

Knowledge Exchange in Innovation Networks: How Networks Support open Innovation in Food SMEs

Bianka Kühne, Virginie Lefebvre, and Xavier Gellynck

*Ghent University, Department Agricultural Economic,
Division Agri-Food Marketing and Chain Management,
Coupure Links 653, B-9000 Gent, Belgium,*

Bianka.Kuhne@UGent.be

Abstract

Knowledge exchange is a prerequisite for learning and consequently for innovation. Through open innovation, the innovating firms establish ties with other organizations, in order to innovate. At the baseline, open innovation is thus the exchange of knowledge through in- and out-flows of the knowledge at a company. Formal networks can provide access to other organizations and otherwise unavailable knowledge and resources and are seen as the locus of innovation. Four main categories of knowledge exchange can be distinguished: socialization, combination, articulation, and internalization. Within these categories, distinct but interdependent processes of knowledge exchange take place as described in the innovation production process (IPP) which consists of three main steps, knowledge accumulation, knowledge transformation, and knowledge exploitation (Roper et al., 2008). The objective of this paper is to explore how formal networks contribute to the categories of knowledge exchange and to each of the three steps of the IPP in order to conclude on how networks can facilitate open innovation among their members.

Data are collected by means of three case-studies conducted in three Flemish formal networks which focus on enhancing the innovativeness and learning capabilities of micro, small and medium sized enterprises (SMEs).

Our findings confirm the importance of networks in the process of knowledge exchange and innovation for SMEs in the food sector. The most important role of the networks is to create the appropriate environment according to the type of knowledge and the step(s) in the innovation production process focused on. Furthermore, it appears to be a very important task of the network to stimulate actively knowledge transformation into innovation outputs such as new or improved technology or product prototypes. Thereby, not only short-term effects should be aimed at, but also long-term effects e.g. for organizational innovation, should be taken into account.

In conclusion, all three networks follow very different approaches in order to facilitate, stimulate and support knowledge exchange and innovation among their members. Based on the results, managerial as well as policy implications are posed towards network members, i.e. the SMEs, network coordinators and researchers.

Key words: knowledge exchange, learning, triple helix networks, SMEs, food industry

1 Introduction

Open innovation is at the baseline the exchange of knowledge through in- and out-flows of the knowledge in a company (Chesbrough, 2003). In particular small and medium sized enterprises (SMEs) profit from applying an open innovation strategy and participating in networks to achieve access to the vast range of new knowledge that is created outside their firm's boundaries, but which is necessary to successfully innovate (Gellynck et al., 2007, Omta, 2002). Open innovation has been found to be applied in a variety of forms in the food sector (Sarkar and Costa, 2008). However, studies focusing on SME networks are yet limited and in particular with regards to the role of networks in knowledge exchange and innovation. Therefore, e.g. Sarkar and Costa (2008) conclude that more focused case-studies and empirical research is needed. The following sections provide a review of the literature about knowledge exchange and innovation, and the role of networks in these two aspects.

1.1 Knowledge exchange and innovation

Knowledge exchange is a prerequisite for learning and consequently for innovation (Lundvall et al., 2002, Powell et al., 1996). Knowledge exchange is considered as the transfer of knowledge by interaction between different parties through linkage and exchange; this can result in mutual learning (Based on Argote and Ingram, 2000, Education, 2011, Inkpen and Tsang, 2005, Nonaka and Takeuchi, 1995). Note, information and knowledge are two different concepts. **Information** is a flow of messages, while **knowledge** is created and organized by the very flows of information, anchored on the commitment and beliefs of its holder (Nonaka, 1994, p.15).

Knowledge is usually distinguished in two main categories, **tacit knowledge and explicit knowledge** (Hall and Andriani, 2002, Nonaka et al., 2000). Tacit knowledge is not articulated or codified, and generally harder to imitate by other organizations. It requires sharing of experiences through observation and imitation (Hall and Andriani, 2002). Therefore it has a greater competitive value. Explicit knowledge is more tangible and easy to transfer between individuals. It can be processed, transmitted and stored relatively easy in form of data, manuals, formulae etc. (Hall and Andriani, 2002, Nonaka et al., 2000). Firms need to use both tacit and explicit knowledge to create innovations (Cowan et al., 2000).

The process of **learning** is characterized by identifying, gathering, exchanging and interpreting relevant information and subsequently using this information to develop and apply new competencies for business improvement and innovation (Keursten et al., 2006). As learning can be considered a social construction process, the conditions under which is learned are strongly influencing on what is learned (Cohen and Levinthal, 1990, Powell et al., 1996). Networks can shape the conditions for optimal learning and fostering learning mechanisms (Powell et al., 1996). **Learning in networks** refers to the organization's ability to combine tacit and explicit knowledge resources through interaction with other organizations in the network in a dynamic process. This knowledge exchange can be divided into four main categories of processes: socialization, combination, articulation, and internalization (Nonaka, 1994, Nonaka and Takeuchi, 1995).

Socialization is the transfer of tacit to tacit knowledge through observation, imitation and practice. Through socialization skills that are difficult to articulate and to transfer are learned by doing and observing.

Combination is the transfer of explicit to explicit knowledge by combining discrete pieces of explicit knowledge into a new whole. For innovation, new knowledge can be created by

combining existing knowledge about markets and customers/consumers with existing knowledge on product characteristics into e.g. a new form of market innovation, which are new ways to reach market or approach consumers.

Articulation is the transfer of tacit to explicit knowledge and that way making tacit knowledge explicit. Nonaka refers to the example of a software developer who trained with/learned from one of the Japans best bakers to explicate the secret of the baker's outstanding but difficult to codify baking technique. After a year of learning and trial-and-error the software developer succeeded in a new kitchen appliance machine which was able to replicate the baker's special kneading technique.

Internalization is the transfer of explicit to tacit knowledge and appears when new explicit knowledge is disseminated/shared within an organization to broaden the employees own tacit knowledge.

The different learning processes are of different importance with regards to the novelty of the innovation under concern. Dependent on the degree of novelty of the innovation (e.g. new to the firm or to the world) different steps of the learning process as well as of the level of learning are required (Cohen and Levinthal, 1990, Tödtling et al., 2009). For instance, incremental innovation has smaller learning requirements because of learning by doing. In contrast, radical innovation requires substantial learning processes, e.g. for developing completely new technologies or ways of doing business.

In this paper **Innovation** is defined as the successful exploitation of new combinations of existing resources into new or improved products, methods of production, sources of supply, ways to organize business, and the exploitation of new markets or new ways to reach existing markets (Lundvall, 1995, Pittaway et al., 2004).

In order to reach innovation, different and functionally distinct but though interdependent processes of knowledge exchange are found to be necessary, as described in the **innovation production process** (Chen and Guan, 2011) or innovation value chain (Roper et al., 2008). The innovation production process usually starts with the process of knowledge accumulation, after which knowledge is then transformed and finally exploited (Chen and Guan, 2011, Hansen and Birkinshaw, 2007, Lefebvre and Gellynck, 2012, Roper et al., 2008).

Knowledge accumulation is the acquisition and accumulation of knowledge and innovation experiences

Knowledge transformation is the step where the accumulated knowledge is translated into innovation outputs such as new or improved technology or product prototypes, based on the allocation of resources related to both R&D and non-R&D to the innovation development.

Finally, **knowledge exploitation** is the phase when the firm derives economic profits from the innovation outcomes.

However, the firm's openness for conducting the innovation production process and in particular for tapping into external knowledge is greatly dependent on the extent of its internal innovation activities. Firms which are more actively involving in innovation are found to be more open to external knowledge and, like in a self-reinforcing cycle, they become more innovative due to being more aware of external opportunities (Cohen and Levinthal, 1990).

1.2 Knowledge exchange and innovation in the food sector and SMEs

In particular for small and medium sized enterprises (SMEs) in the food sector, the increasing complexity of the innovation process has led to a greater dependency on interaction for innovation within networks (Edwards et al., 2005, Zeng et al., 2010). In the **food industry**, innovation is not

purely based on R&D, but rather involves a learning process and interaction between different actors, as described in the theory of the New Economy (Avermaete and Viaene, 2002, Weaver, 2008). In relation to the introduction of innovations, **SMEs** often face internal problems, such as lack of human and financial resources, which result in limited organizational capabilities, poor motivation toward innovation, and lack of strategic vision (Avermaete et al., 2003, Scozzi et al., 2005). Furthermore it has been proven that SMEs are often unable to efficiently allocate and coordinate its resources, do not have access to relevant information and knowledge, and do not focus on learning but rather exhibit a continuation-of-day-to-day work mentality (Avermaete et al., 2003, Scozzi et al., 2005). Most of these problems can be overcome if SMEs are open towards collaboration and involve in networks (Avermaete et al., 2003, Scozzi et al., 2005, Tödtling et al., 2009). Also, recent trends and developments, such as increasing costs and complexity of R&D, shorter technology life cycles, increasingly knowledgeable suppliers and clients, growth of venture capital and growing diffusion of leading-edge knowledge in universities and research labs around the world, have led to a greater dependency of SMEs on knowledge and information available external to the firm (Avermaete et al., 2004a, Enzing et al., 2008, O'Reilly et al., 2003, Sarkar and Costa, 2008, Stewart-Knox and Mitchell, 2003).

Since most of the new knowledge is created outside of the firm's boundaries it is of utmost importance that firms actively tap into these external sources to strengthen their business. **Open innovation** implies the extensive use of inter-organizational ties to insource this external knowledge into the firm, but also the act of marketing internal ideas through channels outside a firm's current business area (Chesbrough, 2004). Through open innovation, the innovating firms establish ties with other organizations, as firms are increasingly forced to collaborate with other organizations in order to develop or absorb new technologies, commercialize new products or simply stay up-to-date on the latest developments and trends (Avermaete et al., 2004a, Enzing et al., 2008, Sarkar and Costa, 2008, Stewart-Knox and Mitchell, 2003). Networks can play a very important role in the formation and maintenance of such ties and collaborations (Pittaway et al., 2004, Sawhney et al., 2006).

1.3 Role of networks in knowledge exchange and innovation

The role of networks in the **stimulation of innovation** has been described widely in the literature (e.g. Brennan and Dooley, 2005, Daskalakis and Kauffeld-Monz, 2005, MacKinnon et al., 2002, Omta, 2004). Within the New Economic theory, many scholars acknowledge the network, within which a firm is embedded, to be more important for the development and implementation of innovation than the firm itself (e.g. Avermaete and Viaene, 2002, Edwards et al., 2005, Matthyssens et al., 2006, Omta, 2002, Pittaway et al., 2004, Weaver, 2008). A network serves as the locus of innovation because it provides access to knowledge and resources, that are otherwise unavailable (Grunert et al., 2008, Omta, 2004, Omta, 2002, Pittaway et al., 2004, Powell et al., 1996).

A **network** can be defined as a set of actors connected by a set of repeated interaction of formal and/or informal ties (Borgatti and Foster, 2003, Granovetter, 1973, Hamdouch, 2010, Owen-Smith and Powell, 2004). The actors are firms (competitors, suppliers, customers, auxiliary businesses etc.), individuals (boundary spanners etc.), knowledge centres (universities, research centres etc.) and other actors (network organizations, governments, special-interest groups, industry organizations etc.). The ties are the relationships between the actors. They may be formal (contractual, institutionalized) or informal (social, trust-based). The network is thus the place where actors within one, or between several related industrial sectors interact and collaborate to add value for the customer (Omta, 2004).

Networks increase the flow of information and have thus an important role in the diffusion and adoption of innovations (Ng et al., 2003, Pittaway et al., 2004). In relation, facilitating collaboration or **networking for innovation** is important, because it offers opportunities for new or alternative relationships, links or markets and allows access to new or complementary competencies and technologies (Lazzarini et al., 2001, Pittaway et al., 2004). In this way, the value of collaboration or networking for innovation is the rapid establishment of a complex knowledge base and diffusion system through streamlining information flows (Pittaway et al., 2004, Sawhney et al., 2006).

In particular for **SMEs**, network building is an important strategy. SMEs are more innovative when they are able to join and manage networking activities (Avermaete and Viaene, 2002, Gellynck et al., 2007, Omta, 2002, Sarkar and Costa, 2008). Previous research has identified that SMEs collaborate in particular with customers, suppliers, competitors, government organizations and research institutions to achieve more successful innovation (Edwards et al., 2005, Gellynck and Kühne, 2010, Pittaway et al., 2004, Ritter and Gemünden, 2003, Saad et al., 2002).

The objective of this paper is to explore how formal networks contribute to the categories of knowledge exchange and to each of the three steps of the IPP in order to conclude on how networks can facilitate open innovation among their members.

The paper is outlined as follows, in the subsequent section methodological aspects are provided, followed by the results and discussion of three case studies in Flanders (Belgium). The paper closes with conclusions and recommendations for science and businesses.

2 Methodology: a case-study approach

Three case studies were analysed to understand more about the role of networks in knowledge exchange and innovation in food SMEs. The focus lies on triple-helix networks, consisting of companies, research institutions and policy makers. Thereby, the latter function as the funding organization in our cases. All networks focus on the stimulation of learning and innovation of food SMEs.

A case-study approach is followed, whereby different actors in food networks are interviewed regarding their learning and innovation in networks. The selection of case-networks was based on an initial specification of structural indicators and an identification of networks, that could assure a broad variation in network alternatives. The initial indicators include: age (< 2 years versus > 2 years), source of finance (public, private, mixed), spatial orientation (local/domestic, global/international), targets in value chain (horizontal, vertical), focus of innovation (product, process, organization, market), network driver (industry, research, focal company, public body or group, SMEs), and scope (food, non-food). For each network, about 10 face-to-face interviews with different network members were conducted; a number that should assure stable results and the consideration of the network diversity. Depending on the type of network, the emphasis was on those triple-helix players that are most important for the type of network.

Table 1: Sections of semi-structured interview guide and main respondent categories

Sections	Main categories of respondents
1. General profile of the network	• Network coordinator or Network founder
2. Network inception	• Companies
3. Network evolution	• Research centers and organizations
4. Network membership	• Public bodies supporting or having supported the network
5. Network configuration and network ties	
6. Network activity	
7. Network governance and management	
8. Performance	

Source: own research

The data collection took place within the FP7 project NetGrow¹. The interviews were carried out simultaneously within a short period from December 2010 until May 2011 to avoid effects from changing economic environments. A semi-structured interview guide was developed and tested in advance. The interview guide was build up by following sections and had been adjusted to the main categories of respondents as indicated in Table 1. The interview guide was adjusted for the different categories of respondents because of the relevance and formulation of questions for each respondent type. Each interview was audio-recorded and transcribed subsequently. The method of analysis used was Open coding based on Grounded theory by (Glaser, 1978). Accordingly the data were first broken down into corresponding paragraphs or quotes with a similar context. Secondly, they were grouped and categorised again by codes, following the open coding methodology.

In Belgium three networks were selected based on the criteria mentioned above. An overview of the explored networks is described below and summarized in Table 2.

Table 2. Summary of Belgian Cases

	FLANDERS FOOD	PLATO	VLAZ
Focus	Product and process innovation	Organizational innovation	Product and process innovation
Strategy	Collaborative projects, individual advise, knowledge dissemination	Group sessions with SME managers and large firms	Bilateral projects between a firm and a university
Sector	Food and beverages sector and related companies	All sectors	Specific branch of the food industry
Age	6 years	21 years	8 years

3 Results of three Flemish case studies

The three networks investigated in Belgium are stimulating learning and innovation within firms and especially within SMEs, but they have a different strategy to accomplish this. In FLANDERS FOOD and PLATO firms share knowledge and experiences and work together in small groups. However, their

¹ The research leading to these results has received funding from the European Union Seventh Framework Program (FP7/2007-2013) under grant agreement n° 245301 NetGrow - "Enhancing the innovativeness of food SMEs through the management of strategic network behavior and network learning performance". The information in this document reflects only the authors' views and the Community is not liable for any use that may be made of the information contained therein. More information about the project: www.netgrow.eu

focus is on different aspects. In FLANDERS FOOD the focus lies on basic research, in contrast to PLATO which focuses on sharing experiences about management practices. In VLAZ only bilateral technological collaboration is done between a firm and a research institution.

In the following sections each network is shortly described and subsequently, it is specified how knowledge exchange is facilitated in the different networks and to which innovations the networks contribute.

3.1 Process of knowledge exchange in innovation networks

When considering knowledge exchange as a social construction process (Powell et al., 1996) it is important to pay attention to the conditions under which knowledge is exchanged as they strongly influence what is learned. Thus, in this section first a description of the conditions under which knowledge is exchanged in the different networks is provided followed by the kind of knowledge exchanged and the openness of the relationships.

FLANDERS FOOD aims at strengthening the competitive power of Flemish food firms by stimulating innovation. The focus lies on the collaboration of food firms, especially SMEs, and research institutions by means of collaborative projects of 1-2 years. In most of these projects, basic research is conducted within research institutions in close collaboration with the participating firms. The topics for the projects are identified based on regular assessment of the needs and opportunities for the sector within the agrofood chain. At a later stage valorisation of the results within the firm is facilitated. All kinds of firms related to the food sector are working together, competitors as well as non-competitors, e.g. producers, technology providers, raw material suppliers, packaging firms, etc.. This way the network facilitates the development of knowledge of its member firms. Furthermore, FLANDERS FOOD aims also at knowledge valorisation, i.e. to spread the learned knowledge and ascertain the food firms actually use the knowledge. Last but not least FLANDERS FOOD actively supports access to and dissemination of knowledge generated in the collaborative projects and elsewhere through seminars, books/booklets, newsletter, workshops/trainings and consultancy.

When the networks started its first collaborative projects the communication and relationship between the participants, in particular among the firms, was not very open. In the beginning communication was mainly directed only towards the network coordinator. One reason for this was the presence of competitors in the same collaborative project. Another reason was the barrier between firms and scientists, not having the same language and cognitive background. However, as the firms had more and repeated contacts and collaborative projects together, trust and hence knowledge exchange about rather sensitive information has improved, though it might still be limited due to the presence of competitors. On the other hand, the presence of firms that represent different aspects throughout the entire food processing chain (e.g. suppliers, processing companies, users) enrich the project, adding different aspects of the topics. Also the communication among firms and scientists has improved over time towards more direct and open contacts, because the firms realized that science can offer them information and knowledge which is useful for their company.

In this network the focus is mainly on knowledge combination and internalisation. During knowledge combination explicit knowledge from both business and science are combined into a new whole of explicit knowledge within the collaborative projects. Subsequently, the new explicit knowledge is internalised by the firms through translation of generic knowledge into specific knowledge both at a collective and individual basis through the dissemination and valorisation activities of the network.

The network coordinator plays an important role towards the “translation” of the knowledge into the firm’s language, so that even the smallest companies are able to grasp the theory of the basic research in order to be able to internalise the relevant knowledge.

The objective of **PLATO** is to facilitate knowledge exchange of CEO’s or key managers of SMEs by sharing their experiences and raising the problems they struggle with, within a small group of 10 – 15 people over a period of 2 years. The group is guided and moderated by 2 “godfather(s)” and/or “godmother(s)” who work in larger firms and have already a lot of field experience. First, godfathers/godmothers are trained in advance, to be sure that they have a clear understanding about what is expected from them and to learn them how to address certain issues. Then, the first group activity is a start-up weekend with all participating firms of the group together with the godfathers/godmothers meant as a relationship- and trust and team building activity. Subsequently, the meetings take place monthly and the themes discussed on these meetings are chosen by the participants. Every participant is free to utter his/her opinion, give suggestions and share experiences within the group. At the monthly meetings also guest speakers provide background information about the topic in question. An important issue is the composition of the groups. The network coordinator watchfully composes the group out of non-competing firms mostly from different sectors. After the start-up weekend and some monthly meetings the group members get to know each other and establish a more open relationship. During the 20 years of existence the project concept has been proven to be successful and thousands of Flemish entrepreneurs took part in the project.

The openness of the participants to exchange knowledge and also sensitive information is stimulated through the specific relationship building activity at the start-up weekend and disclosure agreement within the group, but also through the very clear rule on confidentiality “what is said in the group, stays in the group”. Furthermore, the careful selection of the members of each group, assuring the absence of competitors is an important point for facilitating open knowledge exchange.

Among the group members deep ties are developed allowing the exchange of very sensitive or confidential information. This also allows the transfer of tacit knowledge among the participants when exchanging their know-how and experiences on firm management and improvement of management skills. This process is also called socialization when tacit knowledge from one firm is transferred to another through observation, imitation and practice. However, also knowledge combination, articulation and internalisation easily take place in this kind of setting.

The success of this type of network activity largely depends on the quality and skills of the godfathers/godmothers, i.e. their ability to motivate the SME-managers to listen and to share information with the other participants. Furthermore, the participating SME-managers appreciated very much that they get open and honest feedback about their (daily) problems. Usually the participating SME-managers are working alone or having only few employees, and the group is a valuable “board of advice” and place of regular self-evaluation and reflection to them. A disadvantage might be that there is no exchange between the different groups, neither among godfathers/godmothers nor among SME-managers. Nevertheless, after a group has finished the SME-managers can join another starting group about the same or another topic. In some occasions, an existing groups start a new group together but on another topic. This group is then also open to new participants, however the difference in openness among the group members that knew each other and the newcomers is clearly experienced.

VLAZ established a low-threshold platform for SMEs providing access to technical advice and to conduct research in collaboration with an university with the aim to reinforce innovation in SMEs. Thereby, the theoretical knowledge of the university is translated into more practical knowledge for the firm. If a firm has a certain technological problem, it contacts the network coordinator (university). In most cases the network coordinator first carries out a study visit in the firm and will then try to provide a solution of the technological problem. If the problem is too complex a small research project is set up where the network coordinator brokerages the contact between the firm and a specific research institution, both members of the network. Thus the FLANDERS FOOD activities are mainly bilateral among only one firm and the university (network coordinator), group projects are very rare. The cooperation among the firm and the university/research institution is kept highly confidential.

The networks is set up in a way that there is no exchange between the firms that are members of this network because they are all members of the same branch of the food industry and therefore they are mainly competitors in a mostly high-competitive environment. The bilateral approach in this network between an individual firm and a research institution allows the open exchange of sensitive and even confidential information.

In these bilateral cooperations deep ties are developed among the individual firm and the network coordinator (university). This allows the exchange of explicit knowledge from research made applicable to the company's situation creating new explicit knowledge (knowledge combination). For the more complex problems also knowledge socialization and articulation are taking place, i.e. when the research institute is learning more about the specific problem of the company and creating a specific solution to this problem.

The focus of this network is foremost on providing SMEs easy access to scientific knowledge tailor-made to their problems. The bilateral approach seems necessary due to the (highly) competitive environment the network members (competitors) are operating in. Even though there is no exchange in this FLANDERS FOOD among the members, the firms are able to share openly their knowledge with the research institution they got in contact with. The network coordinator has a central role in this FLANDERS FOODs all contacts are mediated via him.

3.2 Role of the network in the innovation production process

Knowledge exchange is an important antecedent for innovation. As stated above knowledge exchange is part of the first step in the innovation production process, which is composed of three phases: knowledge accumulation, transformation and exploitation (Chen and Guan, 2011, Hansen and Birkinshaw, 2007, Roper et al., 2008). In the literature as well as in other empirical work the focus is mainly on the knowledge accumulation phase and in particular on knowledge exchange as this process seems to be the most difficult in its implementation (Lin et al., 2012). Within this paper we will extend this focus to the other two phases, namely transformation and exploitation into innovation outcomes and the role of the network in these three phases.

FLANDERS FOOD is clearly focusing on all three aspects of the innovation production process, with the main focus on overcoming the barriers of SMEs with regards to knowledge transformation and exploitation. For the knowledge accumulation the network coordinator is monitoring demand and starting-up market-driven, application-oriented research based on the innovative needs of the companies. Thereby the network uses its contacts to domestic as well as foreign knowledge institutions such as universities, colleges, private research centres etc.. Furthermore, existing scientific and technological knowledge is disseminated with the focus on the widest possible access

for SMEs. The knowledge is disseminated to the SMEs via newsletters, seminars, workshops, individual consultancies etc. Within the market-driven, application-oriented research (collaborative projects), individual company visits (consulting) and the other FLANDERS FOODactivities, high attention is paid to knowledge translation with the aim to translate generic knowledge and expertise, both on a collective as well as individual level, into specific knowledge. This knowledge translation mainly results in **product and process innovation** in the SMEs. Knowledge exploitation, i.e. when the firm derives economic profits from the innovation outcomes, is also strongly stimulated at both the individual and the collective level. For instance, collaborative projects must include an activity for knowledge exploitation, e.g. in form of a pilot-scale test in some of the participating companies. However, the results need to be presented and shared with the whole group of the collaborative project. It's important that all participating companies have access and can exploit the knowledge accumulated in the project. Due to the nature of these collaborative projects, rather common problems are tackled, allowing each company to develop a specific innovation based on the knowledge derived from the project. Also at individual level, e.g. at company visits, the firms are encouraged to think good about what they have learned and how they can use that knowledge to fix or prevent (future) problems or tackle technological challenges.

In **PLATO** the focus is on facilitating in particular knowledge transformation through the exchange of experiences of SME-managers and the transfer of management know-how from guest speakers, mentors and SME-managers to the latter. The aim is to establish a network between (very) small and larger companies, as well as among SMEs in particular, leading to **organizational innovation**. Due to the nature of this type of innovation, knowledge exploitation will only occur over time and might only have a minor impact in the short term, but prove to be of high value on the long term. However, the monthly meetings and an open atmosphere allow the participants to accumulate knowledge on specific topics from peers and guest speakers and to get feedback on possible ways for knowledge transformation.

In **VLAZ**, basically knowledge is accumulated and translated to solve (current) problems of the individual member companies. Thereby knowledge is accumulated between an individual firm and an research institution and translated for the latter, as described in the previous section. In this network foremost knowledge is provided that may lead to **product and process innovations**. Within this network it is not explicitly followed up whether the provided knowledge is exploited for economic profits from the innovation outcomes. However, the knowledge is tailor-made to the specific problem of the individual company and due to the high confidentiality assured, the firms can achieve competitive advantage when exploiting the knowledge into economic profits.

4 Discussion of the results

Access to knowledge and information seems to be the most critical factor in particular for SMEs in the food sector in order to innovate (Avermaete et al., 2004b, Cassiman and Veugelers, 2006, Gellynck et al., 2007). Networks are more and more seen as the locus of innovation as they facilitate, stimulate and provide access to the necessary knowledge and the exchange of knowledge (Pittaway et al., 2004, Powell et al., 1996).

Our findings confirm the importance of networks in the process of knowledge exchange and innovation for SMEs in the food sector. The main findings of our case studies are summarized in Table 3a and 3b, highlighting the similarities and differences between the three case studies on the

different aspects investigated. In the reminder of this section we elaborate on the latter in more detail.

The most important role of the networks in knowledge exchange and innovation for SMEs in the food sector found, is to create the appropriate environment according to the type of knowledge and the step(s) in the innovation production process focussed on. For example in VLAZ, where the context is highly competitive, the focus is on bilateral contacts between a firm and a research institute to allow open exchange of rather tacit knowledge and sensitive information. In PLATO instead, the issue of competitors is tackled by the careful selection of the participants, paying high attention to the absence of competitors in order to facilitate open and honest exchange of even confidential information and rather tacit knowledge. Finally, in FLANDERS FOOD, rather explicit knowledge is exchanged and on a less open level than in the other networks investigated. However, the involvement of all actors throughout the food chain is enriching the knowledge base of each participant.

On the aspect of the innovation production process, it appears to be a very important task of the network to stimulate actively knowledge transformation into innovation outputs such as new or improved technology or product prototypes. In particular micro and small enterprises were found to face the greatest problems in grasping all relevant knowledge and in possessing sufficient human and financial resources for transforming the knowledge into tangible innovation outputs. In FLANDERS FOOD, SMEs are accompanied also on an individual level if necessary in order to transform and exploit the scientific knowledge e.g. accumulated in the collective research projects. However, transformation and exploitation might not result in short-term effects but show effects only after a certain time depending on the kind of innovation, as illustrated in the case of PLATO where the focus is on organizational innovation in contrast to product and process innovation created in FLANDERS FOOD and VLAZ.

The role of the network in knowledge exchange and innovation lies thus in the areas/aspects where food firms and in particular SMEs would have difficulties to access the relevant knowledge by themselves. Two of the networks under investigation focus on the transfer of scientific knowledge towards businesses (FLANDERS FOOD and VLAZ), while in the other network (PLATO) the focus is on transferring management skills among businesses. The first two networks tackle thus the problems related to the often occurring incongruity between the outcome of scientific research and the applicability to a business setting. The other network is thus focusing on the improvement of the (lacking) managerial skills of SME-managers in many different areas, which will lead to an overall improvement of their business success and enhancing their sustainable competitive advantage on the long-term.

Table 3a. Summary of main findings highlighting similarities and differences between the three case studies – Contextual aspects

NETWORK	FLANDERS FOOD	PLATO	VLAZ
Level of competitiveness in environment/sector	Competitive	Not competitive	Highly competitive
Sectors	Food & food-related companies	Food & Non-food	Specific branch of food sector
Type and members of network activity	<ul style="list-style-type: none"> • Businesses (SMEs and MNCs) and Researchers • Presence of competitors in groups • 1-2 year research projects 	<ul style="list-style-type: none"> • Groups of SMEs guided by Larger Firms • No competitors • Business network 	<ul style="list-style-type: none"> • SMEs and Research • Bilateral cooperation • Short-term/ direct support
Objectives of network	Access to and valorisation of scientific knowledge	Exchange platform for experiences and (daily) problems on managerial issues	Improve innovation culture in SMEs; Low-threshold platform to access scientific, technological knowledge
Dyadic/Collective level of exchange	Collective	Collective	Dyadic/bilateral
Openness (explanation)	Open (Presence of competitors and all other actors of the food chain)	Very open (Clear rule of confidentiality and high trust within the group)	Very open, (but only in dyad, between one firm and the network coordinator)

Table 4b. Summary of main findings highlighting similarities and differences between the three case studies – Knowledge exchange and Innovation production process

NETWORK	FLANDERS FOOD	PLATO	VLAZ
Ties formed	Mostly wide ties among members	Mostly deep ties among members	Deep ties with network coordinator
Main type of knowledge*	Explicit	Tacit	Tacit
Processes of knowledge exchange	Combination and internalisation	Socialization, combination, articulation and internalisation	Combination, socialization, and articulation
Focus in Innovation production process	Active stimulation of all three steps: knowledge accumulation, transformation, and exploitation	Focus on transformation; Inherent Accumulation; No explicit stimulus of exploitation due appearance of effects only in the long-term	Focus on accumulation and transformation; No follow up on exploitation, but tailored accumulation and transformation lets expect possible exploitation

* Main type of knowledge exchanged in this network. It does not exclude the exchange of the other type of knowledge

As stated by Cowan et al. (2000), a balance between explicit and tacit knowledge is necessary in order to successfully innovate. In our three case-networks both types are exchanged. It appears that the contextual aspects (i.e. level of competitiveness, sectors, types and members, objective) seem to determine which type of knowledge will be more focused on and is possibly easier to exchange. Moreover, the contextual aspects seem also to define the type of ties which are possible to develop between the network members. In FLANDERS FOOD, the focus is rather on explicit knowledge exchanged in rather wide ties in the joint projects due to the limitations of openness and the differences in cultural backgrounds of businesses and researchers, which is countered by the involvement of all actors throughout the food chain enriching the knowledge base of each participant in the joint projects. In contrast, in the other two networks, the focus is rather on tacit knowledge exchanged in deep ties, due to openness in the relationships as confidentiality is assured. However, in VLAZ ties are only formed between with the network coordinator and in contrast, in FLANDERS FOOD deep ties are also developed among the participants in some joint projects where implicit knowledge might be exchanged as well.

5 Conclusions and future research

Three networks for knowledge exchange and innovation have been investigated in this study. All three networks are formal networks focusing on enhancing the competitive advantage of SMEs in the food sector through knowledge exchange and innovation. Nevertheless, all three networks follow very different approaches in order to facilitate, stimulate and support knowledge exchange and innovation among their members.

Our main conclusion is that networks need to adapt their approach and activities depending on the type of innovation aimed at and the impact of their activities on the competitive advantage of their members. The main role of networks for knowledge exchange and innovation is to provide access to knowledge in areas where in particular SMEs are facing difficulties to access the relevant knowledge by themselves, and to facilitate knowledge transformation and exploitation into tangible innovation outcomes. The networks under investigation each have a different approach for to fulfil this role.

In networks where the setting allows open knowledge exchange based on deep ties, Tacit knowledge seems to be more easily exchanged. On the contrary, in a less open setting where mainly explicit knowledge is exchanged, the firms with the capabilities to grasp all relevant knowledge, might be more successful in the eventual transformation and exploitation of the knowledge into innovation, though this issue can be actively tackled by the network coordinator as in the case of FLANDERS FOOD. The creation of an environment which allows open knowledge exchange of both tacit and explicit knowledge is positively influencing the innovation outcome of the network members.

In conclusion, scientists need to adopt a more entrepreneurial culture in order to be able to provide results applicable to a business setting. On the contrary, businesses need to be more open in sharing the relevant knowledge necessary for the development of successful innovation. However, businesses need also to be more open towards tapping into knowledge external to their firm and transforming and exploiting this knowledge as well. Networks play an important role as facilitators and translators in the knowledge exchange process of converting external, scientific or business knowledge into internal knowledge, useable for the creation and implementation of successful innovations.

For future research, the views of the individual members of networks should be investigated separately providing more in-depth insights into the needs and expectations of network members, network providers and network funders in networks that aim at stimulating open innovation in the food sector.

References

- Argote, L. & Ingram, P. (2000) Knowledge transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior and Human Decision Processes*, 82, 150-169.
- Avermaete, T. & Viaene, J. (2002) On Innovation and Meeting Regulation - the Case of the Belgian Food Industry. *DRUID Summer Conference on "Industrial Dynamics of the New and Old Economy - who is embracing whom?"*. Copenhagen/Elsinore, 6-8 June 2002.
- Avermaete, T., Viaene, J., Morgan, E. J. & Crawford, N. (2003) Determinants of innovation in small food firms. *European Journal of Innovation Management*, 6, 8-17.
- Avermaete, T., Viaene, J., Morgan, E. J. & Crawford, N. (2004a) The impact of firm characteristics and macroeconomic performance on innovation in small food firms: Case study from Belgium, Ireland and UK. IN de Noronha Vaz, T., Viaene, J. & Wigier, M. (Eds.) *Innovation in Small Firms and Dynamics of Local Development*. Warsaw, Scholar Publishing House, 79-95.
- Avermaete, T., Viaene, J., Morgan, E. J., Pitts, E., Crawford, N. & Mahon, D. (2004b) Determinants of product and process innovation in small food manufacturing firms. *Trends in Food Science & Technology*, 15, 474-483.
- Borgatti, S. P. & Foster, C. F. (2003) The Network Paradigm in Organizational Research: A Review and Typology. *Journal of Management*, 29, 991-1013.
- Brennan, A. a. L. & Dooley, L., . (2005) Networked creativity: a structured management framework for stimulating innovation. *Technovation*, 25, 1388-99.
- Cassiman, B. & Veugelers, R. (2006) In Search of Complementarity in the Innovation Strategy: Internal R&D and External Knowledge Acquisition. *Management Science*, 52, 68-82.
- Chen, K. & Guan, J. C. (2011) Mapping the Innovation Production Process from Accumulative Advantage to Economic Outcomes: A Path Modelling Approach. *Technovation*, 31, 336-346.
- Chesbrough, H. (2003) *Open Innovation: The New Imperative for Creating Profiting from Technology*, Boston, Harvard Business School Press.
- Chesbrough, H. (2004) Managing Open Innovation. *Research & Technology Management*, January-February, 23-26.
- Cohen, W. M. & Levinthal, D. A. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35, 128-152.
- Cowan, R., David, P. A. & Foray, D. (2000) The Explicit Economics of Knowledge Codification and Tacitness. *Industrial and Corporate Change*, 9, 211-253.
- Daskalakis, M. & Kauffeld-Monz, M. (2005) Trust and knowledge in the behavioural dynamics of innovation networks. *Paper presented on the 4th European Meeting on Applied Evolutionary Economics*. Utrecht.
- Education, R. S. P. i. (2011) *Knowledge Mobilization: terms and definitions*. http://www.oise.utoronto.ca/rspe/KM_Products/Terminology/index.html.
- Edwards, T., Delbridge, R. & Munday, M. (2005) Understanding innovation in small and medium-sized enterprises: a process manifest. *Technovation*, 25, 1119-1127.
- Enzing, C. M., Janszen, F. H. A. & Omta, O. S. W. F. (2008) The impact of the openness of the innovation process on the short term and the long term market performance of new products: Evidence from new product announcements of the Dutch food and drinks industry. *8th International Conference on Management in AgriFood Chains and Networks*. Ede, The Netherlands, 28-30 May 2008, Wageningen Academic Publishers.

- Gellynck, X. & Kühne, B. (2010) Horizontal and Vertical Networks for Innovation in the Traditional Food Sector. *International Journal on Food System Dynamics*, 1, 123-132.
- Gellynck, X., Vermeire, B. & Viaene, J. (2007) Innovation in food firms: Contribution of regional networks within the international business context. *Entrepreneurship & Regional Development*, 19, 209-226.
- Glaser, B. G. (1978) *Theoretical Sensitivity: Advances in the Methodology of Grounded Theory*, Sociology Press.
- Granovetter, M. (1973) The Strength of Weak Ties. *American Journal of Sociology*, 78, 1360-1380.
- Grunert, K. G., Jensen, B. B., Sonne, A.-M., Brunsø, K., Byrne, D. V., Clausen, C., Friis, A., Holm, L., Hyldig, G., Kristensen, N. H., Lettl, C. & Scholderer, J. (2008) User-oriented innovation in the food sector: relevant streams of research and an agenda for future work. *Trends in Food Science & Technology*, 19, 590-602.
- Hall, R. & Andriani, P. (2002) Managing knowledge for innovation. *Long Range Planning*, 35, 29-48.
- Hamdouch, A. (2010) Conceptualising Innovation Networks and Clusters. IN Laperche, B., Sommers, P. & Uzundis, D. (Eds.) *Innovation networks and clusters: The knowledge backbone*. Brussels, P.I.E. Peter Lang S.A.
- Hansen, M. T. & Birkinshaw, J. (2007) The Innovation Value Chain. *Harvard Business Review*, 85, 121-130.
- Inkpen, A. C. & Tsang, E. W. K. (2005) Social capital, networks, and knowledge transfer. *Academy of Management Review*, 30, 146-165.
- Keursten, P., Verdonshot, S., Kessels, J. & Kwakman, K. (2006) Relating learning, knowledge creation and innovation: case studies into knowledge productivity. *International Journal of Learning and Intellectual Capital*, 3, 405-420.
- Lazzarini, S. G., Chaddad, F. R. & Cook, M. L. (2001) Integrating supply chain and network analyses: The study of netchains. *Journal on Chain and Network Science*, 1, 7-22.
- Lefebvre, V. & Gellynck, X. (2012) Intermediary Organizations and Development of Social Capital in Interorganizational Networks: A Belgian Case Study in the Food Sector. *10th Wageningen International Conference on Chain and Network Management "Multi-Stakeholder Dynamics in Chains and Networks"*. Wageningen, The Netherlands, 23-25 May 2012.
- Lin, T.-C., Wu, S. & Lu, C.-T. (2012) Exploring the affect factors of knowledge sharing behavior: The relations model theory perspective. *Expert Systems with Applications: An International Journal*, 39, 751-764.
- Lundvall, B.-A. (1995) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, London, UK, Pinter Publishers.
- Lundvall, B.-A., Johnson, B., Andersen, E. S. & Dalum, B. (2002) National systems of production, innovation and competence building. *Research Policy*, 31, 213-231.
- Mackinnon, D., Cumbers, A. & Chapman, K. (2002) Learning, innovation and regional development: a critical appraisal of recent debates. *Progress in Human Geography*, 26, 293-311.
- Matthyssens, P., Vandenbempt, K. & Berghman, L. (2006) Value innovation in business markets: Breaking the industry recipe. *Industrial Marketing Management*, 35, 751-761.
- Ng, D., Sonka, S. & Westgren, R. (2003) Co-evolutionary Processes in Supply Chain Networks. *Journal on Chain and Network Science*, 3, 45-58.
- Nonaka, I. (1994) A Dynamic Theory of Organizational Knowledge Creation. *Organization Science*, 5, 14-37.
- Nonaka, I. & Takeuchi, H. (Eds.) (1995) *The knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford, University Press.

- Nonaka, I., Toyama, R. & Konno, N. (2000) SECI, Ba and Leadership: A Unified Model of Dynamic Knowledge Creation. *Long Range Planning*, 33, 4-34.
- O'Reilly, S., Haines, M. & Arfini, F. (2003) Food SME networks: Process and governance - The case of Parma ham. *Journal on Chain and Network Science*, 3, 21-32.
- Omta, O. (2004) Management of Innovation in Chains and Networks. IN Camps, T., Diederer, P., Hofstede, G. J. & Vos, B. (Eds.) *The Emerging World of Chains and Networks. Bridging theory and practice*. 's-Gravenhage, Reed Business Information.
- Omta, O. S. W. F. (2002) Innovation in chains and networks. *Journal on Chain and Network Science*, 2, 73-80.
- Owen-Smith, J. & Powell, W. W. (2004) Knowledge networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community. *Organisation Science*, 15, 5-21.
- Pittaway, L., Robertson, M., Munir, K., Denyer, D. & Neely, A. (2004) Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews*, 5-6, 137-168.
- Powell, W. W., Koput, K. W. & Smith-Doerr, L. (1996) Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly*, 41, 116-145.
- Ritter, T. & Gemünden, H. G. (2003) Network competence: its impact on innovation success and its antecedents. *Journal of Business Research*, 56, 745-755.
- Roper, S., Du, J. & al., e. (2008) Modelling the Innovation Value Chain. *Research Policy*, 37.
- Saad, M., Jones, M. & James, P. (2002) A review of the progress towards the adoption of supply chain management (SCM) relationships in construction. *European Journal of Purchasing & Supply Management*, 8, 173-183.
- Sarkar, S. & Costa, A. I. A. (2008) Dynamics of open innovation in the food industry. *Trends in Food Science & Technology*, 19, 574-580.
- Sawhney, M., Wolcott, R. & Arroniz, I. (2006) The 12 different ways for companies to innovate. *MIT Sloan Management Review*, 47, 75-81.
- Scozzi, B., Garavelli, C. & Crowston, K. (2005) Methods for modeling and supporting innovation processes in SMEs. *European Journal of Innovation Management*, 8, 120-137.
- Stewart-Knox, B. & Mitchell, P. (2003) What separates the winners from the losers in new food product development? *Trends in Food Science & Technology*, 14, 58-64.
- Tödtling, F., Lehner, P. & Kaufmann, A. (2009) Do different types of innovation rely on specific kinds of knowledge interactions? *Technovation*, 29, 59-71.
- Weaver, R. D. (2008) Collaborative Pull Innovation: Origins and Adoption in the New Economy. *Agribusiness*, 24, 388-402.
- Zeng, S. X., Xie, X. M. & Tam, C. M. (2010) Relationship between cooperation networks and innovation performance of SMEs. *Technovation*, 30, 181-194.