitors, (b) other firms in other sectors, (c) universities and public research institutes, and (d) private research institutes (see Table 4.3). The choice to focus solely on horizontal and science base actors in order to assess collaborative experience was driven by the following motive: literature points to the particularly challenging nature of collaboration initiatives that involved these actors as compared to collaborative initiatives that involve market-based actors belonging to the chain (e.g. Saguy, 2011; Miotti and Sachwald, 2003; Meeus *et al.*, 2001). Such initiatives are thus more likely to conduct firms to develop their relational capability than the latter as they expose firms to a broader repertoire of experiences. They thus constitute a better source of differentiation among firms than the ones that involve market-based actors belonging to the chain.

4.4.4.2 Innovation objective

Respondents were asked to indicate, in the last two years, whether their firm had introduced 'none', 'one', 'two', 'three, four, five', or 'six or more' of the following three types of innovation (Johne, 1999): new products or services, new processes, and

new markets. They were also asked to indicate the size of their firm (in terms of number of employees in full time equivalent).

Three 'innovation objective' variables – one for each type of innovation – were then created as follows. First, the answers given to the question related to the number of innovations were recoded in the following way: 'none' was recoded as '0', 'one' as '1', 'two' as '2', 'three, four, or five' as '4', 'six or more' as '6'. The three scale variables i.e. 'product innovations', 'process innovations', 'market innovations' were then computed for each respondent by dividing these recoded answers by the number of employees (see Table 4.4).

Table 4.3 Description of all categorical variables in the logit model

Variable code	Description	Type of variable	Frequency
Actor	Network typology	Categorical	
	(0) manufacturers & supply chain members		693
	(1) manufacturers & research institutions		693
Information	Information shared in the network	Categorical	
	(0) open		693
	(1) confidential		693
Support	Type of support	Categorical	
	(0) develop innovation		462
	(1) build a network		463
	(2) manage a network		461
COLLEXP	Collaborative experience	Categorical	
	(0) no use of actors (i.e. competitors, firms in other sectors, universities and public research institutes, or private research institutes) for sourcing scientific knowledge, market and technical information with the aim to innovate		378
	(1) use of actors		1008

Note: *Frequencies based on n = 1386 (choice responses)*

Table 4.4 Description of all scale variables in the logit model

Variable code	Description	Type of variable	Mean	Number of observations
INNO_PROD	Number of innovation in new products/number of employees	Scale	0,26	1386
INNO_PROC	Number of innovation in new processes/number of employees	Scale	0,13	1386
INNO_MARK	Number of innovation in new markets/number of employees	Scale	0,16	1386

4.4.5 Choice modelling approach

The choice based conjoint experiment starts by postulating that an individual has a utility for a choice alternative (cf. Louvière *et al.*, 2000). As it is usually proposed, an individual tries to choose the alternative that maximizes its utility or well-being. Following the random utility theory (Louvière *et al.*, 2000), the utility value of the i^{th} alternative for the q^{th} individual (U_{iq}) can be partitioned into two components: a systematic component or 'representative utility', V_{iq}, and a random component, ε_{iq}, which reflects the unobserved individual idiosyncrasies of tastes.

$$U_{iq} = V_{iq} + \varepsilon_{iq}$$

The key assumption is that individual q will choose alternative i if and only if the utility associated with it is higher than for all other alternatives $j \neq i$ of the choice set A, i.e. is preferred when

$$U_{iq} > U_{jq} \qquad \text{all } j \neq i \in A$$

$$(V_{iq} + \varepsilon_{iq}) > (V_{jq} + \varepsilon_{jq}) <=> (V_{iq} - V_{jq}) > (\varepsilon_{jq} - \varepsilon_{iq})$$

When it is assumed that the distribution of the random components is independent across alternatives and that these are identically distributed (i.e. the ε_j *s* are assumed to have a Weibul form), a conditional logit model is applicable, and the probability to choose an alternative i can be written as follows:

$$P_{iq} = \frac{exp\,(V_{iq})}{\sum_{j=1}^{J} exp\,(V_{jq})}$$

As V_{jq} are assumed to be linear, V_{iq} can be written as follows, where for a given j, β_{jk} is the coefficient associated with the attribute k, and X_{jkq} is the effect variable of the attribute k:

$$V_{jq} = \sum_{k=1}^{K} \beta_{jk} X_{jkq}$$

To construct alternatives choices, we introduce each level of our three qualitative attributes as a variable in the representative utility function and create $L - 1$ dummy variables D where L is the total number of levels for attribute k. The dummy variables are set to 1 when the level is selected and 0 otherwise. In addition, in order to verify whether the firm variables 'collaborative experience' and 'innovation objective' influence the firms' preferences for innovation networks, we cross all dummy-coded attributes with each of these variables. The representative utility function from choosing alternative j can be then expressed as follow:

$$V_{jq} = \beta_0 + \beta_1 D_T + \beta_2 D_I + \beta_3 D_{G2} + \beta_4 D_{G3} + \beta_5 D_T \times d_h + \beta_6 D_T \times i_{prod} + \beta_7 D_T \times i_{proc} + \beta_8 D_T \times i_{mark} + \beta_9 D_I \times d_h + \beta_{10} D_I \times i_{prod} + \beta_{11} D_I \times i_{proc} + \beta_{12} D_I \times i_{mark} + \beta_{13} D_{G2} \times d_h + \beta_{14} D_{G3} \times d_h + \beta_{15} D_{G2} \times i_{prod} + \beta_{16} D_{G3} \times i_{prod} + \beta_{17} D_{G2} \times i_{proc} + \beta_{18} D_{G3} \times i_{proc} + \beta_{19} D_{G2} \times i_{mark} + \beta_{20} D_{G3} \times i_{mark}$$

where D_T is the dummy variable when the attribute 'actor' takes the level 1 (i.e. manufacturers and research institutions), D_I is the dummy variable when the attribute 'information' takes the level 1 (i.e. confidential information sharing), D_{G2} and D_{G3} are the dummy variables when the attribute 'support' takes the level 1 (i.e. help firms to build their network of partners for innovation) and 2 (i.e. help firms to manage their network of partners for innovation) respectively, d_h is the dummy variable 'collaborative experience', and i_{prod}, i_{proc}, and i_{mark} are the scale variables 'product-, process-, and market- innovations' respectively.

4.5 Results

The classification rates and the results of the logit model are reported in Table 4.5 and Table 4.6 respectively. Overall, the model predicts correctly 62% of the choices, with a higher percentage of correct no-choices (76.7%) and a lower percentage of correct choices (43%). These percentages are not fully satisfying. Besides, the Cox & Snell R^2 is rather low (0,085), even for a choice experiment exercise, which is a methodology that tends to have low levels of R^2 relative to most of the other statistical or econometric categories of application (Domencich and McFadden, 1975). The low rate of predicted correct choices as well as the low Cox & Snell R^2 may be attributed to the complexity of the decision-making process related to joining innovation networks in combination with a relatively small sample size and the likely preference heterogeneity of the SMEs included in the sample. As highlighted in the previous 'sample and data collection' section, the observed sample is constituted of SMEs that differ on several dimensions and that therefore probably also differ in terms of network preferences.

Table 4.5 Classification Table

			Predicted		
			Choice		
			0	**1**	**Percentage Correct**
Observed	Choice	0	599	182	76.7
		1	345	260	43.0
	Overall Percentage				62.0

In spite of this, the Wald-tests are significant for all three attributes, hence it can be stated that there is a general preference for specific levels of each network attribute. In addition, the Wald-test results are also significant for certain interaction terms, providing support to the hypotheses that certain firm characteristics affect the network choice through their interaction with specific attributes.

Table 4.6 Logit model outputs: Attributes and determinants in the choice selection

	Estimated Coefficients	**Standard Error**	***Wald test p_value***	**Exp(B)**
Actor (1)	-1,665	,243	0,000***	,189
Information (1)	,656	,232	0,005***	1,927
Support			0,001***	
Support (1)	,919	,261	0,000***	2,506
Support (2)	,124	,261	0,634	1,132
COLLEXP (1) by Actor (1)	1,702	,262	0,000***	5,486
INNO_PROD by Actor (1)	,252	,267	0,346	1,286
INNO_PROC by Actor (1)	-,017	,349	0,961	,983
INNO_MARK by Actor (1)	-,559	,532	0,293	,572
COLLEXP (1) by Information (1)	,168	,248	0,497	1,183
INNO_PROD by Information (1)	-,411	,295	0,163	,663
INNO_PROC by Information (1)	,679	,353	0,054*	1,973
INNO_MARK by Information (1)	-1,471	,565	0,009***	,230
COLLEXP * Support			0,000***	
COLLEXP (1) by Support (1)	-1,233	,273	0,000***	,291
COLLEXP (1) by Support (2)	-,651	,273	0,017**	,521
Support * INNO_PROD			0,282	
Support (1) by INNO_PROD	,258	,307	0,401	1,294
Support (2) by INNO_PROD	-,388	,341	0,256	,679
Support * INNO_PROC			0,618	
Support (1) by INNO_PROC	-,351	,377	0,352	,704
Support (2) by INNO_PROC	-,202	,362	0,578	,817
Support * INNO_MARK			0,133	
Support (1) by INNO_MARK	,971	,624	0,119	2,642
Support (2) by INNO_MARK	1,011	,597	0,090*	2,748
Constant	-,293	,121	0,016**	,746

Cox & Snell R square: 0,085

Note: *Single, double, and triple asterisks indicate significance at the 10, 5, and 1 percent level of significance.*

The Logit estimated coefficients reported in Table 4.6 are in log-odds units and cannot therefore be read as regular regression coefficients. In particular, for categorical variables (like the attributes in our model), the sign of each coefficient denotes an increase (if positive) or a decrease (if negative) of the probability of choosing a variable category with respect to another category usually called 0 (or baseline). In our model the base levels are: Actor (0) equals 'manufacturers and supply chain members', Information (0) 'open information sharing' and Support (0) 'help firm to develop innovation' (see Table 4.3).

By first interpreting the stand-alone attributes, it can be observed that SMEs (among the alternatives designed by the combination of the three attributes) state their preference for a network composed of i) manufacturers and supply chain members (as evidenced by the negative sign of the other alternative level, i.e.

manufacturers and research institutions), ii) where information is shared confidentially among network partners, and iii) that provides support in terms of helping firms to build their network of partners for innovation (compared to a network that provides support in terms of helping firms to develop innovations). These results provide thus support for hypotheses 1a, 1b and 1c. Hypothesis 1d – assuming a preference for networks that provide support for managing the firm's network rather than networks that provide support for developing innovations – is not supported as the probability of choosing the network is not significantly different when the network provides firms with support for managing their network of partners in comparison to when it provides firms with support for developing innovations.

Regarding the interaction variables (i.e. firm characteristic X attribute), the results highlight several cases where the variables 'collaborative experience' and 'innovation objectives' affect significantly the probability of network selection depending on the value of specific attributes.

In particular, SMEs endowed with collaborative experience (COLLEXP (1)) have a higher probability to prefer a network with manufacturers and research institutions (Actor (1)). Moreover, collaborative experience in SMEs increases the probability of choosing a network that provides support to help firms to develop innovations, and decreases the probability of choosing a network that provides support to help firms to build (Support (1)) or manage (Support (2)) their network of partners for innovation. This result supports hypothesis 2a.

Our findings also highlight that a high level of market innovation (INNO_MARK) affects negatively the probability of network selection when information is confidential (Information (1)), while the opposite happens for process innovations (INNO_PROC). Hypotheses 2c and 2d are thus supported while hypothesis 2b is not, as the expected effect for the interaction variable 'product innovation (INNO_PROD) by information' is not found.

Lastly, we find that market innovation also significantly affects the probability of network selection depending on the value of the 'network support' attribute. The higher the number of market innovations, the higher is the probability of choosing the network that provides support to help firms to manage their network of partners for innovation (Support (2)).

4.6 Discussion

This chapter originated from the observation that there is a need to understand more thoroughly the underlying motives of SMEs to join innovation networks. As it appears from literature, innovation networks can be described by a variety of complex components that are intimately related (e.g. Rodan and Galunic, 2004; Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998). Identifying the components that are valued by firms could increase the likelihood of success of innovation

networks when these are designed according to these components. We have sought to address this gap by using a choice experiment.

To the best knowledge of the authors this study is unique in using choice experiments to evaluate network preferences of food SMEs in terms of network attributes. Hence, it is difficult to compare our results with those from existing studies. However, the main outcomes of our study in terms of attributes, and their connection with the firm's collaborative experience and innovation objective, fit with the expectations that can be derived from the existing literature on innovation, and innovation in SMEs in particular.

4.6.1 Network preference

Based on the results related to the attributes only, we find as expected that food SMEs have a higher preference for innovation networks composed of manufacturers and chain members than of research institutes. These results are in line with those of previous studies on SMEs (e.g. Doloreux, 2004) and in low-tech sectors including the food sector (e.g. Menrad, 2004; Miotti and Sachwald, 2003). Food SMEs probably do not value greatly relationships with research institutes as these are more known to provide resources leading to radical innovations (Faems *et al.*, 2005), a type of innovation particularly rare in the food industry (Martinez and Briz, 2000). This type of relationship is also often accompanied with inherent managerial and knowledge exploitation challenges (Saguy, 2011; Meeus *et al.*, 2001) which possibly further reduce their attractiveness for SMEs.

We also find as expected that food SMEs prefer networks where information is shared confidentially among network partners compared to networks where information is shared openly. These findings are not surprising in the view of the risks that firms are potentially taking when participating in inter-organizational relationships (i.e. risk of opportunism and unintended knowledge leakage) (Ozman, 2009; Dyer and Singh, 1998). The firm's choice to opt for confidential knowledge sharing is driven by a need to reduce risk when it decides to join the network as a way to protect its assets. The importance of protecting the firm assets has also been emphasized in other studies where the strength of the firm's appropriability regime has been shown to explain the firm's degree of openness for innovation (Drechsler and Natter, 2012; Bahemia and Squire, 2010). In addition, these findings may also be explained by the 'long-living culture of secret' of food SMEs (Food-MAC Project, 2009) and in the 'risk-averse attitude' that often characterized SMEs' managers (Hausman, 2005).

Our results also show as expected, that food SMEs prefer networks that provide them with support for building their networks of partners over networks that provide them with support for developing innovations. In the perspective of the resource-based theory, these results suggest that SMEs choose the option that will offer them the access to the most valuable resources, i.e. resources that are not readily available to others. This preference may also be explained by the difficulties

that SMEs face when seeking to find partners for innovation (Bianchi *et al.*, 2010; Hausman, 2005). In addition, one could argue that food SMEs have a lower preference for networks that provide them with tangible support for developing innovations because they may actually not need such support when developing e.g. new products. Indeed, innovations in the food sector are habitually of an incremental nature (Martinez and Briz, 2000) and therefore can often be developed based on resources that can be found in the firm itself (Meeus *et al.*, 2001). In view of that, food SMEs may be less concerned with seeking tangible resources (e.g. pilot facilities) in external sources. Contrary to expectations, we do not find that food SMEs have a significant preference for networks that provide them with support for managing their network of partners over networks that provide them with support for developing innovations. This lack of significance suggests that SMEs do not need support for managing their network of partners. This could imply that the obstacles that SMEs generally encounter when managing networks of partners (Columbo *et al.*, 2012) are less than we anticipated.

Regarding the outcomes related to the interaction variables, our results confirm previous studies that generically say that there is a relation between the firm characteristics and the type of networking behaviour (e.g. Drechsler and Natter, 2012; Koka and Prescott, 2008; Gooroochurn and Hanley, 2007; Tether, 2002; Gemünden *et al.*, 1996; Gemünden and Heydebreck, 1995). We find that SMEs who have had collaborative experience have a higher probability to prefer a network with manufacturers and research institutions, and which aims at helping the firms' to develop innovations. The existence of a significant interaction between collaborative experience and network support is consistent with the claim that firms having previous collaborative experience with other actors are more able to develop and benefit from new relationships (Kale *et al.*, 2002; Anand and Khanna, 2000). Such firms probably do not need much external support to help them to develop and/or manage their network of partners, and therefore may value other types of support more such as those that would help them to develop innovations. The probable relation between learning and collaborative experience also helps explain the significant interaction found between collaborative experience and type of actor. Firms having experienced previous collaborations with other actors are not only better at managing inter-organizational relationships but are also probably able to better perceive, anticipate and assess the value of different types of actors. Relationships with research institutes are known to be source of novelty, more than are those with supply chain members (Amara and Landry, 2005; Faems *et al.*, 2005). It is then logical that relationships with research institutes are perceived as more valuable especially when the firm possesses the capacity to reduce the challenges that are usually associated with them.

We also find that the firm's innovation objective influences its preferences for innovation networks. As expected, a high level of market innovation affects negatively the probability of network selection when information is confidential, whereas the opposite happens for process innovations. This is consistent with the expectation that the focus of the firm on process or market innovations also leads to different needs in terms of networking and information. Openness is more useful

when attention is driven by market innovation (Johne, 1999), while process innovation is more often associated with confidentiality requirements (Ruitenburg *et al.*, 2014). Interestingly, no significant interaction effect was found between the product innovation and level of information sharing, suggesting that the appropriation concerns of firms with high level of product innovations are lower than expected. One possible explanation for this lack of support is that SMEs actually rely on other mechanisms than confidentiality to protect their product assets. It is suggested that speed of gaining market share is often regarded as the most effective way to protect product innovations (Ruitenburg *et al.*, 2014). Finally, our results also show that the higher the number of market innovations, the higher is the probability of choosing the network aiming at managing the firms' networks of partners for innovation. This interaction can again be consistent with the reasoning that market-oriented firms are more interested in successfully running networks while firms having other orientations (e.g. focused on process innovations) may be more attracted by networks with specific network focus.

4.6.2 Theoretical and practical implications

Our study contributes to the literature on partner selection and the study on innovation networks in general, by providing insight into the reasons why firms prefer certain innovation networks. Our results showed that network attributes are not evaluated by SMEs in isolation from other considerations, but rather that they play a role on a case-by-case basis, depending on the innovation and networking profile of the firm (and probably several other factors not included in the study). It is therefore very difficult to identify any constant or well-established preferences in terms of innovation network. Still, our results support a logic of strategic resource requirements for explaining SMEs' preference for certain innovation networks. Our results suggest that network choice is driven by resource needs. Food SMEs join innovation networks in order to complement their internal resources. They therefore choose the networks that are the most able to provide them with these complementary resources, but also that allow them to protect and retain their core assets. This is an interesting finding because the literature has so far emphasized the importance of these 'value-protecting' factors once the network is built (e.g. Bessant *et al.*, 2012). Our findings suggest that these factors are already important in the early assembly stage of the network as they explain the potential attraction of a new network.

The practical implications of this study relate to the design of innovation networks. Policy makers and other stakeholders that aim at fostering collective efforts through building innovation networks are recommended to pay particular attention to the needs of potential participants when designing such networks. In particular, they should not seek to follow '*one-size-fits-all recipes'* (Ebbekink and Lagendijk, 2013: 739), but rather should try to assure the fit between the network's strategy and design – in terms of e.g. type of members, appropriability regimes and supports provided – with the type of firms, and in particular the innovation objectives and actual networking behaviour. In line with the findings of van der Borgh et al. (2012)

to assure such a fit, policy makers and network managers are advised to engage in a close and continual dialogue not only with the potential but also the current network participants as their needs will most likely change over time.

4.6.3 Limitations and further research

Several limitations affected the outcomes of our study and may provide the base for future research. The study incorporated only a limited number of attributes and levels and these were kept to a rather wide level of generality. Although this was necessary to maintain a sufficient coverage of firm characteristics affecting network choice and to keep the experiment convenient for respondents, it may have also limited the expression of preferences by the respondents. Future research should seek to overcome this limitation by advancing our experimental approach.

We also have included only a few firm characteristics in our choice model. While we selected them based on their relevance for our object of study, future research could investigate the role that other firm characteristics may have on the firm's decision to join innovation networks. Potential candidates may be the networking capability of the firm, its absorptive or R&D capacity or the nature of its innovations (i.e. radical vs. incremental) (Tödtling *et al.*, 2009; Tether and Abdelouahid, 2008; Bayona *et al.*, 2001). The role of environmental factors on the firm's motives to join innovation networks can be further explored as previous studies have shown that these also impact the firm's networking behaviour (Schweitzer *et al.*, 2011; Koka and Prescott, 2008).

In addition, in line with earlier studies on the antecedents of firm's networking behaviour (e.g. Schartinger *et al.*, 2001), we relied on the perceptions of SMEs owner-managers. This limitation thus rests in the ability of individuals to express the company's point of view and, even more, in using a concept of utility (and a method related to utility theory) to express the firm's viewpoint on networking for innovation. This limitation is especially of importance when knowing that a number of personal, individual, factors such as risk adversity (Bougrain and Haudeville, 2002) can come into play when deciding about participation in networks.

Another potential weakness in this study is in the difficulty to elicit network preferences from firms that are not belonging to networks nor have the intention to engage in networking activity. While the choice experiment questions were designed in order to force the respondents to make a choice among networks (not including the "no-choice" option), so as to make sure to elicit their preferences, the fact that the issue was totally hypothetical may have introduced uncertainty in the answer or induced several respondents to skip the choice experiment part of the questionnaire.

In terms of study design, the use of web-based instruments for the survey may have determined some bias in the sample due to self-selection, though it remains difficult

to assess the representativeness/bias between the sample and the population, as structural information about the sample contacted was not really available.

A further weakness is to be found in the low response rate, which constrained the number of available observations. A higher number of respondents would have probably contributed to a better estimation of the model and more apparent results.

Finally, our focus on the food industry may also be considered a limitation with regards to the generalization of our findings. Still, as it is known that sectorial specificities exist regarding knowledge, learning and actors (Malerba, 2006), an industry-specific approach is recommended when studying innovation networks.

All these weaknesses have certainly contributed to the very low Cox & Snell R^2. It is however open to question whether this overall low ability of the model to explain the variance in the sample is to be explained mainly through the above "technical" issues or through more fundamental insights. The most likely explanation, based also on the complexity of the factors considered in the network literature, is that in fact an ideal type of innovation network does not exist and that firms would more realistically choose different network types for different purposes and needs.

4.7 Concluding remarks

In this chapter, we presented a choice experiment exercise in order to evaluate the importance of selected characteristics of innovation networks in affecting the decision of food SMEs about joining such networks. We also aimed at examining how specific firm characteristics interact with network characteristics in affecting firms' decision.

In spite of the rigorous selection process regarding the attributes and the survey design, the overall explanatory power of the model remains rather low, though it generates several significant results. The result showed that SMEs' choice of network is affected negatively by the fact that it is composed of manufacturers and research institutions, and positively by the fact that information is shared confidentially among network partners and that the network aims at building the firms' networks of partners for innovation.

In addition, the choice of the network is affected by the interaction of specific attributes with two firm variables i.e. the firm's collaborative experience and innovation objective. This is probably one of the most interesting outcomes of the study as it allows the tracing of effects pathways of preference expression and network choices revealed by specific combinations of network features and firms' characteristics.

This work is an explorative attempt at identifying firms' preferences for innovation networks. This is also the reason for several difficulties encountered. Further developments of the work may be suggested in the direction of a more explicit

exploration of the interplay between personal (staff/manager) preferences and firms' preferences in accessing networks, and how networks for specific aims can imply different preferences structures. The results also hint at the fact that the connection between past experience (past and ongoing networking activities) and future preferences deserves to be further investigated.

Chapter 5

Social capital and performance of learning networks

Based on: *Virginie Marie Lefebvre, Douglas Sorenson, Maeve Henchion, Xavier Gellynck (in review). Social capital and knowledge sharing performance of learning networks*

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Abstract: *This chapter investigates the relationship between the social capital accumulated among network members and the performance of learning networks in terms of their ability to enhance knowledge sharing among network members. A network level perspective guided the sampling strategy adopted for this survey involving 150 members of 16 European learning networks. Hierarchical multiple regression and structural equation modelling were employed to investigate the inter-relationships between dimensions of social capital and knowledge sharing in learning networks. The results reveal that social interaction and cognitive social capital are positively and significantly related to knowledge sharing in learning networks. Social interaction is also shown to play an important role in the development of shared vision and shared language (i.e. cognitive social capital) in learning networks. This paper sheds further light on the inter-relationships between different dimensions of social capital from a network (rather than firm) level perspective, and contributes to emerging theory on the antecedents to, and assessment of, performance in learning network entities.*

Keywords: *Learning networks, Social capital, Knowledge sharing, Network performance*

5.1 Introduction

According to the knowledge-based view, knowledge is considered the most important resource for the competitiveness of the firm as its creation and application offers the firm new opportunities (Grant, 1996; Spender, 1996). Organizational learning contributes to an increase in the firm's 'reservoirs' of knowledge and implies knowledge transfers among different levels of action within the firm but also often from entities outside the firm (Argote and Ingram, 2000; Huber, 1991; Crossan *et al.*, 1990).

Successful knowledge transfer within the firm is argued to be difficult (Argote and Ingram, 2000; Szulanski, 1996), but successfully sharing knowledge between organizations is seen as even more challenging due to a variety of factors (Easterby-Smith *et al.*, 2008; Inkpen and Tsang, 2005). In inter-organizational collaborative processes, significant efforts must be deployed by organizations in screening and testing several sources (Lazzarotti and Manzini, 2009). In addition, formal and social coordination mechanisms must be adopted in order to deal with ownership of assets and differences in mentality between parties, and to reduce risks of opportunism and unintended knowledge leakages (Giannopoulou *et al.*, 2011; Wallin and von Krogh, 2010; Easterby-Smith *et al.*, 2008).

In that context, new types of organization have emerged that aim to support such collaboration and knowledge sharing between organizations, which can encompass both innovation intermediaries (Howells, 2006) and brokers (Winch and Courtney, 2007). Of these, inter-organizational entities referred to in the literature as 'learning' (Sherer, 2003; Bessant and Tsekouras, 2001) or 'knowledge transfer' networks (Bond III *et al.*, 2008) are the focus of attention in this chapter. These 'learning' or 'knowledge transfer' networks are established to act as a channel of knowledge distribution. Although learning networks have already been proven useful for facilitating knowledge transfer (e.g. Bond III *et al.*, 2008), studies that investigate the factors that influence their outcomes and success are still scarce (Bessant *et al.*, 2012; Kenis and Provan, 2009). In particular, previous studies have predominantly focused on factors that influence firm level performance, which negates the importance of how collective entities perform (e.g. van Geenhuizen and Soetanto, 2013; Samarra and Biggierro, 2008). To address this gap, this study investigates the relationship between the social capital accumulated among network members and the performance of learning networks in terms of their ability to enhance knowledge sharing among network members. The choice to adopt a social capital perspective on the performance of learning networks was driven by the very essence of both networks and knowledge sharing processes. The core of both is about social relationships, and social capital represents the overarching concept that allows capturing the different properties of the social system of relationships (Wei *et al.*, 2011; Willem and Scarbrough, 2010; van den Hooff and Huysman, 2009; Inkpen and Tsang, 2005). The study also constitutes a welcome contribution to social capital research as it explores the interrelations between different facets of social capital, an area that has been so far largely ignored by empirical studies (Lee, 2009).

In the next section, the authors provide a brief overview of the literature on knowledge sharing, social capital and learning networks. The relationships examined in the chapter are then discussed and testable hypotheses are developed. The authors subsequently describe the study methodology and present the findings. In the final section, the authors discuss these findings, their implications and limitations, and provide future research directions.

5.2 Theoretical background

5.2.1 Knowledge sharing and social capital

Knowledge can be defined as information put into a human or social context (Nonaka *et al.*, 2000; Nonaka, 1994). Knowledge sharing refers to the process of exchanging knowledge between organizational actors (e.g. individuals, groups, or organizations) (Chow and Chan, 2008; Small and Sage, 2005/2006). It is closely related to knowledge transfer as knowledge sharing helps to gain experience from another actor (van den Hooff and Huysman, 2009; Argote and Ingram, 2000). Previous research has investigated a wide variety of antecedents of knowledge sharing. While a first stream of research has focused on organizational and knowledge characteristics as important antecedents of knowledge sharing, another stream of research has centred on the characteristics and dynamics of the inter-organizational context where knowledge sharing takes place (van den Hooff and Huysman, 2009; Chow and Chan, 2008; Easterby-Smith *et al.*, 2008; van Wijk *et al.*, 2008). Given that inter-organizational knowledge sharing is social in nature and involves the resources embedded in relationships, many scholars have investigated it through a social capital perspective (e.g. Wei *et al.*, 2011; van den Hooff and Huysman, 2009; Chow and Chan, 2008).

As the concept of social capital has been utilized in a wide range of social, organization and management studies and at varying levels of analysis, it has been defined in various ways (Adler and Kwon, 2002). Still, most management scholars generally agree that social capital represents the resources an individual or social entity gain through its network of relationships (Payne *et al.*, 2011). The central propositions of social capital theory are that networks of relationships are a valuable resource for the individual or social entity and that value lies both in the network ties and in the assets that can be mobilized through these ties (Inkpen and Tsang, 2005; Nahapiet and Ghoshal, 1998).

Because social capital has been defined in different ways, it has also been conceptualized and operationalized differently by scholars (Payne *et al.*, 2011). In this chapter, similarly to other studies (e.g. Martínez-Cañas *et al.*, 2012; Inkpen and Tsang, 2005; Tsai and Ghoshal, 1998), the authors operationalize social capital following the framework of Nahapiet and Ghoshal (1998). Nahapiet and Ghoshal's (1998) framework groups the various facets of social capital into three dimensions: the structural dimension, the cognitive dimension and the relational dimension. The structural dimension refers to the configuration and pattern of connection

between network actors. It has been analysed from different perspectives (e.g. tie strength and centrality, network stability and size) (Zheng, 2010; Inkpen and Tsang, 2005) but in this research, it focuses on social interaction between network actors who refer to the members of the formal networks in this study (Lee, 2009; Yli-Renko *et al.*, 2001). The cognitive dimension involves the resources providing shared meaning and understanding between network members. In their framework, Nahapiet and Ghoshal (1998) had originally related it to shared language and shared narratives, but other authors have later described it also through shared goals or vision, and shared culture (Inkpen and Tsang, 2005; Tsai and Ghoshal, 1998). In this study, the cognitive dimension entails shared language and shared vision. Finally, the relational dimension of social capital represents the kind of personal relationships people develops with each other through a history of interactions (Nahapiet and Ghoshal, 1998). Among the facets of this dimension, this study focuses on trust, one of the most researched and critical factor affecting knowledge sharing and transfer (Lee, 2009; Inkpen and Tsang, 2005). Because previous studies have suggested that the three dimensions of social capital and their different facets are interrelated (Bond III *et al.*, 2008; Nahapiet and Ghoshal, 1998; Tsai and Ghoshal, 1998), the investigation of the links between them is essential for understanding their role as antecedents of knowledge sharing.

5.2.2 Learning networks

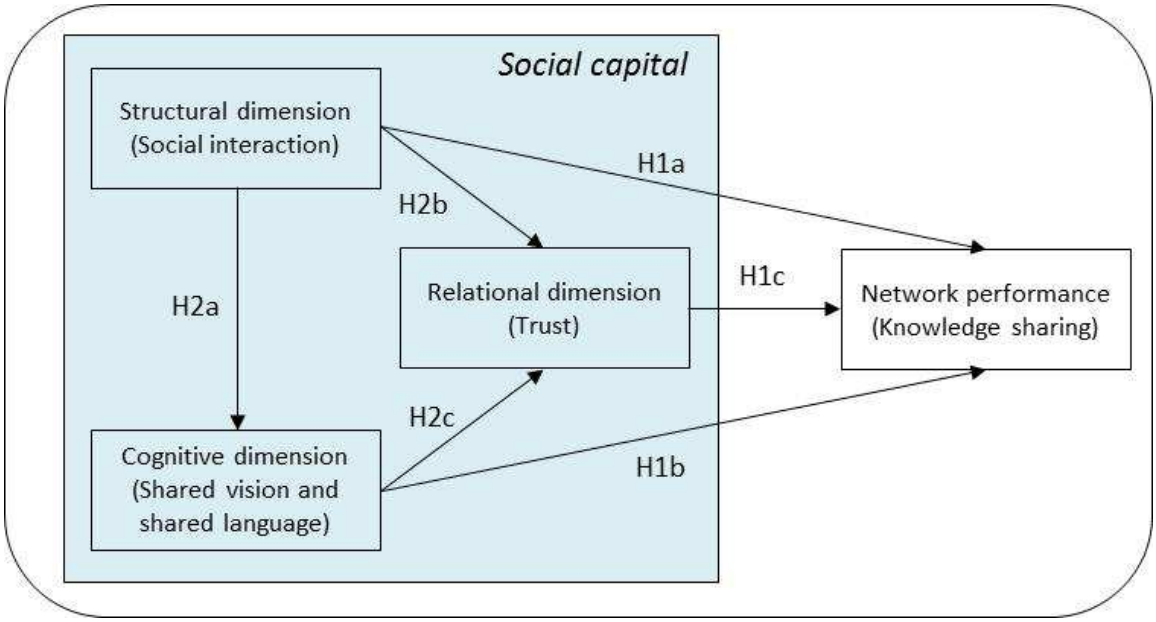
Learning networks are defined as '*networks formally set up for the primary purpose of increasing knowledge*' (Bessant and Tsekouras, 2001: 88). They are characterized by boundaries defining participation and have a clear strategy and ground operations to support knowledge sharing and to generate valuable learning for their members (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001). So defined, they encompass a variety of forms of organization such as formal business clubs (e.g. Schoonjans *et al.*, 2013; Parker, 2008), industry peer networks (e.g. Sgourev and Zuckerman, 2006), 'cure and care networks' (e.g. Kimble *et al.*, 2010), industry collective research centres (e.g. Spithoven *et al.*, 2010), and innovation networks where the collaborative aim is about developing e.g. new products or processes (e.g. Batterink *et al.*, 2010). In this study, the learning networks investigated all provide at least some kind of support for the innovation process (e.g. advice on IP and contractual agreements and support in applying for research grants), besides support for network formation.

Like strategic alliances, learning networks are in fact one form of structure that provides the necessary context for significant knowledge sharing to occur (Easterby-Smith *et al.*, 2008). Yet, although learning networks have already proven valuable in terms of facilitating knowledge transfer among their members (e.g. Bond III *et al.*, 2008) and supporting members' growth (e.g. Schoonjans *et al.*, 2013), they are not always successful (e.g. Huggins, 2000). Existing evidence suggests there is a series of social and non-social factors that come into play in their success of failure. Some studies have highlighted for example the positive impact that novelty, complementary resources, spatial proximity, trust, good network management

practices, and compatibility have on the success of collaborative activities (Bessant *et al.*, 2012; van der Borgh *et al.*, 2012; Huggins, 2000). Nonetheless, there are still important gaps in the understanding of how learning networks operate in order to facilitate effective knowledge sharing (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001). This study contributes to addressing this gap by focusing on the role that social factors identified through the social capital literature play in the success of learning networks in terms of their ability to enhance knowledge sharing among network members.

5.3 Hypotheses and conceptual model

As exemplified by several reviews of the literature on social capital (e.g. Payne *et al.*, 2011; Zheng, 2010; Lee, 2009), the concept of social capital has been utilized at various levels of analysis. Similarly to other studies (e.g. Martínez-Cañas *et al.*, 2012), this research focuses on the relationships among network members of the learning network as a source of social capital and operationalizes it as a three dimensional construct following Nahapiet and Ghoshal's (1998) framework. This study examines the relationship between network level outcomes (i.e. performance of the network in terms of its ability to enhance knowledge sharing among network members) and the accumulation of social capital at the relationship level. A cross-level model, which is characterized by the independent and dependent constructs being at different levels of analysis (Payne *et al.*, 2011), is thus developed. In addition, the study also explores the links between the three dimensions of social capital (See Figure 5.1).



Source: *Own compilation*

Figure 5.1 Conceptual model and hypotheses

5.3.1 Social capital and network performance

Social interaction (i.e. structural social capital) refers to the process of building and forming social ties, and thus, the propensity to make contacts (Lee, 2009). It is assumed that, as information and resources circulate through social ties, an actor may potentially gain access to the resources of others through social interaction (Tsai and Ghoshal, 1998). Social interaction has been shown to be positively related to knowledge acquisition (Yli-Renko *et al.*, 2001) and resource exchange and combination (Tsai and Ghoshal, 1998). Moreover, scholars suggest that intensive social interaction becomes even more crucial when difficult to transfer knowledge is involved (Lane and Lubatkin, 1998). Thus, as social interactions enhance exchange of knowledge, it is likely that their development among network members enhance the ability of the learning network to operate as a platform for knowledge sharing. Thus, the following hypothesis is developed:

Hypothesis 1a. The greater the social interaction between a network member and the other network members, the greater will be the performance of the network in terms of knowledge sharing

In this study, the cognitive social capital refers to shared language and shared vision. Shared vision represents the degree to which network members share goals, concerns and perceptions (Levin *et al.*, 2006; Tsai and Ghoshal, 1998). It has been suggested that individuals who share the same vision can better see the potential value of exchanging and combining their resources (Tsai and Ghoshal, 1998). It has been found to enhance the willingness of individuals to share knowledge in organizations (Chow and Chan, 2008). Conversely, several studies have postulated that a lack of shared vision and perspective between team members can lead to misunderstandings and conflicts that may bring an end to knowledge being shared between members (e.g. Du Chatenier *et al.*, 2009; Horwitz, 2005).

Shared language embodies the degree to which network members use the same codes and vocabulary to discuss and exchange information, ask questions and conduct business in society (Nahapiet and Ghoshal, 1998). It is thought to influence knowledge sharing positively by enhancing the ability of people to access each other's information (Nahapiet and Ghoshal, 1998). Edelman *et al.* (2004) emphasize that shared language helps project members to communicate effectively and function as a cohesive group. Furthermore, Tagliaventi *et al.* (2010: 340) provide evidence for the existence of shared language within inter-organizational communities of practice that enables knowledge flows within these communities but also the '*unambiguous interpretation of what is flowing*'.

In sum, as both shared vision and shared language can be viewed as mechanisms that enhance knowledge exchange, their presence among network members is most

probably associated with a higher ability of the network to enhance knowledge sharing. Thus, the following hypothesis is developed:

Hypothesis 1b. The more a network member shares cognition with the other network members, the greater will be the performance of the network in terms of knowledge sharing

Following Pirson and Malhotra (2011: 1088), trust (i.e. relational social capital) is defined as '*the psychological willingness of a party to be vulnerable to the actions of another party (individual or organization) based on positive expectations regarding the other party's motivation and/or behaviour*'. It is claimed that trust plays a key role in the willingness of network actors to engage in knowledge sharing processes as it erases any confusion that such actors might have about whether or not other network actors are allies or will act opportunistically (Inkpen and Tsang, 2005; Tsai and Ghoshal, 1998). Trust has been found to increase the success of cooperative agreements (e.g. Mora-Valentin *et al.*, 2004) and opportunities for knowledge exchange (e.g. Hardwick, 2013; Tepic *et al.*, 2011; Mu *et al.*, 2008; Kale *et al.*, 2000; Tsai and Ghoshal, 1998). Thus, as the existence of trust facilitates knowledge exchanges, its existence between network members should be positively associated with a network that is better able to promote knowledge sharing amongst its members. Thus, the following hypothesis is developed:

Hypothesis 1c. The more a network member trusts the other network members, the greater will be the performance of the network in terms of knowledge sharing

5.3.2 Relationships between social capital dimensions

Several scholars have argued that social interaction (i.e. structural social capital) encourages the development of shared cognition. Nooteboom (2004) for example emphasizes that close interactions between individuals allow them to share experience and increase their overlap of range, domain and thoughts. Newell *et al.* (2004) provide evidence that low interaction and collaboration undermine the nurturing of teamwork, feeling of solidarity and sense of shared purpose. Similarly, Mu *et al.* (2008) find that cooperation pushes firms to develop common objectives which help them to share common mental codes with the other firms involved. Thus, it is expected that social interactions will help a network member of a learning network to develop shared cognition with the other members with whom he/she interacts. Thus, the following hypothesis is developed:

Hypothesis 2a. The greater the social interaction between a network member and the other network members, the more he/she will share cognition with them

Besides, social interaction has also been found to reinforce the relational social capital, and trust in particular (e.g. Tsai and Ghoshal, 1998). It is argued that frequent interactions and communication help organization's employees and alliance partners to access more information about others and assess their abilities, intentions and behaviours within the relationship thereby creating trust (Abrams *et al.*, 2003; Gulati, 1995). This suggests that a network member will benefit from frequent social interactions with other members because they permit the development of trust. Thus, the following hypothesis is developed:

Hypothesis 2b. The greater the social interaction between a network member and the other network members, the more he/she will trust them

Finally, several empirical studies provide evidence that the cognitive social capital enhances the development of trust. It has been shown that shared values (Morgan and Hunt, 1994), shared vision (Tsai and Ghoshal, 1998) and shared language (Levin *et al.*, 2006; Levin *et al.*, 2002) predicts the development of trust between actors in relational exchanges and knowledge transfer contexts. In their qualitative study, Abrams *et al.* (2003) also emphasize that the establishment of shared vision and language is crucial for the development of interpersonal trust in knowledge-sharing contexts. As such, the cognitive social capital should promote the development of trust among network members in learning networks. Thus, the following hypothesis is developed:

Hypothesis 2c. The more a network member shares cognition with the other network members, the more he/she will trust them

5.4 Research methodology

5.4.1 Study sample and data collection

Formal networks and their respective members were identified for inclusion in this study through the use of non-probability sampling techniques, namely snowball and purposive sampling. Formal networks were identified through a combination of prior awareness on the part of consortium partners, recommendations by colleagues, and through interactions with network managers, policymakers and industry personnel. Thereafter, the formal networks had to meet the following four

criteria to be eligible to participate in this study: (1) have a defined membership, (2) be at least three years old, (3) contain two or more food manufacturers and (4) have learning and/or innovation as core objectives of the network. Data were collected by means of two questionnaires. A questionnaire administered to the relevant network managers collected data on the structural, management and governance characteristics of each network. It was administered by each consortium partner in Belgium, Denmark, Hungary and Ireland by means of a telephone or a face-to-face interview, depending on country circumstances. The potential for interviewer bias was not considered an issue in this instance given the objective nature of the data collected from each network manager. In total, data were collected from sixteen networks that agreed to participate in this study (see Table 5.1).

A second questionnaire was subsequently administered to the members of each network which gathered information on the perceived level of social capital prevailing in each network. The members of each network were also asked to evaluate the performance of their respective network with regard to the extent of knowledge sharing between network members. These measures of social capital and perceived knowledge sharing performance were inter-dispersed with other measures included in the questionnaire (but outside the scope of this chapter) to minimize the effects of retrieval cues (Podsakoff *et al.*, 2003). The consortium partners translated the questionnaires into their national language and then administered each member questionnaire in their respective home countries between January and July 2013 using an online questionnaire format (Qualtrics, 2013). Network members received an invitation email, which included a link to the online questionnaire. Follow-up emails were sent in line with normative practices for online surveys (Andrews *et al.*, 2003). One hundred and fifty five completed questionnaires were returned out of a population of 1,324 members across the 16 formal networks. This yielded a response rate of 11.7 per cent, which was in line with the expected range of response rates for an online survey of corresponding length and complexity (Vehovar and Manfreda, 2008). Listwise deletion of respondents with missing data reduced the number of valid responses to 150 for statistical analysis and hypotheses testing.

5.4.2 Measures

5.4.2.1 Dependent variable

Knowledge sharing performance. A perceptual measure of knowledge sharing performance was deemed appropriate given the absence of hard objective indicators in the literature for measuring network performance (Huggins, 2001). The appropriateness of perceptual measures of performance in industrial organization research has been reported elsewhere (e.g. Deshpandé *et al.*, 1993). Respondents rated how well their network had performed with regard to the extent of knowledge sharing between network members on a 7-point scale ranging from 'extremely poor' to 'excellent'.

Table 5.1 Profile of the networks

Variable	Range	Overall
Number of Networks Surveyed	-	16
Average Age of Networks (yrs)	3 - 65	15.94
Average Size of Networks	8 - 310	81.25
Heterogeneity of Network Membership (Expressed as the Average Number of Organisational Categories Present in Networks)	1 - 8	3.69
Average Number of Coordination Mechanisms Employed by Networks	0 - 4	2.0
Country of Survey Administration		
% Networks based in Belgium	-	18.8%
% Networks based in Denmark	-	18.8%
% Networks based in Hungary	-	37.4%
% Networks based in Ireland	-	25.0%
Geographic Scope of Network Membership		
% Regional Networks	-	18.7%
% National Networks	-	75.0%
% International Networks	-	6.3%

5.4.2.2 Independent variables

Structural social capital. An unweighted aggregate measure of frequency of interaction for innovation with different categories of organizations that constituted the membership of each network (SINTERACT) was constructed as a general proxy measure for social interaction. This measure provided an indication of the level of intra-networking activity engaged in by each member, and allowed for reasonable comparisons to be made across networks. Respondents rated how frequently they interacted for innovation with up to 12 categories of organizations, ranging from food producers and research institutes to industrial support service providers and stakeholder organizations, which constituted their respective network, on a 7-point scale ranging from 'never' to 'always' (adapted from Soo *et al.*, 2004).

Cognitive social capital. Two facets of the cognitive dimension of social capital i.e. shared vision and shared language were measured. For each facet, three items were generated, similar to those used in the study of Levin *et al.* (2002) (see Table 5.2). These items were assessed on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree).

Relational social capital. Trust was measured with one item assessed on a seven-point Likert scale (1 = strongly disagree, 7 = strongly agree (see Table 5.2).

5.4.2.3 Control variables

A series of control variables were included in the study in order to take into account the eventual impact of network characteristics and respondents' characteristics on network performance.

Coordination mechanisms. Formal coordination mechanisms such as third-party enforcements of agreements and integrative process of conflict management have

been shown to influence learning (Kale *et al.*, 2000; Dyer and Singh, 1998) and knowledge resources exchange (Garbade, 2014). They were thus included as a control variable. Four nominally scaled variables collected through the network manager questionnaire, which were adapted from Provan and Kenis (2008), were summed to create a new continuous variable (NUMCM), which denoted the number of coordination mechanisms adopted by each network.

Geographic scope of membership. The geographic scope of alliance partners has been found to impact alliance outcomes and performance (Duysters and Lokshin, 2011; Parkhe, 1993). As such, the geographic scope of membership of learning networks may also influence their performance. They were thus included as a control variable. Two dummy variables denoted the geographic scope of network membership in terms of either national (NAT) or international (INT) membership. The regional scope of network membership represented the baseline variable.

Heterogeneity of network membership. As the heterogeneity of sectors in networks has been suggested to affect cooperation (Huggins, 2001) and create challenges for the continuance and stability of networks (Tepic *et al.*, 2011), the heterogeneity of network membership was included as a control. Twelve continuous variables collected through the network manager questionnaire concerning the proportion of the membership constituted by the different categories of organizations within each network were recoded as binary variables. These binary measures were then summed to create a new continuous variable (NETDIV), which denoted the number of categories of organizations that constituted the membership of each network, and served as a proxy measure for heterogeneity of network membership.

Structural control variables. In addition, five structural control variables commonly utilised in industrial organisation research were included in the questionnaire. The categorical variable concerning the '*country*' in which the member survey was administrated was transformed into three dummy variables, which denoted the country of survey administration: Belgium (BEL), Denmark (DEN) and Hungary (HUN). Ireland was selected as the baseline variable. The continuous variables NETSIZE and NETAGE denoted the *size* and *age of each network*. The two remaining structural control variables SECTOR and NETMEM were specific to the respondent (rather than to the network). The categorical variable INDCLAS represented the industry classification most closely associated with each *respondent*. This variable was then transformed into three dummy variables that grouped respondents as either supply chain actors (SCA), personnel from university & public research institutes (UPI), or other (non-food) industries (NON). Food producers were selected as the baseline variable. Finally, the continuous variable NETMEM denoted the *length of each respondent's network membership*.

Table 5.2 List of measures/items for social capital dimensions and results of confirmatory factor analysis

Variable	Measurement items		Standardized loading	Z-statistic	CR	AVE
Cognitive social capital	*Shared vision*		0.886	8.266	0.94	0.88
	Shared language		0.897	a		
	Shared vision	We [the other members and I] share a common vision regarding the key success factors of the network	0.928	9.17	0.81	0.69
		I think that we [the other members and I] care about the same issues	0.717	a		
		I feel that we [the other members and I] have completely different goals towards the network*				
	Shared language	It feels like we [the other members and I] can understand each other	0.926	16.995	0.94	0.84
		It feels like we [the other members and I] use similar language	0.947	17.751		
		It feels like we [the other members and I] can communicate on the same 'wavelength'	0.876	a		
Relational capital *(manifested as trust)*	I trust the other members of the network		1	*NA*	1	1
Structural social capital *(manifested as social interaction)*	Unweighted aggregate measure of frequency of interaction for innovation with different categories of organisations that constituted the membership of each network		1	*NA*	1	1

Notes: *CR = Composite reliability; AVE = Average variance extracted; a = Parameter set to fix the scale; * = This item was removed from the analysis because of low factor loading; NA = Not applicable*

5.4.3 Statistical method

In order to test the proposed model and hypotheses, the analyses have been conducted in multiple stages. As two of the three dimensions of social capital were latent constructs (i.e. the cognitive and relational dimensions), the first step consisted of testing whether they exhibited sufficient reliability and validity by estimating the measurement model (Anderson and Gerbing, 1988). In the second step, hierarchical linear modelling (HLM) was used to analyse the data and test the main hypotheses (H1a, b, c) and potential effects of the controls. In the third and final step, the links between the different social capital dimensions (H2a, b, c) were also investigated. Structural equation modelling was then used as it allows testing all the hypotheses at the same time by specifying the separate, but interdependent relationships among the different constructs simultaneously (Hair et al., 2010).

5.5 Analysis and results

All statistical analyses were carried out using the PASW statistical computer package, Version 18 (SPSS Inc., 2009) and AMOS 21.0 (AMOS, 2012).

A preliminary hierarchical multiple regression analysis was first carried out to test the explanatory power of the structural control variables selected for this study. This preliminary analysis suggested that none of the five original structural control variables significantly explained variance in perceived knowledge sharing performance. However, two of these variables COUNTRY and NETSIZE were still retained to account for country and size effects so that interpretation of the findings remained valid across networks of different sizes, and across partner countries. Inter-correlations between the independent and remaining control variables were examined (see Table 5.3). Significant bivariate correlations were observed between the dummy variables (NAT and INT) that constituted the geographic scope of network membership, as well as the cognitive social capital (COGNIT) and trust. The regression models were then re-estimated, and diagnostic tests for normality, linearity, multicollinearity and homoscedasticity confirmed that regression assumptions were not violated (Hair *et al.*, 2010).

Table 5.3 Correlation matrix across independent variables

Variable		1	2	3	4	5	6	7
1	NETDIV	1						
2	NAT	-.007	1					
3	INT	-.304**	-.520**	1				
4	NUMCM	-.177*	-.466**	.486**	1			
5	TRUST	.071	-.038	.018	.208*	1		
6	SINTERACT	-.020	-.018	-.016	.209*	.336**	1	
7	COGNIT	-.006	.081	-.095	.120	.651**	.431**	1

Notes: ** Significant at the p≤0.05 level ** Significant at the p≤0.01 level*

5.5.1 Measurement model

The measurement model comprising the three dimensions of social capital was analysed using a confirmatory analysis (CFA) with the maximum-likelihood estimator. One of the three items used to measure shared vision was dropped because it exhibited low loading (see Table 5.2). During estimation to one-item measures (i.e. trust) and aggregated measures (i.e. social interaction), 0% error variance was introduced. As a result, one-item and aggregated measures used in the analyses were totally free of measurement error (Hair et al., 2010).

The following indicators were used to report the fit of CFA: the chi squared (x2) and its associated probability value (p), the adjusted chi-square (x2/df), the goodness of fit index (GFI), the comparative-fit-index (CFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). Recommended norms for good fit are a small x2 with a high p value, x2/df < 3, GFI and CFI > 0.90, SRMR < 0.05 for good fit, and RMSEA < 0.08 for reasonable fit (Byrne, 2008; Hu and Bentler, 1999).

As explained previously, cognitive social capital is conceptualized as a two dimensional construct that includes shared vision and shared language. This calls for a second-order, two-factor model where the two dimensions represent two, first-order factors, and the cognitive social capital represents the overarching, second-order factor. The fit indices for this model showed a good fit (x2 = 15.766 with p = 0.150, x2/df = 1.433, GFI = 0.972, CFI = 0.993, SRMR = 0.0239, RMSEA = 0.054). Besides, the standardized factor loadings (see Table 5.2) were all highly significant (p<0.001), with values well above the recommended minimum of 0.40 for the social science (Ford *et al.*, 1986). The composite reliabilities of all multi-item constructs were also greater than the recommended minimum value of 0.70 (Nunally, 1978 in Acur *et al.*, 2010; Hair *et al.*, 2010). In addition, the average variance extracted (AVE) were all above the threshold of 0.50 (Fornell and Larcker, 1981). It was thus concluded that the measures demonstrated adequate convergent validity and reliability.

We also evaluated the discriminant validity between the first-order constructs i.e. shared vision and shared language. Discriminant validity is established if the AVE for each construct is higher than the squared correlation between the constructs (Fornell and Larcker, 1981). It was found that shared vision and shared language did not fully demonstrate discriminant validity as indicated by their squared correlation of 0.73 being slightly above the AVE value for shared vision (0.69). This suggests that these two constructs are not truly distinct from each other (Hair *et al.*, 2010). In order to rule out this possibility, a first-order, one-factor model where all scale items are clubbed directly under one construct was conducted. This second model indicated a poor fit (x2 = 49.465 with p = 0.000, x2/df = 3.805, GFI = 0.911, CFI = 0.946, SRMR = 0.0499, RMSEA = 0.137). It was thus concluded that our first model was the most appropriate one, and was therefore retained for further analyses.

5.5.2 Hierarchical multiple regression analysis

Tables 5.4 and 5.5 present the results for perceived knowledge sharing performance regressed on the structural control variables (Model 1), control variables related to the heterogeneity (Model 2) and geographic scope of the network membership (Model 3), the number of coordination mechanisms employed by each network (Model 4), and on the independent variables related to social capital (Model 5). Model 1, which comprised the structural control variables was not statistically significant ($F = 1.722$, $p = 0.148$). The addition of the continuous variable NETDIV, which conceptualized the heterogeneity of network membership, did not significantly improve the explanatory power of Model 2 also ($F = 1.960$, $p = 0.088$). While Model 3 suggested that internationalization of the network membership was expected to have a negative relationship with perceived knowledge sharing performance; the geographic scope of the network membership was neither significant ($F = 1.607$, $p = 0.138$) nor explained the variance in perceived knowledge sharing performance (see Table 5.4).

Model 4 was found to be statistically significant ($F = 4.645$, $p \leq 0.000$) and the total number of coordination mechanisms adopted by a network ($\beta = 0.504$, $p \leq 0.000$) explained 13.5% of the variation in perceived knowledge sharing performance (see Table 5.5). The addition of three variables conceptualizing social capital in the final block of the hierarchal multiple regression was also statistically significant ($F = 8.644$, $p \leq 0.000$). Social capital was found to explain a further 19.9% of the variance in perceived knowledge sharing performance. More so, the results suggested that the cognitive dimension (COGNIT) alone – which was measured with the factor score in the regression analysis – accounted for the variance found in Model 5 ($\beta = 0.499$, $p \leq 0.000$), and was more important than either the trust or social interaction (SINTERACT) in explaining perceived knowledge sharing performance.

Table 5.4 Hierarchical regression analysis for knowledge sharing performance (Models 1-3)

	Model 1 Unstandardized Coefficients				**Model 2 Unstandardized Coefficients**				**Model 3 Unstandardized Coefficients**			
	β	Std. Error	**t**	**Sig.**	β	Std. Error	**t**	**Sig.**	β	Std. Error	**t**	**Sig.**
(Constant)	5.281	.173	30.496	.000	5.100	.203	25.116	.000	4.810	.414	11.619	.000
BEL	-.060	.244	-.245	.807	-.178	.252	-.707	.481	.103	.358	.288	.774
DEN	-.044	.316	-.140	.889	-.196	.327	-.599	.550	-.178	.331	-.539	.591
HUN	-.511	.210	-2.431	.016	-.565	.211	-2.672	.008	-.507	.217	-2.339	.021
NETSIZE	-.002	.001	-1.121	.264	-.002	.001	-1.673	.097	-.002	.002	-1.449	.150
NETDIV					.087	.052	1.681	.095	.077	.069	1.113	.268
NAT									.312	.320	.973	.332
INT									-.166	.606	-.273	.785
R Square	0.045				0.064				0.073			
R Square Change	0.045				0.018				0.010			
F	1.722				1.960				1.607			
N	150				150				150			

Table 5.5 Hierarchical regression analysis for knowledge sharing performance (Models 4-5)

	Model 4				**Model 5**			
	Unstandardized Coefficients				**Unstandardized Coefficients**			
	β	Std. Error	**t**	**Sig.**	β	Std. Error	**t**	**Sig.**
(Constant)	4.186	.404	10.350	.000	1.638	.526	3.116	.002
BEL	-.267	.341	-.784	.434	-.341	.300	-1.138	.257
DEN	-.825	.334	-2.471	.015	-.762	.296	-2.577	.011
HUN	-.925	.218	-4.235	.000	-.817	.195	-4.187	.000
NETSIZE	.002	.002	.971	.333	.001	.002	.422	.674
NETDIV	.017	.065	.257	.797	.056	.059	.950	.344
NAT	.360	.297	1.209	.229	.254	.261	.974	.332
INT	-1.559	.630	-2.474	.015	-.801	.569	-1.408	.161
NUMCM	.504	.103	4.908	.000	.331	.095	3.500	.001
TRUST					.013	.082	.159	.874
SINTERACT					.118	.060	1.954	.053
COGNIT					.499	.126	3.947	.000
R Square	0.209				0.408			
R Square Change	0.135				0.199			
F	4.645				8.644			
N	150				150			

5.5.3 Structural model

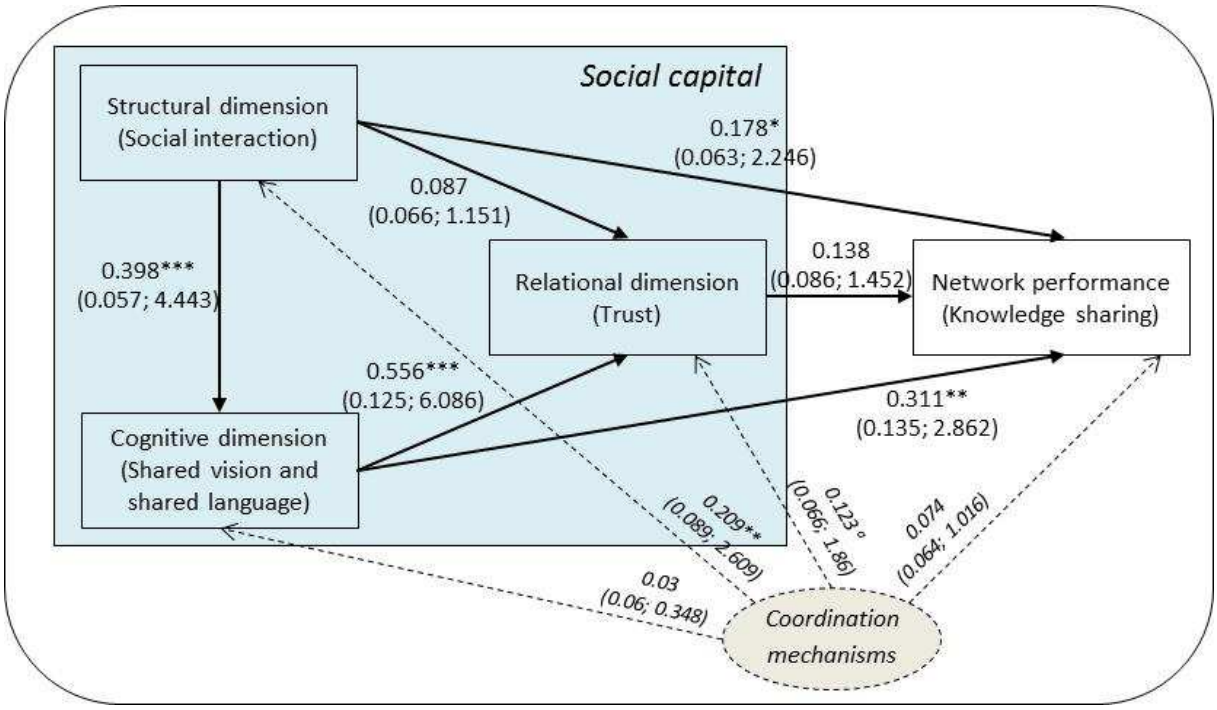
The whole conceptual model was estimated by using structural equation modelling with the maximum-likelihood estimator. Similarly to estimation to trust and social interaction, the error variance was fixed at zero during estimation to knowledge sharing performance and relationship mechanisms. The fit indices indicated that the model represented the data well, with x2 = 32.653 with p = 0.050, x2/df = 1.555, GFI = 0.956, CFI = 0.984, SRMR = 0.0392, RMSEA = 0.061. Our analysis shows that both social interaction and the cognitive dimension of social capital are positively and significantly related to knowledge sharing performance, providing support for H1a and H1b respectively (see Table 5.6). No significant relationship between trust and knowledge sharing performance is found, thus H1c is not supported. Furthermore, the data show that social interaction positively affects the cognitive dimension, supporting H2a. They do not show however a significant relationship between social interaction and trust, in disagreement of H2b. As predicted in H3c, the cognitive dimension positively affects trust. Finally, regarding the control variable i.e. coordination mechanisms, no significant influence is found on knowledge sharing performance.

Table 5.6 Structural equation modelling results: Proposed model

		Standardized coefficient	**Standard error**	**Critical ratio**	**Hypothesis supported**
H1a	Social interaction --> Knowledge sharing performance	0.179*	0.063	2.241	Yes
H1b	Cognitive dimension --> Knowledge sharing performance	0.312**	0.134	2.865	Yes
H1c	Trust --> Knowledge sharing performance	0.139	0.085	1.484	No
H2a	Social interaction --> Cognitive dimension	0.400***	0.056	4.614	Yes
H2b	Social interaction --> Trust	0.112	0.066	1.481	No
H2c	Cognitive dimension --> Trust	0.56***	0.126	6.053	Yes
Control	Coordination mechanisms --> Knowledge sharing performance	0.07	0.063	0.979	No

Notes: *[a] p < 0.1, * < 0.05, ** p < 0.01, *** p < 0.001*

In addition to the proposed conceptual model, the authors tested an alternative model where direct paths were added between the coordination mechanisms and each of the social capital dimensions (see Figure 5.2). This alternative model was justified by the complementary nature of both formal and social coordination mechanisms that has been put forward in the alliance literature (Poppo and Zenger, 2002; Kale *et al.*, 2000). The fit indices indicated that this model represents better the data than the proposed model (with x2 = 28.903 with p = 0.068, x2/df = 1.521, GFI = 0.960, CFI = 0.987, SRMR = 0.0331, RMSEA = 0.059). In the alternative model, no change appears in the significant effects identified in the first model. But significant relationships are found between the coordination mechanisms and both social interaction and trust (Figure 5.2).



Notes: *Standardized solutions for hypothesized relationships ([a] p < 0.1, * < 0.05, ** p < 0.01, *** p < 0.001); standard errors and critical ratios are in parentheses.*

Figure 5.2 Structural equation modelling results: Alternative model

5.6 Discussion

5.6.1 Social capital and network performance

In this study, the authors answer to the call for more research on the operationalization of learning networks as successful platforms for knowledge sharing (Bessant *et al.*, 2012; Bessant and Tsekouras, 2001). Starting from the premise that the core of both networks and knowledge sharing concerns social relationships (Wei *et al.*, 2011; Inkpen and Tsang, 2005), the authors use a social capital perspective in order to understand the internal factors driving knowledge sharing performance of learning networks (Nahapiet and Ghoshal, 1998). Their findings reveal that more than any structural characteristics of networks, social capital plays a key role in explaining knowledge sharing performance. This chapter also constitutes a welcome contribution to the social capital literature as it sheds further light on the inter-relationships between different dimensions of social capital; an important research area that has so far been neglected by empirical studies (Lee, 2009). The findings suggest that social interaction (i.e. structural social capital) has an important role to play in the development of shared vision and shared language (i.e. cognitive social capital).

In addition, this research also contributes to extending the body of knowledge concerning trust and its relationship with group performance. This study did not confirm a significant relationship between social interaction and trust. However, in line with the findings of previous studies, the results demonstrate that the cognitive

social capital has a positive impact on trust (Levin *et al.*, 2006; Levin *et al.*, 2002; Tsai and Ghoshal, 1998). Quite unexpectedly however, the authors' prediction that the relational dimension of social capital, manifested as trust, would enhance significantly performance is not supported. A limitation to this study could therefore relate to a deficiency in the measure of trust selected. However, an equally valid explanation could relate to the nature of cooperation occurring in learning networks. Following Sherer (2003: 330), firms in learning networks '*seek cooperatively to learn about some of the complex changes essential to competitiveness*'. Elements of 'commercial risks' are thus not necessarily present in learning networks, on the contrary to R&D alliances for example (Oxley and Sampson, 2004). There is therefore little need to guard against opportunistic behaviour by using trust as a 'relational governance' mechanism (Poppo and Zenger, 2002).

Finally, this study also contributes to the emerging literature on the antecedents of social capital (Zheng, 2010; Mu *et al.*, 2008), by revealing the inter-relationships between social capital and the coordination mechanisms put in place in learning networks. This empirical research suggests that the presence of coordination mechanisms helps to develop both social interaction and trust. These positive associations are consistent with the assumption that in environments where risks of opportunism and appropriation concerns are high, firms view the actions of network partners with scepticism and hesitate to engage in cooperative behaviours (Dhanaraj and Parkhe, 2006; Dyer and Singh, 1998). The presence of coordination mechanisms such as contracts, regulations and dispute resolution procedure probably helps to reduce the risks and concerns that members may perceive within learning networks, and hence, increase their level of interaction and trustworthiness.

5.6.2 Limitations

The authors acknowledge a number of limitations and/or delimitations of scope to this study. First, the authors only included certain facets of each social capital dimension in this study. However, the authors encourage future research to take a much broader perspective and to include more facets of social capital. In particular, future research endeavours should include measures for identity; a facet of social capital postulated to be relevant for knowledge transfer in learning networks (Bond III *et al.*, 2008), although investigations to date has been largely restricted to conceptual papers (Lee, 2009).

Second, the use of cross-sectional data does not actually allow testing the direction of the proposed cause-effect relationships. It is therefore possible that the causality may flow in an opposite direction to the one suggested in the process of building the hypotheses, or may be reciprocal (Yli-Renko *et al.*, 2001). Reciprocal causality between the different dimensions of social capital is probably likely, and one could even assume the presence of a reinforcing feedback between them. The use of

longitudinal data from a larger dataset in future research may aid in verifying the existence of such feedback.

A further delimitation of scope of this study concerns the narrow scope of performance reported upon in this chapter. Provan and Milward (2001) stress the importance of assessing the performance of networks at different levels of analysis (i.e. the environment, network, and participant levels) as it is only by minimally satisfying the needs and interests of stakeholders at these different levels that the network will be successful. Although this study constitutes a welcome contribution to the network performance literature by focusing on the under-researched network level performance (Turrini *et al.*, 2010), the authors acknowledge that the measure of network performance adopted for this study does not address the impact of the network on it members or its external environment. The authors therefore encourage other researchers to investigate the extent of inter-relationships between the characteristics of networks, performance at the network (group) level, and impact on an organisational (individual/firm) level. Such research would provide for a more holistic understanding of those network-related characteristics that are most important for the proper functioning of networks, and those which are most important for realising improvements in performance at the firm level also.

5.6.3 Practical implications

The findings presented in this chapter have important policy implications in terms of how learning networks should be evaluated.

First, those responsible for setting up and managing these types of networks must ensure that social interactions are fostered and shared vision and shared language are established among network members. This implies that 'process' measures of social interaction and the dimensions of cognitive social capital should now form an integral part of the assessment criteria when evaluating the performance of learning network entities.

Second, research on the performance of learning networks has up to now mainly focused on firm performance (e.g. van Geenhuizen and Soetanto, 2013; Samarra and Biggierro, 2008), and has often neglected the performance of the network entity itself (Turrini *et al.*, 2010). This firm level perspective neither recognises the various synergies that would be expected from increased coordination and integration at the network level nor acknowledges the importance of other key factors such as the legitimacy, maintenance and sustainability of the network entity (Turrini *et al.*, 2010). On the other hand, the network level perspective does not necessarily translate into equivalent levels of member performance so a shift to include network level measures should not be at the expense of measures of member performance (Provan and Milward, 2001). Moreover, and as highlighted in this chapter, the determinants of performance at network level can be different to those that determine performance from an individual member perspective. Although the geographic scope and heterogeneity of membership were not significant

determinants of the knowledge sharing performance of networks, their relevance to firm performance should not be overlooked as a consequence of the network level perspective adopted for this chapter. In fact, a greater diversity is likely to be beneficial from an individual member's perspective as they may have access to a greater range of knowledge.

The authors of this chapter therefore argue that policy makers (and network managers) should adopt a broader framework when evaluating learning networks to address performance from a network as well as individual member perspective.

Chapter 6

Conclusions

6.1 Answering the research questions

As it has been outlined in the introduction, this PhD dissertation revolves around four research questions that were developed in line with the conceptual framework (see Figure 1.1). These research questions are answered in this section.

RQ1: How do different external sources of knowledge relate to different types of innovations in food SMEs?

In order to answer research question 1, data were gathered via an online survey targeting food and drink manufacturing SMEs in six European countries (i.e. Belgium, France, Hungary, Ireland, Italy and Sweden). The analysis was performed on a sample of 214 food SMEs using logistic regression models. For the innovation types, the categorization of Lundvall (1995) was adopted. Therefore, four types of innovations were distinguished (i.e. product/service, process, market, and organizational innovations).

The results presented in Chapter 2 are in line with the recent studies that advocate that the introduction of different types of innovation is associated with different types of sources of knowledge (e.g. Tödtling *et al.*, 2009; Freel, 2003). They indicate a positive significant relation between the introduction of product innovations and collaboration with customers. In addition, they show that the introduction of organizational innovations is positively and significantly related to collaboration with competitors. Regarding the other types of innovations i.e. process and market innovations, no significant relationship was found between the external sources of knowledge and innovations. This suggests that these types of innovations may be influenced by other factors than the external sources of innovations included in the study. Previous research has for example pointed out the importance of the firm financial structure for the development of process innovations (e.g. Capitanio *et al.*, 2010).

The results also support previous works that highlight that market base actors play a more distinct role in innovation than science base actors for both SMEs and food firms (Bigliardi et al., 2011; Zeng et al., 2010; Knudsen, 2007; Doloreux, 2004; Menrad, 2004). In the study, and on the contrary to market base actors, science base actors were not associated with the introduction of innovations in food SMEs. It is likely that these results are influenced by the usual incremental nature of innovations in the food sector (Martinez and Briz, 2000). Indeed, relationships with science base actors are more often the source of radical innovations than of incremental innovations (Tödtling *et al.*, 2009). Nonetheless, this supposition is to be confirmed by future studies where a distinction would be made between innovations and their degree of novelty.

RQ2: In an innovation network such as an innovation cluster, what are the factors that influence the success of collaborative research projects for food SMEs? What role does the cluster organization (i.e. the innovation broker) play?

A case study approach was employed in order to address research question 2. Data were collected using 13 semi-structured interviews that were conducted with different actors involved in a collaborative research project that had taken place in the context of the Belgian innovation cluster, Wagralim.

The results of Chapter 3 raise interesting issues with respect to the factors that influence the success of collaborative projects for food SMEs in innovation clusters. They highlight the importance of a number of key roles that were either played by the cluster organization or by the project manager in the project under study, but which could well have been played by the cluster organization only (see e.g. Comacchio et al., 2012; Hakanson et al., 2011; Batterink et al., 2010; Johnson, 2008). These key roles are the following:

- Regulator: Following the study, it is crucial to establish proper formal regulations for the success of collaborative projects (Howells, 2006). The results point to the importance of having a competent project manager and confidentiality and intellectual property agreements for creating positive interactions among network members and allowing SMEs to retrieve benefits from the project.

- Boundary spanner: The results highlight the positive impact that a competent project manager can have on the success of collaborative projects. They first show that a project manager can foster cooperation among network members by relaying and translating the information between the different types of partners; or in other words, by playing a boundary spanning role.

- Mediator: The project manager can also contribute to the development of constructive interactions among project members by playing a mediator role when contentious situations arise.

- Match-making: Finally, the project manager can contribute to the success of collaborative projects by fostering the development of interactions between specific partners when opportunities for synergies appear.

RQ3: Do network features, such as the type of members, support and formal coordination mechanisms, explain the food SMEs' willingness to join innovation networks; and if so, in what way?

In order to answer research question 3, a choice based conjoint experiment was designed and ran on a sample of 231 food SMEs (see Chapter 4). In the experiment, innovation networks were described according to three network characteristics:

a. The type of actors engaged in the network (supply chain members or research institutions)
b. The level of information sharing (open or confidential information sharing)
c. The type of support offered to the network members (support to either develop innovations, build or manage networks for innovation)

The data were gathered via the same online questionnaire that was used to answer research question 1.

The results obtained suggest that the willingness of a food SME to join a particular innovation network depends on the innovation network and its characteristics but also on the fit between these characteristics and the characteristics of the firm. The results provide evidence that network choice is driven by a logic of resource needs and resource preservation.

More specifically, the results show that food SMEs prefer networks that are composed of manufacturers and supply chain members, where information is shared confidentially among network partners, and that provides the firms with support for building their network of partners for innovation.

In line with previous studies that advocate a relation between the firm characteristics and its type of networking behaviour (e.g. Drechsler and Natter, 2012; Gemünden and Heydebreck, 1995), the results also show that the food SMEs preference for networks depends upon their collaborative experience and innovation objective. It is found that SMEs with collaborative experience are more likely to prefer networks with manufacturers and research institutions and which aim at helping the firms' to develop innovations. In addition, a high level of market innovation affects negatively the probability of network selection when information is confidential, whereas the opposite happens for process innovations.

RQ4: How do the development of social capital among network members and formal coordination mechanisms impact the knowledge sharing performance of learning networks?

The data used to answer research question 4 were collected through a survey that involved the network managers and 150 members of 16 European learning networks. Hierarchical multiple regression and structural equation modelling were employed to investigate a series of hypotheses which related the different facets of social capital to the knowledge sharing performance of learning networks.

The results presented in Chapter 5 suggest that social capital plays a key role in explaining knowledge sharing performance; more than any structural network characteristics (i.e. geographic scope of membership, heterogeneity of membership, network size and network age). The analysis show that both the structural social capital (manifested as social interaction) and the cognitive social capital (manifested as shared vision and shared language) are positively and significantly related to knowledge sharing performance. Besides, the data show that the structural social capital positively affects the cognitive dimension, suggesting that social interaction can lead to the development of shared vision and shared language within networks.

Contrary to expectations, the study results do not confirm a significant relationship between the relational social capital (manifested as trust) and knowledge sharing performance. A deficiency in the measure of trust may explain the lack of significant results. Another possible explanation may be rooted in the nature of cooperation occurring in learning networks. On the contrary to 'hard' networks, such as R&D alliances for example (Oxley and Sampson, 2004), sensitive knowledge and expertise are not necessarily shared in 'soft' networks such as learning networks (Sherer, 2003). As such, there is little need to guard against opportunistic behaviour by using trust as a 'relational governance' mechanism (Poppo and Zenger, 2002).

Surprisingly, the results do not show any significant influence of the formal coordination mechanisms on knowledge sharing performance. Still, the results suggest that formal coordination mechanisms do influence the performance of learning networks indirectly as they are found to help to develop social interaction (i.e. structural social capital).

6.2 Main conclusions

In view of the growing number of innovation policy schemes that support the establishment of networks and alike (Ebbekink and Lagendijk, 2013; Martin and Sunley, 2003), networks seem to be the magic wand necessary for improving industrial innovativeness. Networks have met mixed results, however, and the

question about what actually constitutes the success of networks remains to be answered (Rampersad *et al.*, 2010; Hanna and Walsh, 2008; Huggins, 2001).

Although this PhD dissertation certainly does not pretend to answer this question thoroughly, it does provide interesting insights about the impact of a series of factors on the success of networks for learning and innovation in food SMEs. This section summarizes the key findings of the different studies conducted.

6.2.1 Network composition

Past studies have shown that firms, including SMEs, can rely on a wide variety of external partners in order to acquire new resources and develop innovations (e.g. Lasagni, 2012; Cassiman and Veugelers, 2006; Faems *et al.*, 2005). Firms can interact for example with their chain members (i.e. customers and suppliers), competitors, universities and other public research institutes. In view of the variety of actors available, a first key task in formal networks is therefore to correctly identify the necessary actors (Batterink *et al.*, 2010; Keast and Hampson, 2007).

The results of the studies presented in Chapter 2 and 3 suggest that the network members are properly chosen when these are selected in consideration of the type of innovations to be developed. In line with past studies (e.g. Tödtling *et al.*, 2009; Nieto and Santamaría, 2007), the results indicate that collaborative relationships with certain types of members are suitable for the development of certain types of innovations. In Chapter 2 for example, competitors appeared to be positively associated with organizational innovations in food SMEs. In Chapter 3 on the contrary, the presence of competitors in the project consortium, which was built with the aim of developing product innovations, seemed to seriously jeopardize constructive interactions among the project partners.

In addition, the results in Chapter 3 and 4 suggest that partners should be selected in accordance with the characteristics of the '*recipient firm*', e.g. a food SME (Easterby-Smith *et al.*, 2008: 679). It appears that, in order to benefit from collaborative relationships with certain types of actors, firms must possess certain resources and capabilities. In line with prior studies (e.g. Tödtling *et al.*, 2009; Bayona *et al.*, 2001), the results highlight in particular the importance of having the necessary research capability and collaborative experience in order to engage in – and retrieve benefits from collaboration with scientific partners such as universities. As such, brokering academia-business relationships will only be a success if the firms involved possess the required capabilities or are provided with extra support (by the innovation broker for example) in case they would lack them.

6.2.2 Network management

According to the RBV, the formation of relationships and participation in networks can be seen as the attempt of the firm to access to additional, preferably complementary, resources in order to remain competitive (Ozman, 2009; Ireland *et al.*, 2002; Hitt *et al.*, 2000). Accessing these resources can be challenging, however. Relationships must be carefully built and managed so that a series of social factors conducive to productive interactions and knowledge transfer can be developed.

Following the results of Chapter 3 and 5, one such factor appears to be the existence of shared cognition between network members. In Chapter 5, it was found that learning networks performed better in terms of knowledge sharing when network members shared the same vision and language. In Chapter 3, a certain level of shared cognition appeared to be essential in order that food SMEs engage in productive collaboration with scientific partners (see Chapter 3).

The results suggest that shared cognition can be fostered *via* different mechanisms. First, it may be enhanced through increased social interactions between network actors (see Chapter 5). As such, fostering inter-organizational socialization, through exchange forums and meetings for example, will be a key element in assuring the success of the network (Dhanaraj and Parkhe, 2006). Shared cognition may develop also through the actions of the innovation broker (e.g. project manager, cluster organization staff). This seems to be in particular the case when the innovation broker is able to play the role of boundary spanner and mediator within the network (see Chapter 3). Carefully selecting the innovation broker based on his/her ability to take on such role also thus constitutes an important element to guarantee the success of the network.

Numerous prior studies indicate that trust is another social factor beneficial for the success of networks (e.g. Cooper *et al.*, 2012; Mu *et al.*, 2008; Mora-Valentin *et al.*, 2004; Kale *et al.*, 2000). The results in Chapter 5 do not confirm this assumption, however, as no significant positive relationship was found between trust and the knowledge sharing performance of learning networks. Yet, the findings presented in Chapter 3 seem to endorse the view that trust matters for the effectiveness of collaborative initiatives, at least when the development of product innovations is concerned. Indeed, they suggest that the opportunities for knowledge exchange started to increase within the consortium once the food SMEs had realized that they could trust the other project members, in particular the scientific partners, to not disclose any sensitive information to their competitors.

Both the results of Chapter 3 and 5 indicate that trust can be developed through formal coordination mechanisms, such as contracts, laws and regulations governing the behaviour of network members and sanctions for non-compliant, non-active, or dormant members. From the case study findings (see Chapter 3), it appeared that central to the development of trust was the presence of confidentiality agreements and maintenance of confidentiality during the whole project. In Chapter 5, a positive and significant relationship was found between the presence of formal coordination mechanisms within learning networks and trust.

The establishment of formal coordination mechanisms within networks seem to be thus another important aspect for their success.

Yet, the presence of formal coordination mechanisms does not seem to always be associated with network success, at least when confidentiality is concerned. In Chapter 4, it was found that the preference for networks characterized by confidential information sharing depended upon the innovation objective of the SMEs. SMEs with high level of market innovation were less likely to favour such networks on the contrary to SMEs with high level of process innovation. Although these results do not contribute to increasing our understanding of the role of trust within networks or the relationship between trust and confidentiality, they do suggest that, in networks, the appropriateness of coordination mechanisms such as confidentiality agreements is likely to be context dependent.

6.3 Contributions

6.3.1 Scientific contributions

This PhD dissertation constitutes a welcome contribution to the literature on network composition and network management.

The findings of Chapter 2 add to the limited amount of studies that have sought to explore the relation between the types of external sources firms can potentially use for innovating and the types of innovations (Chen *et al.*, 2011b; Nieto and Santamaría, 2007). The case study results in Chapter 3 expand the understanding of the role of innovation brokers in the success of collaborative projects, thereby answering the research call of a series of scholars (Johnson, 2008; Ojasalo, 2008; Sapsed *et al.*, 2007; Winch and Courtney, 2007; Pittaway *et al.*, 2004). Through the investigation of the relation between the firm profile and its network preference, the study presented in Chapter 4 contributes to the limited research that focus on understanding the motives for firms to join particular innovation networks (Bessant *et al.*, 2012; van der Borgh *et al.*, 2012). Finally, Chapter 5 contributes to the thin body of literature that investigates the antecedents of network performance at the network level (Bessant *et al.*, 2012; Turrini *et al.*, 2010; Kenis and Provan, 2009). It also constitutes a welcome contribution to the literature on social capital. First, it explores the inter-relationships between the different social capital dimensions, an area that has been so far largely ignored by empirical studies (Lee *et al.*, 2010). Second, it contributes to the emerging literature on the antecedents of social capital by revealing the relation between the social capital dimensions and the formal coordination mechanisms present in learning networks (Zheng, 2010; Mu *et al.*, 2008).

Furthermore, while the majority of studies on innovation and networks focus on large, high-tech enterprises, this PhD dissertation contributes to the underdeveloped research on innovation and networks in SMEs and low-tech sectors

(Gassmann *et al.*, 2010; van de Vrande *et al.*, 2009b; Hirsch-Kreinsen *et al.*, 2005; Barnett and Storey, 2000).

6.3.2 Managerial and policy implications

This PhD dissertation provides valuable inputs for policy-makers and network managers who wish to build and improve inter-organizational networks as innovation and regional development tool.

One of the most prominent findings of this PhD dissertation is that food SMEs cannot be considered as a homogenous group of firms. Food SMEs are likely to differ in terms of collaborative experience and capabilities in contract design, research, manufacturing, distribution and marketing for example. As such, they are not similarly equipped to successfully engage and access to strategic resources in inter-organizational initiatives. Policy makers and other stakeholders that support the creation and maintenance of networks for learning and innovation are therefore recommended to pay particular attention to the needs of the network participants, e.g. food SMEs, when designing such networks. They should avoid copying best practices and follow '*standardized one-size-fits-all recipes*' (Ebbekink and Lagendijk, 2013: 739). Instead, they should try to assure the fit between the network design – in terms of the types of members, formal coordination mechanisms and support provided for example – and the type of firm. In order to be able to do so, they should engage in a close and continual dialogue with each of the current and prospective firms and assist them with demand articulation, that is the diagnosis and analysis of problems and identification of (latent) needs (van der Borgh *et al.*, 2012; Klerkx and Leeuwis, 2008). The identification of latent needs is especially required when SMEs are concerned as their lack of awareness of their strategic, organizational, and technological deficiencies (Kaufmann and Tödtling, 2002) may seriously jeopardize the success of their networking efforts.

The findings also resolutely indicate that shared cognition between the network members is crucial for the success of networks. A key task for those responsible for setting up and managing networks is thus to foster the development of shared cognition. They can do so by increasing social interactions between network actors, through the organization of exchange forums and meetings for example (Dhanaraj and Parkhe, 2006). They can also appoint individuals (e.g. project managers) to play a role of boundary spanner and mediator within the network.

A final recommendation to those responsible for managing networks concerns the use of formal coordination mechanisms within networks, such as contracts, laws and regulations governing the behaviour of network members. In agreement with prior studies (e.g. Ojasalo, 2008), the findings indicate that formal coordination mechanisms have a positive effect on the success of networks. Their presence was found to influence positively social interaction and trust within networks, which in turn were found to be positively related to the development of constructive

interactions and knowledge sharing among network members. As such, network managers are encouraged to put such mechanisms in place.

Yet, the findings also suggest that certain coordination mechanisms may be more suitable in certain conditions. For example, confidentiality agreements may be required when process innovations are at stake, but not when market innovations are concerned. Network managers should therefore not think that simply setting up coordination mechanisms in the network will suffice for assuring its success. It is likely that they will need to adapt and change them depending on the network goal and the nature of the relationships between network members. This should however be confirmed by future research.

6.4 Limitations and direction for future research

As it is the case for all research, this PhD dissertation is characterized by several limitations that should be taken into account when considering the reliability and generalizability of the results obtained. In this section, only the general, recurrent limitations across the research chapters are presented. The limitations that are specific to a particular study can be found in the research chapter that relates to the study in question.

In two research chapters (see Chapter 2 and 5), cross-sectional data were used to investigate the research questions and eventual related hypotheses. This type of data does not allow testing causal relationships. As such, the results regarding cause-effects relationships in these chapters should be taken with caution. It may be that the causality flows in an opposite direction to the one proposed or that is goes in both directions. Future studies based on longitudinal datasets will help to conclude on the causality of the relationships that exist between the use of external sources of knowledge and innovation outputs (see Chapter 2), and between the different facets of social capital and the knowledge sharing performance of learning networks (see Chapter 5).

Furthermore, the data used in Chapter 2 and Chapter 4 were gathered from single informants (i.e. the SMEs' owner-managers) which may have resulted in self-report bias (Podsakoff *et al.*, 2003). Although previous studies recognize the appropriateness of SMEs' owner-managers as sources of information about the firm innovation decision and outcomes (e.g. Branzei and Vertinsky, 2006), future research should attempt to control for this bias by e.g. collecting data through several in-company sources or conducting observational studies.

In the same chapters, the low response rate impacted the representativeness of the sample. The generalization of the findings to all European food SMEs may therefore be limited. The reason for the low response rate may be attributed to the online survey method selected but also to the particular characteristics of the food sector and the size of the firms. As such, in order to increase the response rates – and thus the generalizability – of future studies, efforts should first be deployed to

evaluate the appropriateness of current survey tools for collecting innovation related data in food SMEs.

Finally, the focus of this PhD dissertation on the food industry may constitute another limitation with regards to the generalizability of the findings. While they can possibly be extended to sectors that are known to share similarities with the food sector regarding innovation and related elements, for example the textile and paper industries (Kirner *et al.*, 2009), they may not be valid in high-tech, less traditional sectors where the reality of SMEs differs widely.

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Appendices

Appendix 1. Questionnaire – Chapters 2 and 4

(NetGrow – WP4 questionnaire)

Dear Sir, Madam, CEO,
The members of the European project Netgrow would like to receive your opinion about innovation and networks in the agri-food sector.
All answers are completely anonymous and will only be used in the frame of Netgrow.
If you are interested in the results, please subscribe to our **newsletter**.
If you would like more information, **click here** or send us an **e-mail**.
FOR STARTING THE SURVEY, PLEASE CLICK ON THE '>>' (next button) below.
We would like to thank you in advance for your cooperation.

1. FIRM GENERAL CHARACTERISTICS

Q1. Please indicate in what country your company is situated?

- ❒ Belgium
- ❒ France
- ❒ Hungary
- ❒ Ireland
- ❒ Italy
- ❒ Sweden
- ❒ Other (please specify): .....

Q2. To what of the following categories does your firm belong?

- ❒ food processor
- ❒ technology suppliers (e.g. packaging)
- ❒ ingredient/raw materials suppliers
- ❒ logistics (e.g. transportation)
- ❒ Other (please specify): .....

Q3. Please select your main business activity from the following NACE-code list:

Please use the box below for any comment or remark with regards to your main business activity:

Additional comments: .....
.....

Q4. What is your firm's primary geographical market?

- ❒ local/regional
- ❒ national
- ❒ European
- ❒ world wide

Q5. Please indicate:

Q5a	Firm's year of establishment	**.....**
Q5b	Current number of employees	**.....** (full-time equivalent)
Q5c	Compared to 2 years ago, the number of employees has … *(circle suitable answer)*	decreased – remained the same – increased – don't know
Q5d	Compared to 2 years ago, our profit has … *(circle suitable answer)*	decreased – remained the same – increased – don't know

Additional comments: .....
.....

Definitions:
INNOVATION is understood as:
New products or services, new processes, new markets (e.g. new types of customers or new geographical markets), and new business models or management tools

Q6. Which of the three following statements is the most in line with your firm's innovation strategy? *(Cross where appropriate; only one answer possible)*

Q6a	We are often first to market and respond rapidly to new opportunities	❒
Q6b	We are seldom first to market, but are a fast follower	❒
Q6c	We focus on our niche in the market and pay attention to industry changes only if they have a direct influence on our areas of operations	❒

Q7. Has your firm realized any of the following innovations in the last two years? *(Cross where appropriate; provide examples of realized innovations if you wish)*

		Don't know	None	1	2	3, 4 or 5	6 or more
Q7a	New products or services Example(s): ……	❒	❒	❒	❒	❒	❒
Q7b	New processes Example(s): ……	❒	❒	❒	❒	❒	❒
Q7c	New markets Example(s): ……	❒	❒	❒	❒	❒	❒
Q7d	New business models or management tools Example(s): ……	❒	❒	❒	❒	❒	❒

Q8. Has your firm been member of the following organizations in the last two years? *(Cross where appropriate)*

		Don't know	Not member	Member of 1	Member of 2	Member of 3 or more
Q8a	Chambers of commerce (e.g. VOKA) and trade organizations (e.g. FIT)	❒	❒	❒	❒	❒
Q8b	Industry associations & sector organizations (e.g. Choprabisco, Fevia)	❒	❒	❒	❒	❒
Q8c	Clusters (e.g. Flanders Food)	❒	❒	❒	❒	❒
Q8d	Scientific and technological parks	❒	❒	❒	❒	❒
Q8e	Business clubs (e.g. Cercle de Wallonie)	❒	❒	❒	❒	❒

Q9. In the last two years, how frequently has you firm collaborated with/used the following 'organizations' in order to source the following types of knowledge or resources for the purpose of innovation? *(Cross where appropriate)*

		Don't know	Scientific knowledge ?	Technical info & resources ?	Managerial/legal know-how ?	Market info & facilitation ?	Financial resources
Q9a	Suppliers (raw materials, machines, packaging)	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9b	Customers	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9c	Competitors	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9d	Other firms in other sectors	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9e	Universities and public research institutes	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9f	Private research institutes	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9g	Chambers of commerce (e.g. VOKA) and trade organizations (e.g. FIT)	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9h	Industry associations and sector organizations (e.g. Choprabisco, Fevia)	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always

Q9i	Clusters (e.g. Flanders Food)	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9j	Scientific and technological parks	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9k	Business clubs (e.g. Cercle de Wallonie)	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9l	Training institutes and consultants	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always
Q9m	Fairs, exhibitions, conferences	❒	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always	❒ Never ❒ Sometimes ❒ Often ❒ Always

? ***Scientific knowledge*** *relates for example to Food Science, Food & Nutrition, Biotechnology, Medical, etc.*
Technical information and resources *relate for example to engineering, product design, etc. and equipment, IT facilities, etc.*
Managerial and legal know-how *relate for example to management experiences and intellectual property*
Market information and facilitation *relate for example to knowing customers' demand, how to reach the target market segment, etc.*

Definitions:
PARTNERS are understood as:
Any firm or research institute (private & public) with whom your firm has developed relationships with the aim to innovate

Q10. To what extent do you agree or disagree with the following statements?

		Strongly disagree			Neither agree nor disagree			Strongly agree
Q10a	The relationships we have developed with our partners are strong and harmonious	1	2	3	4	5	6	7
Q10b	In general, we don't manage to get what we want from each of our partners	1	2	3	4	5	6	7
Q10c	Our partners possess capabilities and know-how which are complementary to ours	1	2	3	4	5	6	7
Q10d	We frequently develop relationships with new partners with the aim to innovate	1	2	3	4	5	6	7

2. FIRM INNOVATION CULTURE and CAPABILITIES

Q11. Does your firm have any of the following in place?

Q11a. Training courses by external experts about collaboration, management of partnerships ☐ Yes ☐ No
Q11b. In-house training courses about collaboration, management of partnerships ☐ Yes ☐ No
Q11c. Partner selection procedures ☐ Yes ☐ No
Q11d. Joint business planning sessions ☐ Yes ☐ No
Q11e. Codified best practices (collaboration, partnerships) ☐ Yes ☐ No
Q11f. Intranet for collaboration and partnership resources, etc. ☐ Yes ☐ No
Q11g. Full-time partnership manager ☐ Yes ☐ No

Q12. To what extent do you agree or disagree with the following statements?

		Strongly disagree			Neither agree nor disagree			Strongly agree
Q12a	My firm believe that networking and collaboration with other organizations play a role in the future success of the firm	1	2	3	4	5	6	7

Q13. To what extent do you agree or disagree with the following statements?

The employees managing the network of partners know ...		Strongly disagree			Neither agree nor disagree			Strongly agree
Q13a	... what the future targets of the firm are	1	2	3	4	5	6	7
Q13b	... how the firm monitors and handles changing market conditions	1	2	3	4	5	6	7
Q13c	... the firm's strategic assets and capabilities and how they must change to create future value	1	2	3	4	5	6	7
Q13d	... the firm's strengths and weaknesses	1	2	3	4	5	6	7

Q14. To what extent do you agree or disagree with the following statements?

The employees managing the network of partners ...		Strongly disagree			Neither agree nor disagree			Strongly agree
Q14a	... usually feel and listen to what each of our partners actually wants	1	2	3	4	5	6	7
Q14b	... care about the concerns of each of our partners even if we do not expect any advantages to arise for us in the short term	1	2	3	4	5	6	7
Q14c	... adapt their communication to our partners so they can understand us better and quicker	1	2	3	4	5	6	7
Q14d	... establish processes in our firm to coordinate the relationships and activities with our partners	1	2	3	4	5	6	7

Q15. To what extent do you agree or disagree with the following statements?

We put a lot of effort ...		Strongly disagree			Neither agree nor disagree			Strongly agree
Q15a	... in seeing the point of view of our partners	1	2	3	4	5	6	7
Q15b	... to make our partners understand our product and services offering	1	2	3	4	5	6	7
Q15c	... to make our partners understand our position in the market	1	2	3	4	5	6	7
Q15d	... to make clear what we expect from each of our partners	1	2	3	4	5	6	7
Q15e	... to make clear what we can offer to each of our partners	1	2	3	4	5	6	7
Q15f	... to make clear to our partner how we should communicate with one another	1	2	3	4	5	6	7

3. NETWORK PREFERENCE

Q16. Now we come to the last part of this survey. Imagine the ideal world, where you would be able to find the ideal 'innovation network'. How would this innovation network look like? What characteristics would it have?

You will be provided with 3x2 networks described by a set of the following characteristics:

	DESCRIPTION	CHARACTERISTIC
Types of members	Extent to which the members of the network are peers, actors of the supply chain, research institutes and innovation consultants	– Manufacturers & supply chain members – Manufacturers & research centers
Information openness	Degree to which information circulates internally within the network	– Open information sharing – Confidential information sharing
Network goal	Range of supports for innovation the network aims to provide to its members	– Help firms to develop innovations (e.g. market info, pilot facilities) – Help firms to build their network of partners for innovation – Help firms to manage their network of partners for innovation

Carefully read the description of 2 potential network, called A and B below. Which of the two networks is more likely helping your firm to innovate? Please indicate the according network by clicking on the bullet below the respective network.

	Network A	**Network B**
Types of members	Manufacturers + supply chain members	Manufacturers + research centers
Information openness	Confidential information sharing	Open information sharing
Network goal	Helps to build a network	Helps to manage a network
Choice	❒	❒

Appendix 2. Questionnaire A – Chapter 5

(NetGrow – WP6 questionnaires, Q1a)

1. GOALS & ACTIVITIES OF ***NETWORK NAME***

Q1: *Network Name*? .....

Q1a: What is your job title? .....

Q2. In which year was *Network Name* established? .....

Q3.

Q3a. Please list the main goals of *Network Name*		**Q3b. How important are each of these goals to the members?**						
Network Goals		Not at all Important						Very Important
1	.....	1	2	3	4	5	6	7
2	.....	1	2	3	4	5	6	7
3	.....	1	2	3	4	5	6	7
4	.....	1	2	3	4	5	6	7
5	.....	1	2	3	4	5	6	7
6	.....	1	2	3	4	5	6	7
7	.....	1	2	3	4	5	6	7

Q4.

	Q4a. Does *Network Name* offer any of the following activities/services? *(Please tick as appropriate)*			**Q4b. Where applicable, to what extent is *Network Name* involved in the delivery of each activity/service?** *(Please tick as appropriate)*	
	The network...	Yes	No	Organise the activity/service	Facilitate the activity/service
	Organisational Development Support				
1	...organises or facilitates access to education and/or training courses	❒	❒	❒	❒
	Network Formation Support				
2	...provides updates on network events/activities via newsletter and/or	❒	❒	❒	❒

	website				
3	…provides networking events e.g. social meetings	❒	❒	❒	❒
4	…organises or facilitates participation in conferences/seminars/workshops	❒	❒	❒	❒
5	…provides support in finding potential (collaborative) partners within and/or outside the network	❒	❒	❒	❒
6	…supports collaborative projects (e.g. ploughing championships)	❒	❒	❒	❒
Demand Articulation Support					
7	…provides or facilitates access to market information	❒	❒	❒	❒
8	…organises or facilitates participation in business/innovation awards	❒	❒	❒	❒
Innovation Process Support					
9	…provides or facilitates access to advice on legal matters e.g. IP rights, contractual agreements	❒	❒	❒	❒
10	…supports members in applying for research grants and/or attracting investments	❒	❒	❒	❒
11	…provides or facilitates assistance in achieving accreditation and standards	❒	❒	❒	❒
12	…provides or facilitates access to information on new products and/or new technologies/processes	❒	❒	❒	❒
13	…organises or facilitates access to knowledge providers and/or experts	❒	❒	❒	❒
Internationalisation Support					
14	…organises or facilitates participation in cross-border/international events e.g. trade events, business missions, study visits	❒	❒	❒	❒
15	Other(s), please specify	❒	❒	❒	❒

2. MANAGEMENT OF ***NETWORK NAME***

Q5. Which of the following best describe how *Network Name* is governed? *(Only one answer may be given)*

- ❒ Most, if not all, network members are responsible for making key decisions as well as managing network activities and relationships
- ❒ Designated network members are responsible for making key decisions as well as managing network activities and relationships
- ❒ All major network-level activities and key decisions are coordinated through and by a single participating member, acting as a lead organisation
- ❒ A separate external administrative entity is set up specifically to govern the network and its activities
- ❒ Other, please describe ……

Q6. How would you describe the board governance structure in Network Name (e.g. Board of Directors, Board of Managers, Board of Governors, Committee, etc.)? (*Please describe/comment)*

……

……

Q7. Does *Network Name* pay professionals to manage and provide administrative support to the network?

- ❒ Yes; if answered yes, please go to Q9
- ❒ No; if answered no, please answer Q8

Q8. Does *Network Name* have secretarial/administrative support services provided by an external organisation?

- ❒ Yes
- ❒ No

Q9. Does *Network Name* have any of the following in place?

	Yes	No
A formal process of vetting potential members e.g. screening, probationary period	❒	❒
Contracts, law and regulations governing member behaviour in the network	❒	❒
Sanctions for non-compliant, non-active, or dormant members	❒	❒
A dispute resolution procedure	❒	❒

3. NETWORK MEMBERSHIP

Q10. Please provide an approximate breakdown of the network membership (number of members as a % of total membership) across each of the following categories of organisations where applicable. *(Please do not leave blanks. Type in 0 for non-applicable sector categories)*

Q11. In addition, which of these categories of organisations drove the creation of Network Name? *(Please tick the most appropriate boxes. more than one answer may be given)*

Categories of Organisations	**Q10** (number of members as a % of total membership)	**Q11** (organisations that drove the creation of the network)
Government (e.g. local government, government agencies/institutions, public bodies etc)	.....	❒
Universities (including public and/or private research organisations attached to Universities)	.....	❒
Other higher education institutions (e.g. higher education schools/institutes, technical/engineering colleges etc)	.....	❒
Private research organisations (outside Universities)	.....	❒
Public research organisations (outside Universities)	.....	❒
Food & beverage manufacturers (including food/beverage ingredient producers)	.....	❒
Food wholesalers and retailers (including food service)	.....	❒
Suppliers of industrial equipment, and general industrials (including containers and packaging)	.....	❒
Transportation and logistics (including distributors)	.....	❒

Industrial support services (e.g. training centres, advisory service providers, management consultants, advertising and market research agencies etc)	.....	❒
Other stakeholder and/or membership organisations (e.g. foundations, non-profit organisations, NGOs, trade associations, trade unions etc)	.....	❒
All other industries/service providers not listed above (e.g. ICT, Pharma & biotech, chemicals, non-food consumer goods, financial services including investors, general retail, arts, entertainment and recreation, professional activities such as legal and accounting services etc) *(Please Specify)*	.....	❒

4. NETWORK PROFILE

Q12. Which most closely describes the legal status of *Network Name*? *(only one answer may be given)*

- ❒ Limited liability
- ❒ Other, please specify.....

Q13. Which of the following sub-sectors of food and beverage manufacturers are members of *Network Name*? *(Please tick the most appropriate boxes; more than one answer may be given)*

- ❒ Manufacture of **beverages**
- ❒ **Processing/preservation of meat and meat products**
- ❒ **Processing/preservation of fish, crustaceans and molluscs**
- ❒ Processing/preservation of **fruit and vegetables**
- ❒ Manufacture of **animal/vegetable oils and fats**
- ❒ Manufacture of **dairy products**
- ❒ Manufacture of **grain mill products, starches and starch products**
- ❒ Manufacture of **bakery and farinaceous products**
- ❒ Manufacture of **other food products, please describe** .....

Q14. Which most closely describes the geographic scope of the network membership? *(Only one answer may be given)*

- ❒ Regional (sub-national) membership only
- ❒ National membership only
- ❒ International membership

Q15. Does your network have international links to other networks or organisations? *(Only one answer may be given)*

- ❒ Yes
- ❒ No

Please describe

……
……

Q16. Please provide an approximation of the network membership numbers for the 1st year in operation (i.e. year of establishment), and then for the last 3 years from 2009 to 2011.

Year of establishment	**2009**	**2010**	**2011**
Total membership (N)	……	……	……	……

Q17. Please provide an approximation for the network finances (contribution of each source as a % of total network finance) across each of the following sources for the last 3 years from 2009 to 2011.

	2009 (%)	**2010** (%)	**2011** (%)
Membership fee	……	……	……
Income generating activities e.g. social events, workshops, seminars etc.	……	……	……
Grant-aid (public funding)	……	……	……
Competitive public funding	……	……	……
Other, please specify	……	……	……

IMPORTANT: The purpose of Q18 and Q19 is to identify potential respondents for the purpose of conducting face-to-face interviews. These interviews will investigate the value of measuring network performance from the perspective of different stakeholders. We therefore wish to identify a mix of different stakeholders (e.g. food manufacturers, non-food manufacturers, service providers, consultants, public bodies/government agencies, Universities, etc.) relevant to your network. These stakeholders can be members (internal) or non-members (external) but all are most active/support the activities/services of the network.

Q18. Please list the MOST IMPORTANT internal stakeholder organisations (i.e. MEMBERS) that are MOST ACTIVE and/or SUPPORT the activities of *Network Name*. Please consider a mix of different types of organisations as appropriate to your network.

1. **Organisation:** ……
   Contact name: ……
   ……
   ……
2. **Organisation:** ……
   Contact name: ……
   ……
   ……

3. **Organisation:** .....
   Contact name: .....
   .....
   .....
4. **Organisation:** .....
   Contact name: .....
   .....
   .....

Q19. Please list the MOST IMPORTANT external stakeholder organisations (i.e. NON-MEMBERS) that are MOST ACTIVE and/or SUPPORT the activities of *Network Name*. Please consider a mix of different types of organisations as appropriate to your network.

1. **Organisation:** .....
   Contact name: .....
   .....
   .....
2. **Organisation:** .....
   Contact name: .....
   .....
   .....
3. **Organisation:** .....
   Contact name: .....
   .....
   .....
4. **Organisation:** .....
   Contact name: .....
   .....
   .....

Appendix 3. Questionnaire B – Chapter 5

(NetGrow – WP6 questionnaires, Q1b)

Welcome to the NetGrow Survey on Network performance
Thank you for taking the time to participate in this survey. You have been selected in this survey as a member of ***Network Name***.
Taking part in this survey is your opportunity to express your views on the performance of ***Network Name***.
This questionnaire takes approximately 25 minutes to complete. If you start this questionnaire, and wish to complete it at a later time, you must click the 'next button' to save your progress, and you must also return to the same computer.
Please click on the red 'next' button to begin the survey.

1. BACKGROUND INFORMATION

Q1. Which of the following categories best describes the industry sector your organization operates in?

Q2. In which year did your organisation join *Network Name*
……

2. NETWORK GOALS & ACTIVITIES

IMPORTANT: For companies that are part of a larger business, please base your answers to this questionnaire on your strategic business unit

Q3.

Network Goals		Q3a. How important are each of the following goals of *Network Name* to your organisation? (*Please circle any number between 1 and 7 corresponding to the level of importance of each network goal to your organisation)* Not at all Important						Very Important	Q3b. How satisfied are you with the progress of *Network Name* in attaining each of these goals? (*Please circle any number between 1 and 7 corresponding to your level of satisfaction with the network in attaining each goal)* Not at all Satisfied						Very Satisfied
1	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
7	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7

IMPORTANT: For the purpose of this questionnaire, INNOVATION is understood as: "New products or services, new processes, new markets (e.g. new types of customers or new geographical markets), and new business models (e.g. joint marketing initiatives) or management tools (e.g. ISO standards, HACCP system, Six Sigma)"

Q4.

		Q4a. How frequently does your organisation take part in or use each of the following activities/services offered by *Network Name*? (*Please circle any number between 1 and 7 corresponding to your frequency of participation in/use of each activity/service)*							**Q4b. How important is each activity/service to acquiring knowledge for innovation for your company?** *(Please circle any number between 1 and 7 corresponding to the level of importance of each activity/service as a source of knowledge for innovation for your company*						
The network…		Never When Offered						Always When Offered	Not at all Important						Very Important
1	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
7	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
9	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
10	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
11	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
12	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
13	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
14	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
15	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7

3. NETWORK MANAGEMENT QUALITIES

Q5. How would you assess the collective skills/qualities of the person(s) that represent the management team/organiser(s) of *Network Name* based on the following statements? *(Please circle any number between 1 and 7 corresponding to how much you agree with each statement)*

The management team/organiser(s)…	Strongly Disagree						Strongly Agree
…possesses the necessary **scientific** knowledge, skills and competencies relevant to the requirements of ***Network Name***	1	2	3	4	5	6	7
…possesses the necessary **business** knowledge, skills and competencies relevant to the requirements of ***Network Name***	1	2	3	4	5	6	7
…possesses the necessary skills to **develop ideas and solve problems**	1	2	3	4	5	6	7
…possesses the necessary **inter-personal skills** to interact effectively with network members	1	2	3	4	5	6	7
…has excellent **communication skills**	1	2	3	4	5	6	7
…commands **respect** from other members of ***Network Name***	1	2	3	4	5	6	7
…can **motivate** network members	1	2	3	4	5	6	7
…maintains **morale** within ***Network Name***	1	2	3	4	5	6	7
…is **proactive**	1	2	3	4	5	6	7
…plays an important role in helping members **build relationships** with other members of ***Network Name***	1	2	3	4	5	6	7

…facilitates and supports the **flow of knowledge** within ***Network Name***	1	2	3	4	5	6	7
…is enthusiastic towards the **continuous improvement** of ***Network Name***	1	2	3	4	5	6	7

4. NETWORK RELATIONSHIPS

IMPORTANT: As a reminder, for the purpose of this questionnaire, INNOVATION is understood as: "New products or services, new processes, new markets (e.g. new types of customers or new geographical markets), and new business models (e.g. joint marketing initiatives) or management tools (e.g. ISO standards, HACCP system, Six Sigma)"

Q6.

Category of Organisation		**Q6a. How frequently does your organisation interact for innovation with each of the following organisations which are MEMBERS of *Network Name*?** (*Please circle any number between 1 and 7 for each category of organisation)* Never						Always	**Q6b. How important is the knowledge acquired for innovation from each organisation you interact with which is a MEMBER of *Network Name*? (***Please circle any number between 1 and 7 for each category of organisation where applicable)* Not at all Important						Very Important
1	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
7	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
8	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
9	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
10	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
11	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7
12	……	1	2	3	4	5	6	7	1	2	3	4	5	6	7

5. PREVAILING NETWORK CULTURE

IMPORTANT: For the purpose of this questionnaire, THE NETWORK is understood as: "The formal organisation composed of both its members AND the people that manage and govern the network"

Q7. To what extent do you agree with the following statements with regard to *Network Name*? *(Please circle any number between 1 and 7 corresponding to how much you agree with each statement)*

	Strongly Disagree						Strongly Agree
The network is **important to me**	1	2	3	4	5	6	7
I would **abandon the network** only as a result of significant changes [to its goals, strategy, activities etc.]	1	2	3	4	5	6	7
I am willing to **assign people and/or other resources** permanently to the network	1	2	3	4	5	6	7
It feels like we [the other members and I] **can communicate on the same 'wavelength'**	1	2	3	4	5	6	7
It feels like we [the other members and I] **can understand**	1	2	3	4	5	6	7

each other							
It feels like we [the other members and I] **use similar language**	1	2	3	4	5	6	7
We [the other members and I] **share a common vision** regarding the key success factors of the network	1	2	3	4	5	6	7
I think that we [the other members and I] **care about the same issues**	1	2	3	4	5	6	7
I feel that we [the other members and I] **have completely different goals** towards the network	1	2	3	4	5	6	7

Q8. To what extent do you agree with the following statements with regard to *Network Name*? *(Please circle any number between 1 and 7 corresponding to how much you agree with each statement)*

	Strongly Disagree						Strongly Agree
I trust the **network managers and/or network staff**	1	2	3	4	5	6	7
I trust the **other members** of the network	1	2	3	4	5	6	7
I would **recommend the network** because I predict a good future for the network	1	2	3	4	5	6	7
In my sector, it is considered **prestigious to be a member** of this network	1	2	3	4	5	6	7
When trying to establish new business opportunities, I **downplay my association** with ***Network Name***	1	2	3	4	5	6	7
This network **does not have a good reputation** in my sector	1	2	3	4	5	6	7
I am very interested in **what other organisations in my sector think** about the network	1	2	3	4	5	6	7
When I talk about this network, I usually say **'we' rather than 'they'**	1	2	3	4	5	6	7
If a story in the media criticised the network, I would **feel embarrassed**	1	2	3	4	5	6	7

6. NETWORK PERFORMANCE

Q9. Please assess the performance of *Network Name* under each of the following categories for 2010 (where applicable) and 2012?

	… in 2012 was …							**… in 2010 was …**						
	Extremely poor						Excellent	Extremely poor						Excellent
The level of knowledge sharing **between members** of ***Network Name***	1	2	3	4	5	6	7	1	2	3	4	5	6	7
The level of interaction/collaboration **between members** of ***Network Name***	1	2	3	4	5	6	7	1	2	3	4	5	6	7
The quality of the relationships **between members** of ***Network Name***	1	2	3	4	5	6	7	1	2	3	4	5	6	7
The number of collaborative projects/initiatives **within** ***Network Name***	1	2	3	4	5	6	7	1	2	3	4	5	6	7

7. FIRM PERFORMANCE

IMPORTANT: As a reminder, for companies that are part of a larger business, please base your answers to this questionnaire on your strategic business unit

Q10. Please assess the performance of your firm in 2012 under each of the following categories?

	Extremely poor						Excellent
…ability to acquire new knowledge	1	2	3	4	5	6	7
…ability to apply this new knowledge to new projects	1	2	3	4	5	6	7
…knowledge of new products and/or new processes/technologies	1	2	3	4	5	6	7
…knowledge of new markets	1	2	3	4	5	6	7
…marketing capabilities	1	2	3	4	5	6	7
…management skills and/or capabilities	1	2	3	4	5	6	7
…ability to innovate/develop innovations	1	2	3	4	5	6	7

8. FIRM PROFILE

Q11. Which of the following categories best describes the sub-sector of food and beverage manufacturing your business unit/company operates in? *(Please choose one answer from the list below)*

Q12. Please indicate the average number of employees as full time equivalents (FTEs) in your business unit/company over the last 3 years between 2009 and 2011.

……

9. FIRM PROFILE

Would you like to receive a copy of the report(s) detailing the key findings from this study? If so please provide your company's name and a contact e-mail address below. This information will be treated confidential and will only be used to provide you with the findings of this study on network performance.

Company name: ……

Contact e-mail address: ……

Appendix 4. Description of the innovation types – Chapters 2

	Type of innovation			
Number of innovations	**Product**	**Process**	**Market**	**Organizational**
Don't know	0	2	4	13
0	40	87	73	124
1	35	67	68	41
2	45	25	31	11
3,4,5	50	15	21	3
6 or more	40	5	6	2
Missing value	4	13	11	20

Summary

Innovation is often considered as the main gateway to competitiveness. While innovation was traditionally regarded as the result of the firms' isolated efforts, it is progressively seen as a cooperative phenomenon. Firms, including small and medium-sized enterprises (SMEs), develop external relationships and participate in networks in order to access to additional resources that can help them to enhance their innovation performance.

A rich collection of books and scientific articles have been dedicated to the investigation of the relation between networks and innovation. Nevertheless, it is acknowledged that further research is required to understand how networks are built and operated in order to facilitate learning and innovation. In this regard, the overall objective of this PhD dissertation is to investigate the impact of a series of factors related to network composition and management (i.e. type of network members, innovation broker, formal coordination mechanisms, and social capital) on the success of networks for learning and innovation in food SMEs.

This PhD dissertation is a compilation of research papers. It revolves around four research questions that are answered in four, independent studies. Insights are gained by means of primary and secondary data that were collected in the frame of the FP7 project NetGrow in the period 2011-2013. The main findings of this research are presented below:

The purpose of the first study is to examine the role that different external sources of knowledge play in product, process, market and organizational innovations in food SMEs. The results support the findings of recent studies that advocate that the introduction of different types of innovations is associated with different types of sources of knowledge. They indicate that collaboration with customers matter for product innovations in food SMEs while they suggested that collaboration with competitors is more important for the development of organizational innovations in this type of firm. In line with previous works, the results also show that collaboration with science base actors (e.g. universities) does not appear relevant for innovation in food SMEs.

The second study aims to investigate the factors that influence the success of collaborative projects for food SMEs, including the potential role of the cluster organization, a particular type of innovation broker. The case findings indicate that cluster organizations can play a number of roles to enhance the success of collaborative projects for food SMEs. They emphasize in particular the roles of regulator, boundary-spanner, mediator and match-making.

The objective of the third study is to assess whether and how network characteristics, such as the type of members, support and formal coordination mechanisms**,** influence the food SMEs' willingness to join innovation networks. The results of the choice experiment used suggest that the willingness of a food SME to join a particular innovation network depends on the innovation network and its characteristics but also on the fit between these characteristics and the characteristics of the firm. More specifically, they show that food SMEs prefer networks that are composed of manufacturers and supply chain members, where information is shared confidentially among network partners, and that provides the firms with support for building their network of partners for innovation. In addition, the SMEs' choice of the network is also affected by the interaction between specific network characteristics and two firm characteristics i.e. the firm collaborative experience and innovation objective.

The final study investigates the link between the social capital accumulated among network members and the performance of learning networks in terms of their ability to enhance knowledge sharing among network members. More specifically, the results reveal that social interaction and cognitive social capital are positively and significantly related to knowledge sharing in learning networks. Social interaction is also shown to play an important role in the development of shared vision and shared language (i.e. cognitive social capital) in learning networks. The study also explores the relation between the use of formal coordination mechanisms (e.g. contracts, laws and regulations governing the behaviour of network members) and the knowledge sharing performance of networks. No direct, significant relation is found, but formal coordination mechanisms appear to be positively and significantly related to both social interaction and trust.

This PhD dissertation contributes to the literature on network composition and network management and to the underdeveloped research on innovation and networks in SMEs and low-tech sectors. It also provides valuable inputs for policy-makers and network managers who wish to build and improve inter-organizational networks as innovation and regional development tool.

Samenvatting

Innovatie wordt vaak beschouwd als de belangrijkste toegangspoort tot concurrentievermogen. Terwijl innovatie traditioneel werd gezien als het gevolg van geïsoleerde inspanningen van ondernemingen, wordt het in toenemende mate gezien als een coöperatieve ontwikkeling. Bedrijven, met inbegrip van kleine en middelgrote ondernemingen (KMO's), bouwen aan externe relaties en maken deel uit van netwerken om toegang te krijgen tot extra middelen die hen kunnen helpen om hun innovatie capaciteit te verbeteren.

Een rijke verzameling van boeken en wetenschappelijke artikelen is gewijd aan het onderzoek naar de relatie tussen netwerken en innovatie. Niettemin wordt erkend dat verder onderzoek nodig is om te begrijpen hoe netwerken worden samen gesteld en beheerd met het oog op het bevorderen van leren en innoveren binnen het bedrijf. In dit opzicht is de algemene doelstelling van dit proefschrift om te onderzoeken wat de impact is van een reeks van factoren die verband houden met het beheer en de samenstelling van een netwerk (bijvoorbeeld het type: leden binnen het netwerk, innovatie makelaar, formele coördinatiemechanismen, sociaal kapitaal) op het succes van de netwerken om leren en innoveren binnen KMO's uit de voedingsindustrie te bevorderen.

Dit proefschrift is een compilatie van wetenschappelijke publicaties. Centraal staan vier onderzoeksvragen die worden beantwoord in vier onafhankelijke studies. Inzicht is verkregen door middel van primaire en secundaire gegevens die in het kader van het FP7-project NetGrow werden verzameld in de periode 2011-2013. De belangrijkste bevindingen van dit onderzoek worden hieronder gepresenteerd:

Het doel van de eerste studie is het onderzoeken van de rol die verschillende externe informatiebronnen spelen in product, proces, markt en organisatorische innovaties binnen de KMO's uit de voedingsindustrie. De resultaten ondersteunen de uitkomsten van recente studies die aangeven dat de invoering van verschillende innovaties met verschillende informatiebronnen geassocieerd is. Zij tonen aan dat de samenwerking met klanten belangrijk is voor productinnovatie in KMO's uit de voedingsindustrie, terwijl de samenwerking met concurrenten belangrijker is voor de ontwikkeling van organisatorische innovaties in dit type bedrijf. Bovendien tonen de resultaten aan dat de samenwerking met wetenschappelijke actoren (zoals universiteiten) niet relevant lijkt te zijn voor de innovatie capaciteit van deze KMO's.

De tweede studie onderzoekt de factoren die bepalend zijn voor het succes van samenwerkingsprojecten voor dergelijke KMO's, met inbegrip van de potentiële rol

van de cluster organisatie, een bepaald type van innovatiemakelaar. De bevindingen van de case study geven aan dat cluster organisaties een aantal rollen kunnen spelen om het succes van de samenwerkingsprojecten voor voedsel KMO's te verbeteren. De resultaten benadrukken in het bijzonder de rol van: *regulator, boundary-spanner, mediator en match-making*.

Het doel van de derde studie is te onderzoeken of en, zo ja, hoe typerende kenmerken van het netwerk, zoals het soort leden en de ondersteunende en formele coördinatiemechanismen, de bereidheid van de KMO's om deel te nemen aan innovatienetwerken beïnvloeden. De resultaten van de gebruikte keuze experimenten suggereren dat de deze bereidheid niet alleen bepaald wordt door het netwerk en haar kenmerken, maar ook door de overeenkomst tussen deze kenmerken en de kenmerken van de onderneming zelf. Meer specifiek tonen de resultaten aan dat deze KMO's netwerken verkiezen, die zijn samengesteld uit fabrikanten en leden van de toeleveringsketen, waar informatie vertrouwelijk wordt gedeeld tussen netwerkpartners, en die de bedrijven steunen bij de opbouw van hun netwerk met innovatiepartners. Daarnaast wordt de keuze van het netwerk van de KMO's 'ook beïnvloed door de interactie tussen specifieke netwerk kenmerken en twee specifieke kenmerken van de KMO's in het bijzonder, namelijk de ervaring met samenwerking enerzijds en de doelstelling betreffende innovatie anderzijds.

De laatste studie onderzoekt het verband tussen het sociaal kapitaal, opgebouwd tussen leden van het netwerk, en de prestaties van de leernetwerken, uitgedrukt als hun potentie om het delen van kennis tussen de leden van het netwerk te verbeteren. De resultaten tonen aan dat sociale interactie en cognitief sociaal kapitaal, positief en significant gerelateerd zijn aan het delen van kennis in leernetwerken. Bovendien wordt aangetoond dat sociale interactie een belangrijke rol speelt in de ontwikkeling van een gedeelde visie en een gedeelde taal (cognitief sociaal kapitaal) in leernetwerken. Tenslotte onderzoekt deze studie de relatie tussen het gebruik van formele coördinatiemechanismen (bijvoorbeeld contracten en de wet- en regelgeving met betrekking tot het gedrag van de leden van het netwerk) en de prestaties van het netwerk betreffende het delen van kennis. Er wordt geen directe, significante relatie gevonden, maar formele coördinatiemechanismen lijken positief en significant gerelateerd te zijn aan zowel sociale interactie als vertrouwen.

Dit proefschrift draagt bij aan de literatuur over netwerksamenstelling en netwerkbeheer en aan het schaarse onderzoek omtrent innovatie en netwerken in KMO's en de low-tech sectoren. Het biedt ook waardevolle conclusies voor beleidsmakers en netwerkbeheerders die beogen om netwerken tussen organisaties als instrument voor innovatie of regionale ontwikkeling op te starten of te verbeteren.

Curriculum Vitae

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WORK EXPERIENCE	**Universiteit Gent (BE)** *(Jan. 2010 – July 2014)* Scientific researcher - NETGROW (http://www.netgrow.eu/): Enhancing the innovativeness of food SMEs through the management of strategic network behaviour and network learning performance (FP7 Programme; 01/05/2010 – 31/05/2014) - MEET&FEELFOOD: Feasibility study about the development of a new Master program in Food Development (Leader – Flemish Government fund, 01/01/2010 – 30/06/2012) - CAPINFOOD (http://www.capinfood.eu/): Improving the enabling environment and public awareness for innovation in the South-East-European food sector through transnational collaboration (SEE Programme, 01/03/2011 - 31/08/2014) **Salesiana University, Quito (EC)** *(May 2009 – August 2009)* Intern - Qualitative research on innovation transfer and innovation development in marginal agricultural areas **Medisch Comité Nederland-Vietnam, Ho Chi Minh/Can Tho (VN)** *(April 2008 – August 2008)* Intern - Strategy and performance analysis of a non-profit organization providing traditional medical products in rural Southern Vietnam
LIST OF PUBLICATIONS	**Articles in peer-reviewed international journals included in the Science Citation *Index* (A1)** • **Virginie M. Lefebvre, Meri Raggi, Davide Viaggi, Clarissa Sia-Ljungström, Francesca Minarelli, Bianka Kühne, Xavier Gellynck** (2014). SMEs' Preference for Innovation Networks – a Choice Experimental Approach. *Creativity and Innovation Management Journal*, vol. 23 (4), pp. 415-435

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