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Relationship Quality and Innovation Capacity of Chains: The Case of the Traditional Food Sector in the EU

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Abstract

The purpose of the paper is to explore how the perceived relationship quality is related to the innovation capacity in chains of the traditional food sector. Based on suggestions from theory and previous studies, empirical evidence is drawn from a survey of 90 traditional food chains including 270 chain partners from three European countries in four traditional food product categories. Heterogeneity across these chains is first examined based on cluster analysis that identifies three distinct clusters interpreted as reflecting three levels of intensity in innovation capacity: high, medium, and low. Next, we define measures of the chain relationship quality through characteristics such as trust, conflict and reputation. Results suggest that various aspects of chain relationship quality and relationship directions are differently important for the innovation capacity levels in traditional food chains. In particular the perception of the relationship quality between the food manufacturer and its supplier (and vice versa) is explored to be important. The better this relationship is perceived by one chain partner, the higher is the innovation capacity of the whole chain. Thus, our results strengthen the emerging conclusion that firms benefit from participating in networks but depend on its partner's choices and perceptions. In future research, it should be explored how different national and cultural environments facilitate or hamper the innovation capacity in traditional food chains. It is also suggested to extend the complexity of the investigated system and to apply our novel approach to other food sectors, than the traditional food sector, in order to improve its generalizability.

Keywords: innovation capacity, chain relationship quality, traditional food products, SMEs, different chain relationship directions

1 Introduction

Innovation in the food industry is considered not to draw purely on R&D but is rather involving a learning process and interaction between different actors. This is also referred to as the New Economy (Avermaete & Viaene, 2002; Weaver, 2008). In the New Economy the generation of innovation is taking place in networks where value is created through productive working relationships or collaboration (Avermaete & Viaene, 2002). Thus, the locus of innovation is not the single enterprise anymore but increasingly the network the enterprise is embedded in (Grunert et al., 2008; Omta, 2004; Omta, 2002; Pittaway et al., 2004; Powell et al., 1996). Several studies have pointed out that firms in the agrifood sector are highly dependent on external sources of information for innovation and hence have to open up their innovation process to their network (Avermaete et al., 2004a; Enzing et al., 2008; Sarkar & Costa, 2008; Stewart-Knox & Mitchell, 2003). Such a network can be the direct food chain, consisting of the food manufacturer, its supplier and its customer (Mentzer et al., 2001).

In our paper, innovation is defined as an ongoing process of learning, searching and exploring, resulting in new products, new techniques, new forms of organization, and new markets (Lundvall, 1995) which are new to the enterprise or to the industry ranging from incremental to radical innovations. We focus our

attention on the traditional food sector because several authors stress the challenge of innovating traditional food products (Amilien et al., 2005; Gellynck & Kühne, 2008; Jordana, 2000). Traditional food products are defined as follow: (1) the key production steps of a traditional food product must be performed in a certain area, which can be national, regional or local. (2) The traditional food product must be authentic in its recipe (mix of ingredients), origin of raw material, and/or production process. Further, (3) the traditional food product must have been commercially available for at least 50 years and (4) it must be part of the gastronomicheritage.

Up to the present, only few studies have been conducted focusing particularly on innovating traditional food products (Jordana, 2000). Innovations in the traditional food sector should aim at strengthening and widening the market for traditional food products in accordance to emerging problems such as poor imitations and changing eating patterns towards more manufactured foods and convenience (Trichopoulou et al., 2006). Moreover, the food sector and in particular the subsector of traditional food products, is compiled of more than 99% of small and medium sized enterprises (SMEs), i.e. firms employing less than 250 people (CIAA, 2008). In the more and more globalised and competitive market, innovation is an important strategic tool for SMEs to achieve competitive advantage (Avermaete et al., 2004a; Gellynck et al., 2007; Murphy, 2002).

Further, the case of traditional food products is not yet extensively analyzed from the chain perspective, with some noteworthy exceptions (Barjolle & Sylvander, 2002; Gellynck & Molnár, 2009). Previous studies investigating the chain compared groups of stakeholders, e.g. at the level of the supplier, the manufacturer, and the customer and did not consider links between individual actors. (e.g. Fischer et al., 2008; Hardman et al., 2002; Pannekoek et al., 2005). Other studies conducted intensive case-studies on a limited number of individual chains (e.g. Aramyan et al., 2007; Barjolle & Sylvander, 2002; Bröring, 2008; Raynaud et al., 2005; Soosay et al., 2008). A broader overview on these studies is provided in Gellynck et al. (in press). The investigation of the role of personalized links between the chain members and their role in innovation at a quantitative level has not been pursued in past literature to our knowledge.

However, the introduction of innovations is often hampered by numerous problems, including the controversy of tradition and innovation and limited resources and possibilities to realize economics of scale (Avermaete et al., 2004a; Lazzarini et al., 2001; Maravelakis et al., 2006; O'Regan et al., 2006; Pittaway et al., 2004; Scozzi et al., 2005). The understanding of how SMEs innovate will improve by evaluating their intra- and inter-organizational links (Edwards et al., 2005). SMEs will be able to overcome the various problems and to enhance their innovativeness through networking and use of the complementary capacities and technologies of their chain partners (Pittaway et al., 2004). An improved involvement of all members in the chain will support the innovation capacity of the chain and reduce the risk of implementing innovations, e.g. by joint cost management (Omta, 2002; Pittaway et al., 2004).

The aim of our paper is to explore how perceived quality of relationships among chain members is related to the innovation capacity of chains in the traditional food sector.

This paper is structured as follows. In the subsequent section our conceptual framework and theoretical model is presented illustrating how the chain relationship quality might influence the innovation capacity. Following, methodology and results are presented in the subsequent sections. Finally, conclusions are drawn.

2 Conceptual framework

Since the innovativeness of an enterprise depends on its access to information, internal and external resources that support access to information are important factors contributing to innovation (Avermaete et al., 2004b; Gellynck et al., 2007; Pannekoek et al., 2005; Petroni & Panciroli, 2002; Roy et al., 2004). Internal resources include enterprise characteristics, such as the R&D structure, qualified staff, experience of the manager, the openness toward new ideas, financial structure, and the size of the enterprise (Bröring, 2008; Diederen et al., 2000; Fey & Birkinshaw, 2005; Grünert et al., 1997; Omta, 2002; Pannekoek et al., 2005; Petroni & Panciroli, 2002; Roy et al., 2004; Soosay et al., 2008; Tuominen & Hyvönen, 2003). External resources belong to the enterprise's strategic environment and include the potential of business-to-business relationships, available infrastructure for collaboration and networking, and access to support from research providers and government (Avermaete & Viaene, 2002; Bröring, 2008; Omta, 2002; Pannekoek et al., 2005; Petroni & Panciroli, 2002; Roy et al., 2004; Scozzi et al., 2005; Soosay et al., 2008; Ussman et al., 1999).

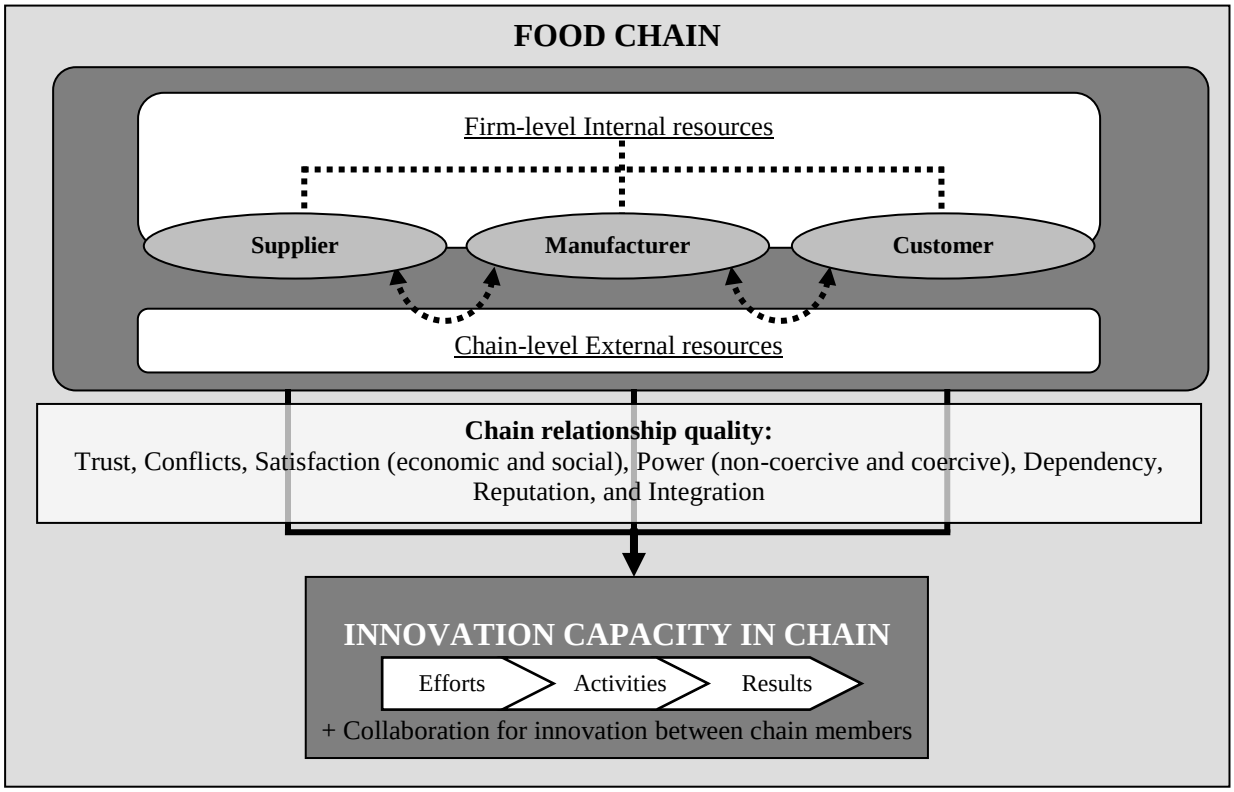

Figure 1.
Conceptual framework for investigating innovation capacity in food chains, adapted from Gellynck at al. (2007)

For assessing the innovation capacity of chains, indicators for innovation efforts (human and financial resources for R&D), innovation activities (implementation of product, market and organizational innovation during a certain period of time) and innovation results (perceived contribution of innovation activities to the business success) are applied, both from the food manufacturers, and their suppliers and customers. Process innovations are not included in our model, because in traditional food products process innovations are not frequently observed (Gellynck & Kühne, 2008). For assessing the innovation capacity at chain level, collaboration for innovation was included as linking element between the chain members, recording whether the chain members carry out joint activities for research and development.

SMEs need an environment that fosters the involvement of both suppliers and customers in the innovation process (Ussman et al., 1999). This is supported by the fact that the place of innovation is no longer the individual enterprise but increasingly the chain in which the enterprise is embedded (Omta, 2002; Pittaway et al., 2004; Powell et al., 1996). Consequently, the chain is an important factor for SMEs in the process of developing innovation capacities (Figure 1). The chain is the place where the internal and external resources of an enterprise are combined and possibly transformed into innovation capacities (Gellynck et al., 2007). Through the optimal use and combination of both internal and external resources in the chain, an enterprise can attain a higher innovation capacity in its chain and will be able to achieve sustainable competitive advantage with the chain as a whole (Cassiman & Veugelers, 2002; Lengnick-Hall, 1992).

However, it is not always possible to optimally combine the resources in the chain for the development of innovation capacity. The feasibility of achievement of such a goal depends on the quality of the chain relationships which is influenced by several success factors and barriers (Gellynck et al., 2007; Omta, 2002; Petroni & Panciroli, 2002; Roy et al., 2004; Tuominen & Hyvönen, 2003). Most researchers recognize trust between chain partners to be the most important success factor that supports innovation (Ameseder et al., 2008; Fritz, 2009; Gellynck et al., 2007; Grunert et al., 2008; Omta, 2002; Pittaway et al., 2004; Ritter & Gemünden, 2003; Roy et al., 2004). Trust is affecting the character and extent of interactions in a relationship and evolves when network density results in strong ties where the partners are extensively connected (Lazzarini et al., 2001). However, other authors state that sparse networks, characterized by structural holes and weak ties, are generating more new information and offer more diverse knowledge bases than dense networks (Lazzarini et al., 2001). Achievement of knowledge diversity in the innovation process is very important as it generates positive externalities and provides increased opportunities for innovation (Lazzarini et al., 2001; Omta, 2004). Subsequently, good communication of the knowledge is important for successful innovation (Pannekoek et al., 2005). Nevertheless, good communication in chain

relationships can be disturbed by conflicts of interests (Pittaway et al., 2004). These conflicts are mainly not about costs and benefits of the outcome of the chain relationship, but rather about disagreements, different expectations, or distrust (Batterink et al., 2008). Hence, conflicts can form a barrier to a successful innovation process.

Nonetheless, there are more factors influencing a successful innovation process. These factors are related to other determinants of long-term business relationships, i.e. satisfaction, power, dependence, reputation and integration. Satisfaction is an important requisite for the improvement of a business relationship (Bruce & Daly, 2003). Since satisfaction derives from all aspects of a business relationship, both economic and social aspects of this relationship should be considered (Batt, 2004). Economic satisfaction refers to the business partner's positive affective response to economic rewards that result from the relationship. Social satisfaction is the business partner's positive affective response to non-economic aspects of the relationship. This includes that there is fulfilling, gratifying and easy information exchange because the business partners believe they are concerned, respectful and willing to exchange ideas for/with each other (Batt, 2004).

Power and dependence are closely related to each other and are achieved when one chain member holds critical resources important for the innovation process of another chain member (Batt, 2004; Omta, 2002). In case, one chain partner is using his power on critical resources to force the other partner(s) into action, the quality of the business relationship is probably to decrease. This kind of power is also referred to as coercive power (Jonsson & Zineldin, 2003). The more power a chain partner achieves over another chain partner the greater the dependency will be (Batt, 2004). Though, power does not have necessarily a negative connotation, but can also be a driver for improved networking and better performance (Arend & Wisner, 2005; Omta, 2002). For instance, when non-coercive power is used, the business relationship will be driven by teamwork and common interests (Jonsson & Zineldin, 2003). Reputation is acknowledged as another prerequisite for successful innovation, since it helps to foster initial trust and to solve competition and coordination problems in a business relationship (Arend & Wisner, 2005; Omta, 2002; Roy et al., 2004). Finally, integration is a form of governance structure ranging from spot market to vertical integration. The way chains are governed is having an important influence on their contribution to successful innovation (Coles et al., 2003) and in each chain relationship it is necessary to determine the appropriate governance structure (Pittaway et al., 2004).

3 Theoretical model

Despite the depth of empirical studies based on conceptual frameworks previously mentioned, little progress has been made to develop in parallel a microeconomic theory of the determination of innovation capacity. As a foundation for empirical modeling consider the following. Define a set of *n* firms, N = {1,2.,…n}. Define *r* = (*i, j)* as a relationship between two firms *i* and *j* . If we assume each firm has a set of relationships that it maintains at time, we can define that set of relationships as the firm's neighborhood. In the real world, such neighborhoods compose chains based on vertical relationships and horizontal relationships with peer firms to define networks. That is, for the set N of firms, we can suppose they define a network (or chain) *c*.

The essence of such a network is that any particular firm benefits and incurs cost from not only its own relationships *r* but also those of its immediate partners. Define *R(r,c)* as a vector of indicators that describe the characteristics (e.g. quality) of relationship *r* in neighborhood *c*. Let π_i *(r,c)* define the payoff (e.g. enhanced present value of expected revenue) expected by firm *i* due to its relationships *r* in neighborhood *c*. In general, stepping aside of intertemporal aspects for now, we can define this payoff as follows:

$$\pi_i(r,c) = \sum_{j \in N | i} \delta(R(r,c))\rho(r,c) - \sum_{r \in c_i} \kappa(r,c) \quad (1)$$

where we define the expected benefits of relationship *r* in network *c* as $\rho(r,c)$ and the cost of its maintenance as $\kappa(r,c)$. We define $\delta(R(r,c))$ as a discount factor that defines the share of expected benefits that are transferred in the relationship as conditional on the vector *R(r,c).* In practice, elements of *R(r,c)* will describe trust of partners, the form of relationship *f(r,c*), and the bargaining power characteristics *p(r,c)*.

Next, consider the nature of benefits from relationships. In the case of interest in this paper, we focus on benefits as resulting from innovation based on the knowledge transfers associated with a relationship. Define the explicit knowledge set φ_j held by any firm in a network is a public good and can be assumed to be instantaneously transferred through relationships. Thus, an immediate benefit of participation in a

network is access to the network knowledge set φ_c. However, tacit knowledge can be assumed to be transferred only through bilateral relationships and conditional on the characteristics of those relationships. Defining tacit knowledge held by firm *j* as τ_r we can define the tacit knowledge transferred in relationship *r* as τ_r. Based on this notation, we suppose the expected benefits of the relationship are conditional on the tacit knowledge stock held by the partner. However, as the relationship is virtual, firms do not have complete information concerning their partner's tacit knowledge stock and so depend on quality dimensions of their relationship to establish whether communicated tacit knowledge could be valuable. That is, within this context, we can suppose $\rho(r,c)$ is conditional on perceived reputation of partners. For example, we can suppose that $\rho(r,c)$ increases as the share of tacit knowledge transfer gained from a relationship increases. Finally, we define the cost of any relationship as conditioned the cost of transactions defined in terms of negotiation, conflict resolution, etc.

If we view formula (1) as the objective for the selection of collaborative relationships for innovation, it is clear that it requires further elaboration to incorporate the stochastic nature of innovation. In particular, it is important to note that the expected benefit of the collaboration will depend on an assessment of the probability of success where that probability is conditioned by both the tacit, relationship specific knowledge and the explicit knowledge that is generally accessible from the network. Further, we must suppose that control of the probability of innovation is feasible by the firm and perhaps its partners through their effort. From this perspective, a formal analysis would look for each firm to solve an optimal control problem based on formula (1) in which the controls would be choice of business relationships to form (see Weaver, 2009), the specification of the form of such business relationships, and choice of innovation efforts and activities to pursue to affect the probability of innovation. From another perspective, this probability of innovation can be viewed as innovation capacity which as already noted is endogenous to the firm's optimal control problem. Unfortunately, as Weaver (2009) noted, the firm is not free to make its choices independent of the choices made by other firms in its network. Thus, each firm's optimal control problem is constrained by the actions and decisions of those other firms. By implication, each firm's innovation capacity is similarly conditioned by the determinants of the choices of other firms in its network.

4 Methodology

Drawing on the theoretical and conceptual framework a questionnaire was developed. The quantitative data were collected by means of 270 individual, face-to-face interviews with traditional food manufacturers, their suppliers and their customers. These firms were drawn from triplets of 90 traditional food chains across three European countries (Belgium, Hungary and Italy). Each triplet included the food manufacturer (FM), the supplier of the food manufacturer (S) and the customer of the food manufacturer (C) Moreover, as an inclusion criterion, in this study the food manufacturers must be an SME (a firm that employs fewer than 250 people and has a maximum turnover of fifty million Euros (according to EC, 2001) and producing traditional food products. However, these restrictions did not apply for the supplier and the customer of the food manufacturer. Hence, non-probability judgment sampling was applied. This is an appropriate sampling method for providing a first insight (De Pelsmaker & Van Kenhove, 2006) into the formation of innovation capacity in food chains and its determinants in a quantitative research setting with identified and inter-linked triplets of chain partners.

Traditional food subsectors with a relevant socio-economic importance in their respective country were selected based on number and size of firms, employment rates (direct and indirect), value added, turnover, investments, import/export, and consumption rates. The following subsectors were selected: Belgium - cheese and beer, Hungary - white pepper, dry sausage and bakery products, and Italy - cheese and ham.

In each subsector, traditional food manufacturers were identified and selected for the interviews. First, the traditional food manufacturer was identified via the NACE-code and the member list of the national or specific food federations. Further, national statistics about firm size and turnover were consulted to assure the inclusion of SME food manufacturers. Second, either via secondary sources (e.g. specific food federations and/or the EC's DOOR-database (EC, 2009)) or during the first telephone contact, it was ensured that the food manufacturer was producing traditional food products according to our definition. Thereby, both labeled and non-labeled traditional food products were included. During the phone contact, the food manufacturer was introduced to our study and his/her willingness to participate in the survey was explored. In case of a positive answer, an interview at the premise of the food manufacturer was appointed. During the interview, each food manufacturer was asked to select and identify one of his/her main supplier and main customer. The choice of who the 'main' supplier and customer were, was up to the food manufacturer in form of snowball sampling. This is a suitable method when the

identification of respondents (in our case the main supplier and customer of the food manufacturer) is not possible on beforehand (De Pelsmaker & Van Kenhove, 2006). Subsequently, the identified supplier and customer were interviewed in respect to his/her food manufacturer. In case the supplier or customer was not willing to participate in the survey, this chain was not included in the sample. However, in most cases the both, supplier and customer were willing to participate. The response rate in terms of interviewing ninety complete triplets of food manufacturers and his/her supplier and customer was approximately eighty percent due to the specific approach used in this survey. The non-response bias of the chains where one or two chain partners were not willing to respond cannot be estimated due to the lack of other sources (Malhotra, 1999). However, it might be that our sample is overrepresenting chains where collaboration for innovation is taking place. Details about the composition of the sample are provided in Annex 1.

Data collection took place between December 2007 and June 2008. In order to assure that all questions are understood in the same way in all three countries, several meetings among the involved researchers took place during the questionnaire development stage prior to the data collection stage. Each construct of the questionnaire was discussed in-depth, in order to ensure common understanding and consensus about the definition of each construct. During the pilot test some further country specific differences were revealed and further definitions or clarifications were included to the questionnaire.

For the investigation of the innovation capacity in chains indicators for innovation efforts, activities and results of the individual chain members as well as for collaboration of innovation were used. For assessing the collaboration for innovation among the chain members, the food manufacturer answered whether he/she was collaborating for innovation with his/her supplier and with his/her customer, while the supplier and customer answered the same question related to collaboration with their food manufacturer. A complete list of the statements and the scales used is provided in Annex 2. These statements have been selected based on a comprehensive literature review (ibidem). The final phrasing of the statements was based on pilot test results and drawn from discussion with experts in the food industry.

For the investigation of the quality of the chain relationships, suppliers, food manufacturers, and customers were asked to what extent they agree or disagree with statements about nine items (comprising 21 statements) using a seven-point Likert-scale ranging from completely disagree (1) to completely agree (7). The items used are: 1) trust, 2) economic satisfaction, 3) social satisfaction, 4) dependency, 5) non-coercive power, 6) coercive power, 7) reputation, 8) conflict, and 9) level of integration. The 21 statements were presented to the food manufacturers and their selected chain partners. The food manufacturers answered the statements related to their supplier and customer, and vice versa. For instance, the level of agreement of the food manufacturer e.g. on the trust statements corresponds with a perceived level of trust the food manufacturer has in its supplier. Details about the statements measuring the quality of chain relationships together with the corresponding literature are provided in Annex 3. The data were analyzed using SPSS 15.0 and R 2.1.9. Data for the innovation capacity were collected at the firm level of all three chain members and aggregated to chain level based on cluster analysis implemented with R 2.1.9. The data set was organized by chain. The first step was to reduce the dimensionality of the indicators of innovation. Based on satisfactory Cronbach's alpha (i.e. values above 0.60), each respondent's response across the items included in the three important aspects of enterprise innovation was aggregated to create a score for each of those three aspects. These aspects included human efforts, financial efforts, and innovation results. For each of these variables the median of the contributing items was calculated for each chain member. Aggregation and univariate descriptive statistics were conducted using SPSS 15.0. Then, the scores for human efforts, financial efforts and innovation results were standardized as follows:

$$z_{if} = (r_{if} - 1)/(M_f - 1) \quad (2)$$

where r_{if} is the value assigned by the *i*-th respondent to the *f*-th aggregate variable (e.g. 'human efforts') and M_f is the maximum possible value of that aggregate variable *f* and $r_{if} \in \{1,\ldots,M_f\}$. This standardized variable z_{if} resulted in the value of each variable falling within the closed interval [0,1].

The scores for innovation activity were also scaled by dividing the number of innovation activities pursued by the number of possible applicable innovation types to generate indicators scaled to the range [0,1]. Thus, a respondent who applied 6 types of innovation activities out of 9 applicable types of innovation activities was assigned a score of 0.67 to indicate less intensive innovation activity than a respondent who applied 6 innovation activities out of 6 applicable with an indicator score of 1.00.

The indicators for the quality of the chain relationship were computed by formulating the median of the

underlying statements of each indicator and chain member. In order to obtain a score indicating the relationship quality at chain level, the median on all three chain members was calculated for each indicator.

An important aspect of model specification is sample specification. Within the context of the present study based on cross-section data, the homogeneity of the sample of firms interviewed is of particular importance to establish. Of interest is whether the sample is composed of sub-groups of firms with differing innovation capacity. We examined this possibility empirically before estimation of parametric models of innovation capacity. To do so, we chose cluster analysis as a tool. Based on the aggregated and standardized scores for the innovativeness and the binary variables for innovation collaboration, hierarchical and k-medoid cluster analyses were conducted in R 2.1.9 to derive a score for the innovation capacity in chains. Cluster analysis classifies observations based on a selected similarity metric. While Euclidean distance is a very useful metric of similarity for continuous data, however it is not appropriate for our ordinal data. Instead, we chose to use the Gower similarity metric, see Gower (1967), as it is appropriate for both binary and ordinal data and for cases when such data is not symmetrically distributed.

For the hierarchical clustering, agnes-R and Ward's method were applied for verification of the number of different subgroups of our sample. Then, Partitioning Around Medoid (PAM) was used to implement k-medoid cluster analysis. This approach focuses on classification of observations by consideration of their distance from the multivariate medoids of the sample. We subsequently re-examined the hypothesis of dissimilarity of the resulting clusters using nonparametric (Kruskal-Wallis and Mann-Whitney-U post hoc test) tests, as well as with cross-tabulation of Chi^2-statistics. The Kruskal-Wallis test is a non-parametric equivalent of the One-Way ANOVA, examining the hypothesis that k independent samples are heterogenic. The Mann-Whitney-U post hoc test is a non-parametric equivalent of the Duncan post hoc test and is used to explore the statistical significant difference between 2 independent samples indicating specific significant differences within the sample, i.e. the clusters in our case.

For the description of the independent variables the median and the interquartile range are used due to the ordinal character of the Likert-scale. The interquartile range (IQR) is the difference between the 75^{th} and 25^{th} percentile and hence, includes the middle 50% of all values (Malhotra, 1999). It is a robust statistic, because it is not influenced by outliers and has a breakdown point of 25%. Dissimilarities between the clusters and the independent variables were also explored by Kruskal-Wallis and Mann-Whitney-U post hoc test.

5 Results and discussion

The cluster analysis suggested a three-cluster solution (Table 1) that supports our expectations that the sample is composed of distinct types of chains. In the first cluster, we interpret results as indicating these chain members to have very low innovation capacity compared to the other clusters. Further, very little collaboration for innovation between these chain members was evident. Hence, we label this cluster as “Chains with low innovation capacity” (LICCs). The second cluster is composed of chain members indicating a higher level of innovation capacity than the members in the first cluster, but not reaching the level of innovation capacity of the chain members in the third cluster. Furthermore, in the chains of the second cluster there is also not much collaboration for innovation capacity. Thus, this cluster is labeled as “Chains with medium innovation capacity” (MICCs). Finally, the third cluster comprises chains where most chain members indicate the highest innovation capacity in comparison to the other clusters as well as intense collaboration for innovation. Consequently, this cluster is named “Chains with high innovation capacity” (HICCs). The numbers of chains in each class is not the same in the current sample. We found more LICCs and MICCs than HICCs. We interpret this result as consistent with the view that SME-food manufacturers and their chain members are not very intensively applying innovation efforts and activities for achieving results.

We also find that food manufacturers do not use collaboration for innovation to extents seen in other industries, such as the biotechnology or the pharmaceutical industry. Thus, our sample is clearly not biased towards overrepresenting chains with collaboration for innovation. In the MICCs no collaboration is observed between the chain members. Similar, in the LICCs, there is mostly no collaboration between the chain members. On the contrary, this is not the case for the HICCs; here chain members state high collaboration intensity. High collaboration is thus clearly associated with higher levels of innovativeness of the firms in this sample. This is in line with the findings of Avermaete et al., (2004b) and Gellynck et al.. (2007)

Table 1.
Descriptives for Innovation capacity of traditional food chains[#], median, mode and IQR with unstandardized variables, and k-medoid cluster analysis with standardized variables (range 0-1) and Kruskal-Wallis test, n=90

Cluster	1) Chains with low innovation capacity				2) Chains with medium innovation capacity				3) Chains with high innovation capacity				Total			K-W Sig.[$]
Innovation capacity	Median	Mode	IQR	Cluster medoid	Median	Mode	IQR	Cluster medoid	Median	Mode	IQR	Cluster medoid	Median	Mode	IQR	
Human innovation efforts[1]																
Food manufacturer	1.00	1.00	2.00	0.00[a]	3.00	0.002	2.00	0.33[b]	4.00	4.00	1.25	0.50[c]	3.00	1.00	3.00	**0.002**
Supplier	1.00	1.00	2.00	0.00[a]	3.00	0.000	1.00	0.33[b]	4.75	5.00	2.00	0.63[c]	3.00	3.00	2.50	**0.000**
Customer	1.00	1.00	2.50	0.00[a]	2.00	0.069	2.00	0.17[a]	3.00	3.00	1.25	0.33[a]	2.00	1.00	2.50	0.069
Financial innovation efforts[2]																
Food manufacturer	1.00	1.00	0.50	0.00[a]	2.00	0.000	1.00	0.33[b]	2.00	2.00	1.00	0.33[b]	2.00	2.00	1.00	**0.000**
Supplier	1.00	1.00	0.50	0.00[a]	2.00	0.000	0.25	0.33[b]	1.50	1.00°	2.00	0.17[b]	2.00	2.00	1.00	**0.000**
Customer	1.00	1.00	0.50	0.00[a]	1.00	0.000	1.00	0.00[a]	2.50	3.00	1.13	0.50[b]	1.00	1.00	1.00	**0.000**
Innovation activities[3]																
Food manufacturer	0.33	0.33	0.11	0.33[a]	0.56	0.001	0.33	0.56[b]	0.72	0.78	0.22	0.72[c]	0.44	0.33	0.33	**0.001**
Supplier	0.22	0.22	0.25	0.22[a]	0.44	0.000	0.22	0.44[b]	0.44	0.33°	0.36	0.44[b]	0.44	0.33	0.28	**0.000**
Customer	0.33	0.33°	0.44	0.33[a]	0.44	0.002	0.44	0.44[a]	0.50	0.67	0.44	0.76[b]	0.44	0.67	0.44	**0.002**
Innovation results[4]																
Food manufacturer	5.00	5.00	2.00	0.67[a]	5.50	0.094	1.00	0.75[a]	6.00	6.00	0.63	0.83[a]	5.50	5.00	1.00	0.094
Supplier	5.00	4.00	1.50	0.67[a]	5.50	0.000	1.25	0.75[b]	5.00	5.00	1.00	0.67[b]	5.00	5.00	1.00	**0.000**
Customer	5.00	4.00°	1.50	0.67[a]	5.50	0.215	1.75	0.75[a]	5.00	5.00	0.13	0.67[a]	5.00	5.00	2.00	0.215
Collaboration for innovation[5]																
FM-S[*]	0.00	0.00	0.25	0.00[a]	0.00	0.000	0.00	0.00[a]	1.00	1.00	0.25	1.00[b]	0.00	0.00	1.00	**0.000**
FM-C[*]	0.00	0.00	0.00	0.00[a]	0.00	0.001	0.00	0.00[a]	1.00	1.00	1.00	1.00[b]	0.00	0.00	0.00	**0.001**
S-FM[*]	0.00	0.00	0.00	0.00[a]	0.00	0.000	1.00	0.00[a]	1.00	1.00	0.00	1.00[b]	0.00	0.00	1.00	**0.000**
C-FM[*]	0.00	0.00	0.00	0.00[a]	0.00	0.002	1.00	0.00[a]	1.00	1.00	1.00	1.00[b]	0.00	0.00	1.00	**0.002**
No. chains	n=31				n=49				n=10				n=90			

FM: Food manufacturers, S: Suppliers, C: Customers.
IQR: Interquartile range is the difference between the 75th and 25th percentile and hence, includes the middle 50% of all values
[a,b] Different superscripts indicate significant differences of group means in the Mann-Whitney U post hoc test ($p < 0.05$)
[*] Multiple modes exist. The smallest value is shown
[#] The median mode and IQR are presented for the original values, while cluster medoids are reported for the standardized variables for each cluster and respective variables. The k-medoid cluster method identifies clusters by grouping observations to minimize their distance from a metric of the center of each group as measured by the group's observed data. The center metrics are called medoids. This approach is attractive when the data include ordinal observations implying use of a group mean would be inappropriate. The optimal clustering identifies medoids for a pre-selected k number of clusters. The estimated k-medoids reported indicate the value of the medoid associated with the column (each innovator type). Thus, each cell row in a particular column provides the estimated position score of the associated variable at that column's (innovator type's) medoid. As noted in the text, the observed scores are standardized to the closed interval [0 1], implying the medoid positions are also contained in [0 1].
[$] Reports estimated significances of the Kruskal-Wallis test, assessing the hypothesis that there is heterogeneity across the clusters for each of the innovation capacity categories and chain partners. If the K-W values are small (< 0.050) significant differences between the clusters are considered (values in bold). The smaller the K-W values the more significant the heterogeneity is confirmed.
[1] Measured on a 7-point frequency scale, with 1 (never applying human innovation efforts) to 7 (Applying human innovation efforts several times a week)
[2] Measured on a 4-point scale, with 1 (never spending financial resources for innovation efforts) to 4 (having a distinct budget on year-base for innovation efforts)
[3] Measured on a Yes-No-Non applicable scale for introduction of innovation activities, presenting the relative score of applicable innovation activities on a range from 0 (no innovation activities are applied) to 1 (all applicable innovation activities are applied).
[4] Measured on a 7-point Likert scale indicating the extent of agreement that the applied innovation activities (see [3]) contributed to success of the firm, with 1 (strongly disagree) to 7 (strongly agree)
[5] Measured on a binary scale with 0 (no collaboration for innovation) and 1 (collaboration for innovation)
[*] Indicates the collaboration for innovation between two chain members, whereby the first mentioned is answering whether he/she collaborates with the second mentioned, e.g. 'FM-S' refers to the answers of the food manufacturer towards his/her supplier

In relation to the structural and sectoral characteristics of the clusters, we examined the hypothesis that heterogeneity exists across countries and types of products. Results are reported in Table 2. We investigated different types of products in the three different countries. In Italy and Belgium, chains of hard and half-hard traditional cheeses were investigated, forming the largest part of the LICCs. The low innovation capacity of the cheese chains is contradictory to the high innovation capacity of the dairy sector in total (see CIAA, 2008). That might be explained by the fact that cheese can be considered as a mature product and that innovations occur rather seldom. From our results, it seems that there are only few innovations taking place in the cheese segment. The comparably high rate of LICCs in Italy could also be related to the high amount of PDO* -labeled cheese products in Italy (EC, 2009). PDO products have precise product specifications (EC, 2006) which imply that there is little space for alterations through product or process innovation. In contrast, the Hungarian sausage chains, Hungarian bakery product chains and Belgian beer chains are the main components of the MICCs. There are less PDO/PGI† products in these product segments (EC, 2009) though this is probably not the only explanation for their higher innovation capacity in comparison to the cheese chains. Other factors influencing the innovation capacity of chains could be related to different education and innovation support policies in the different countries, as suggested by several authors (Edquist & Hommen, 1999; Lundvall, 1995; Varsakelis, 2006). Finally, the HICCs are mainly composed of Italian ham chains, followed by Italian and Belgian cheese chains. However, the latter account for only 20% each.

We also examined evidence that might indicate variation across the clusters with respect to enterprise size of chain partners. As shown in Table 2, we find evidence that LICCs are mainly composed of micro-sized chain partners (<10 employees) whereas MICCs are mainly compiled of small and medium sized food manufacturers and suppliers. In comparison, HICCs are mainly assembled of either micro- or medium sized (51-250 employees) food manufacturers, small suppliers (11-50 employees) and large customers (> 50 employees). These findings indicate that micro-sized firms face the largest problems related to innovation capacity. This reciprocal relationship between enterprise size of the food manufacturer and innovativeness was also found by Avermaete et al. (2004a). However, our results also indicate that being a micro-sized food manufacturer does not necessarily imply low innovation capacity, in case larger chain partners are involved.

If there is intensive collaboration for innovation among the chain members involving larger customers and/or suppliers, the micro-sized firms seem to be able to overcome their limitations related to their size. Thereby, in particular the size of the customer seems to be positively associated with the innovation capacity of chains. Finally, profitability is significantly lower in the LICCs than in the other two clusters (Table 2). However, the results for profitability are very similar for the latter two. Hence, possessing innovation capacity is positive associated with profitability of the firms in the chains.

* Protected Designation of Origin - For definition see EC (2006)

† Protected Geographical Indication - For definition see EC (2006)

Table 2.
Structural and sectoral description of the different clusters, frequencies based on Crosstab and ANOVA, n=90

Cluster	1) Chains with low innovation capacity		2) Chains with medium innovation capacity		3) Chains with high innovation capacity		Total		Sig.[#]
Structural & sectoral variables	%	N	%	N	%	N	%	N	Chi^2
Country & Type of product[1]									0.000
Italian cheese	**43.3**	**13**	2.2	1	20.0	2	18.8	16	
Italian ham	10.0	3	15.6	7	**40.0**	**4**	16.5	14	
Hungarian bakery products	16.7	5	**17.8**	**8**	10.0	1	16.5	14	
Hungarian sausage	3.3	1	**20.0**	**9**	10.0	1	12.9	11	
Belgian cheese	**26.7**	**8**	11.1	5	20.0	2	17.6	15	
Belgian beer	0	0	**33.3**	**15**	0	0	17.6	15	
Total	100	30	100	45	100	10	100	85	
Nr of employees – FM									0.070
< 10 employees	**64.5**	**20**	34.7	17	**40.0**	**4**	45.6	41	
11 - 50 employees	22.6	7	**38.8**	**19**	20.0	2	31.1	28	
50 - 250 employees	12.9	4	26.5	13	**40.0**	**4**	23.3	21	
Total	100	31	100	49	100	10	100	90	
Nr of employees - Supplier									0.004
< 10 employees	**54.8**	**17**	26.5	13	10.0	1	34.4	31	
11 - 50 employees	35.5	11	30.6	15	**60.0**	**6**	35.6	32	
50 – 250 and more employees	9.7	3	**42.9**	**21**	30.0	3	30.0	27	
Total	100	31	100	49	100	10	100	90	
Nr of employees - Customer									0.074
< 10 employees	**56.7**	**17**	**42.9**	**21**	11.1	1	44.3	39	
11 - 50 employees	30.0	9	32.7	16	33.3	3	31.8	28	
50 – 250 and more employees	13.3	4	24.5	12	**55.6**	**5**	23.9	21	
Total	100	30	100	49	100	9	100	88	
Business growth									0.184
Low business growth	6.57	2	33.3	1	0	0	3.3	3	
Medium business growth	**77.4**	**24**	**63.3**	**31**	**50.0**	**5**	66.7	60	
High business growth	16.1	5	34.7	17	**50.0**	**5**	30.0	27	
Total	100	31	100	49	100	10	100	90	
Profitability									0.011
Low profitability	0	0	0	0	0	0	0	0	
Medium profitability	**87.1**	**27**	**57.1**	**28**	**50.0**	**5**	66.7	60	
High profitability	12.9	4	**42.9**	**21**	**50.0**	**5**	33.3	30	
Total	100	31	100	49	100	10	100	90	

FM: Food manufacturer
Bold figures: indicate highest value per cluster (column)
[1] Without the Hungarian vegetable sector (white pepper, n=5)
[#] Chi-square tested the hypothesis that there is heterogeneity across the clusters for each of the structural and sectoral variables, if the chi-square values are small (<0.100) significant differences between the clusters are considered. The smaller the chi-square values the more significant the heterogeneity is confirmed.

Next, the relationship of the perceived relationship quality on the innovation capacity in chains of the traditional food sector is explored. A description of the chain relationship quality is presented for each cluster in Table 3. See Annex 3 for definition of variables. While the clusters differ across innovation capacity, we find similarity in most of the relationship quality measures.

All types of chains have relatively high levels of economic satisfaction and low levels of dependency. Further, for trust, conflict, coercive power and integration significant and slightly significant differences can be revealed for certain relationship directions only. However, highly significant differences at the chain level are explored for social satisfaction, non-coercive power and reputation.

A closer look at each variable with significant differences for the chain relationship quality is revealing that trust levels seem not linear rising with level of innovation and collaboration. Trust level is highest for the MICCs, with significant differences only for the relationship of the food manufacturer with his/her customer. A couple of interpretations can be considered for this result. First, trust might be an important factor for the intermediate step of becoming an Innovator chain, as it is an important factor which influences the character and extent of interactions between chain partners (Lazzarini et al., 2001; Roy et al., 2004). Once successful collaboration is established, trust levels are still high, but lower than in the situation where collaboration is not yet achieved, because the HICC members do not need to rely fully on trust as they know what the chain partners are doing due to transparency in the chain relationship. Second, the variation of trust levels could also be related to cultural differences because mutual trust is best developed between partners with a comparable culture at country or enterprise level (Omta, 2002). Thus, as innovation expands beyond enterprise and/or country level it may do so at a cost of reducing trust levels. That is, a dynamic relationship may exist across trust and innovation capacity. Third, trust might be easier developed among firms with similar size as indicated by (Kühne et al., 2010). In the MICCs the food manufacturers and the customers are mainly micro- and small-sized firms, while in the HICCs more medium or larger sized customers are involved.

Social satisfaction is highly significant different between the clusters and for each relationship direction. Similar to trust, it also seems not linearly associated with higher levels of innovation and collaboration, though it is highest for the HICCs while it is lowest in the MICCs. Social satisfaction is related to uncomplicated information exchange and that the chain partners perceive each other as respectful and concerned (Batt, 2004) which form a good base for collaboration for innovation. Thus, the low levels of collaboration in the MICCs might be explained by the low levels of social satisfaction.

On the contrary, non-coercive power seems to be a driver for innovation capacity. Nevertheless, the overall level of non-coercive power is rather at the neutral point of the scale for the whole chain. The more detailed information about the different relationship directions reveal that among the food manufacturer and the supplier (and vice versa) more non-coercive power is applied than among the food manufacturer and the customer (and vice versa). Further, there is a clear tendency that in the HICCs more non-coercive power is applied than in the other two clusters, especially among the food manufacturer and the supplier. The latter might also be explained by the comparable size of the food manufacturer and the supplier in the HICCs. Thus we can support the results from other authors such as Arend and Wisner (2005) and Omta (2002) who found non-coercive power as facilitator of improved innovation capacity.

At the same time the levels for coercive power are highest in the MICCs, while lowest in the HICCs. Nevertheless, in general the coercive power is rather not applied in traditional food chains. Significant differences can only be observed for the supplier. In the MICCs the suppliers feel more suppressed by the food manufacturer than in the other two clusters. Coercive power is referred to when one chain partner using his power over a critical resource in the chain to force the other partners into action, which in the most cases leads to a decrease in the relationship quality (Jonsson & Zineldin, 2003). As there is much less coercive power in the HICCs than in the MICCs this variable might also be an explaining factor for the lower levels of collaboration in the latter chains.

Further, our results are consistent with our hypothesis concerning reputation effects on innovation capacity of chains. Higher levels of reputation seem to lead to higher innovation capacity. Hence, being perceived positively seems to be an important success factor for becoming an Innovator chain. This is in particular significant for the relationship between the food manufacturer and the supplier. A good reputation is contributing to problem-solving with competition and coordination issues in the business relationships (Arend & Wisner, 2005; Omta, 2002; Roy et al., 2004).

Table 3.
Description of chain relationship quality aspects per cluster of innovation capacity, N=90

Cluster	1) Chains with low innovation capacity	2) Chains with medium innovation capacity	3) Chains with high innovation capacity	Total	Sig.
Chain relationship quality[1]	Median and (IQR)	Median and (IQR)	Median and (IQR)	Median and (IQR)	K-W test[#]
Trust_chain	6.00[a] (1.50)	6.25[a] (1.00)	6.00[a] (1.56)	6.00 (1.13)	0.092
FM-S[*]	6.00[a] (2.00)	6.00[a] (1.00)	6.50[a] (1.63)	6.00 (1.50)	0.397
S-FM[*]	6.00[a] (2.00)	6.00[a] (1.75)	6.25[a] (2.00)	6.00 (2.00)	0.878
FM-C[*]	5.75[a,b] (1.38)	6.00[b](1.50)	5.25[a](1.25)	6.00 (2.00)	**0.039**
C-FM[*]	6.00[a] (2.00)	6.00[a] (1.00)	6.00[a] (1.63)	6.00 (1.50)	0.378
Economic satisfaction_chain	5.25[a] (1.25)	5.25[a] (1.13)	5.13[a] (1.06)	5.00 (1.00)	0.691
FM-S[*]	5.50[a] (1.13)	5.50[a] (1.50)	5.50[a] (2.13)	5.50 (1.50)	0.385
S-FM[*]	4.50[a] (1.50)	5.00[a] (1.25)	5.25[a] (1.63)	5.00 (1.50)	0.219
FM-C[*]	5.50[a] (1.63)	5.50[a] (2.00)S	5.25[a] (1.75)	5.50 (1.75)	0.912
C-FM[*]	5.50[a] (1.50)	6.00[a] (1.00)	5.00[a] (1.00)	5.50 (1.50)	0.342
Social satisfaction_chain	5.00[a] (1.75)	4.75[a] (1.38)	6.25[b] (1.44)	5.50 (2.00)	**0.028**
FM-S[*]	5.25[a] (2.00)	4.50[a] (2.00)	6.25[b] (2.13)	5.00 (2.00)	**0.033**
S-FM[*]	5.50[a,b] (2.13)	5.00[a] (2.00)	6.00[b] (2.13)	5.00 (2.00)	**0.034**
FM-C[*]	5.00[a] (2.50)	5.00[a] (1.50)	6.50[b] (1.00)	5.00 (2.00)	**0.044**
C-FM[*]	5.50[a] (2.00)	5.00[a] (2.75)	6.00[a] (1.13)	5.25 (2.00)	0.051
Dependency_chain	3.50[a] (1.00)	3.50[a] (2.75)	3.50[a] (2.50)	4.00 (1.63)	0.687
FM-S[*]	4.00[a] (2.25)	4.00[a] (3.00)	5.00[a] (0.75)	5.00 (3.00)	0.421
S-FM[*]	3.00[a] (2.25)	4.00[a] (3.50)	3.50[a] (3.25)	3.00 (2.50)	0.227
FM-C[*]	4.00[a] (2.00)	3.00[a] (3.00)	3.00[a] (2.25)	3.00 (3.00)	0.438
C-FM[*]	3.00[a] (2.00)	3.00[a] (3.50)	2.50[a] (4.50)	3.00 (3.00)	0.998
Non-coercive power_chain	3.75[b] (1.50)	3.25[a] (1.50)	4.00[b] (0.75)	3.50 (1.50)	**0.014**
FM-S[*]	4.00[a] (2.25)	4.00[a] (2.50)	5.00[a] (2.50)	4.00 (3.00)	0.070
S-FM[*]	3.00[a] (2.75)	3.00[a] (3.00)	4.25[a] (1.38)	3.25 (3.25)	0.086
FM-C[*]	4.00[a] (1.13)	3.50[a] (2.00)	4.00[a] (0.88)	4.00 (2.00)	0.105
C-FM[*]	3.00[a] (2.00)	3.50[a] (4.75)	4.00[a] (1.50)	3.00 (3.00)	0.907
Coercive power_chain	2.75[a] (2.50)	3.25[a] (2.63)	1.75[a] (1.38)	2.50 (3.00)	0.360
FM-S[*]	3.00[a] (3.50)	3.00[a] (3.00)	2.00[a] (1.25)	2.50 (2.63)	0.210
S-FM[*]	1.50[a] (2.13)	4.00[b] (2.75)	2.00[a] (2.25)	3.00 (4.00)	**0.001**
FM-C[*]	3.50[a] (3.00)	3.50[a] (2.63)	2.00[a] (2.75)	3.50 (2.75)	0.286
C-FM[*]	2.50[a] (2.50)	2.50[a] (3.75)	2.00[a] (3.13)	2.50 (3.00)	0.918
Reputation_chain	5.50[a] (1.50)	6.00[b] (1.25)	6.25[b] (1.13)	6.00 (2.00)	**0.024**
FM-S[*]	5.00[a] (1.13)	6.00[b] (1.50)	7.00[b] (1.00)	6.00 (2.00)	**0.001**
S-FM[*]	6.00[a] (2.00)	6.00[a] (2.00)	6.50[a] (1.25)	6.00 (2.00)	0.243
FM-C[*]	6.00[a] (1.00)	6.00[a] (2.00)	6.00[a] (2.00)	6.00[a] (2.00)	0.743
C-FM[*]	6.00[a] (2.00)	6.00[a] (1.50)	6.00[a] (1.25)	6.00 (2.00)	0.751
Conflict_chain	3.00[a] (3.00)	2.25[a] (1.63)	1.75[a] (0.75)	2.00 (2.00)	0.080
FM-S[*]	3.00[a] (3.50)	2.50[a] (2.00)	1.50[a] (1.25)	2.50 (2.75)	0.065
S-FM[*]	2.50[a] (3.50)	2.00[a] (2.25)	1.50[a] (1.75)	2.00 (2.50)	0.115
FM-C[*]	3.00[a] (3.50)	2.25[a] (2.00)	2.00[a] (1.00)	2.50 (2.38)	0.492
C-FM[*]	3.00[a] (3.00)	2.00[a] (2.00)	2.00[a] (0.50)	2.00 (1.63)	0.077
Integration_chain	3.00[a] (1.00)	3.00[a] (1.50)	3.50[a] (1.13)	3.00 (1.00)	0.774
FM-S[*]	3.00[a] (2.00)	4.00[a] (2.00)	2.00[a] (1.25)	3.00 (2.00)	0.232
S-FM[*]	3.00[b](1.00)	2.00[a](2.00)	2.50[a,b] (1.25)	2.00 (2.00)	**0.026**
FM-C[*]	3.00[a] (2.00)	4.00[a] (1.00)	4.00[a] (1.00)	3.00 (1.00)	0.154
C-FM[*]	3.00[a] (1.00)	3.00[a] (2.00)	4.00[a] (2.00)	3.00 (2.00)	0.281

Table 3.
(continued)

Cluster	1) Chains with low innovation capacity	2) Chains with medium innovation capacity	3) Chains with high innovation capacity	Total	Sig.
Chain relationship quality[1]	Median and (IQR)	Median and (IQR)	Median and (IQR)	Median and (IQR)	K-W test[#]
Conflict_chain	3.00[a] (3.00)	2.25[a] (1.63)	1.75[a] (0.75)	2.00 (2.00)	0.080
FM-S[*]	3.00[a] (3.50)	2.50[a] (2.00)	1.50[a] (1.25)	2.50 (2.75)	0.065
S-FM[*]	2.50[a] (3.50)	2.00[a] (2.25)	1.50[a] (1.75)	2.00 (2.50)	0.115
FM-C[*]	3.00[a] (3.50)	2.25[a] (2.00)	2.00[a] (1.00)	2.50 (2.38)	0.492
C-FM[*]	3.00[a] (3.00)	2.00[a] (2.00)	2.00[a] (0.50)	2.00 (1.63)	0.077
Integration_chain	3.00[a] (1.00)	3.00[a] (1.50)	3.50[a] (1.13)	3.00 (1.00)	0.774
FM-S[*]	3.00[a] (2.00)	4.00[a] (2.00)	2.00[a] (1.25)	3.00 (2.00)	0.232
S-FM[*]	3.00[b](1.00)	2.00[a](2.00)	2.50[a,b] (1.25)	2.00 (2.00)	**0.026**
FM-C[*]	3.00[a] (2.00)	4.00[a] (1.00)	4.00[a] (1.00)	3.00 (1.00)	0.154
C-FM[*]	3.00[a] (1.00)	3.00[a] (2.00)	4.00[a] (2.00)	3.00 (2.00)	0.281

[1]Measured on a 7-point Likert scale
IQR: interquartile range is the difference between the 75[th] and 25[th] percentile and hence, includes the middle 50% of all values
[#] Reports estimated significances of the Kruskal-Wallis test (KW-test), assessing the hypothesis that there is heterogeneity across the clusters for each of the chain relationship quality categories (rows). If the K-W values are small (< 0.050) significant differences between the clusters are considered (values in bold). The smaller the K-W values the more significant the heterogeneity is confirmed.
[*] Indicates the relationship direction between two chain members, whereby the first mentioned was answering about the second mentioned, e.g. 'FM-S' refers to the answers of the food manufacturer about his/her supplier
[a,b] Different superscripts indicate significant differences of group means in the Mann-Whitney U post hoc test ($p < 0.05$)

Conflict is inversely related with higher innovation capacity with the highest levels for the LICCs and lowest levels for the HICCs. Conflict is measured as the extent of disagreements and differences in expectations. The lower these extents are the higher the innovation capacity was estimated. This is confirming earlier results by Batterink et al. (2008).

Last but least, integration values indicate that traditional food chains are mainly governed by non-contractual relationships with qualified partners. Such relationships are characterized as long-term, informal relationships where it is a prerequisite that the chain partner has a certain qualification or third party certification (Gellynck, Molnár, 2009). Our results suggest that in particular lower integration between the supplier and the food manufacturer is a facilitator of becoming a more innovating chain.

6 Conclusions

Our study aimed at filling the gaps about the innovation capacity in traditional food chains with SME food manufacturers, by using an unique and novel approach. We extend the measurement of innovation capacity to the level of individual chains and therefore contribute to a better understanding of how innovation capacity is achieved in chains and which aspects of the chain relationship quality are important to achieve high levels of innovation capacity.

Our study reveals that chains with three different levels of innovation capacity exist in the traditional food sector: low, medium and high innovation capacity chains. These types of chains differ significantly in relation to their characteristics. We found that chains composed of micro-sized firms face the most difficulties to achieve high levels of innovativeness and of collaboration, though these difficulties are possible to overcome by involving the chain partners in the innovation process. The size of the supplier or customer in the chain seems to be positively associated with the innovation capacity. The influence of enterprise size and innovativeness was also confirmed in previous studies (e.g. Avermaete et al., 2004a). Further we also found significant differences between countries and types of products. These differences might be related to the different national situations shaping different cultural conditions and infrastructure for networking and innovation (Edquist & Hommen, 1999; Lundvall, 1995; Pittaway et al., 2004; Varsakelis, 2006).

Further, we explored the influence of the chain relationship quality on the innovation capacity. We found three constructs to be significantly associated with higher levels of innovation capacity in chains and four constructs with significant differences for some relationship directions. These are social satisfaction, non-coercive power and reputation as well as trust, conflict, coercive power and integration. We find that the

higher the estimated innovation capacity is, the lower are the perceived coercive power, integration and conflict levels, and the higher are social satisfaction, reputation and trust levels.

In order to become more innovative, SMEs need to invest more in the innovation process through effort and activities, and to strengthen collaboration for innovation with their chain partners. The latter is important in order to gain access to external sources of innovation. Chain members and other partners of the direct environment are the main sources for innovative ideas (Gellynck et al., 2007; Pannekoek et al., 2005).

Further, the relationship quality is important for the innovation capacity of chains. Thereby, it is important to build up high levels of social satisfaction for achieving high levels of innovation capacity in the chain. Thus, considering each others position and exchanging knowledge honestly and without opportunistic behavior is an important factor for improving the innovation capacity in the traditional food chain.

Similarly, higher levels of non-coercive power will enhance the level of innovation capacity in the chain. Non-coercive power includes that one chain partner is rewarding the other chain partner when needs and requirements are met regularly or without requiring a specific behavior. This way it functions as a stimulator for innovation (Arend & Wisner, 2005; Omta, 2002).

Next, the establishment of a good reputation is important. This can be achieved by caring about the business partners, providing excellent expertise and being accurate in all activities. Reputation is an important success factor for innovation due to its ability to promote initial trust and to overcome problems related to competition and coordination of the information flow (Arend & Wisner, 2005; Omta, 2002; Roy et al., 2004).

Besides, it is important to build up high trust levels in order to become an innovative chain. However, once high levels of innovation and collaboration are established in the chain, trust is having a minor role, in particular in the relationship of the food manufacturer with his/her customer. In order to achieve trust it is important to keep promises, achieve high confidence in and by the chain partners, provide correct information and consider how decisions might affect the chain partner's situation.

Conflicts and coercive power should be avoided in order to become a highly collaborating and innovating chain. In order to avoid conflicts, the common goals and the expectations of every chain member should be communicated clearly from in the beginning when collaborating for innovation (Batterink et al., 2008). Coercive power should not be used for forcing another chain partner into action as this has a negative influence on the quality of the chain relationship (Jonsson & Zineldin, 2003) and hence on the overall innovation capacity.

As Pittaway et al. (2004) state, each chain relationship needs to adopt the best fitting governance structure. The suppliers, food manufacturers and customers in traditional food chains govern their relationships mainly through non-contractual relationships with partners that can provide a certain qualification or third party certification. Hence, traditional food chains are not highly vertically integrated.

Further, our results are in line with Roy et al. (2004), who stated that an enterprise needs to treat its suppliers differently from its customers as they differ in terms of volume, size, importance and other issues. Furthermore, suppliers contribute in a different way to the innovation process than customers (Pittaway et al., 2004). We explored the chain relationship quality from different perspectives of relationship directions (food manufacturer about supplier and customer, and vice versa). Not all relationship directions are found to be significant different among the three clusters, which leads to the conclusion that the positive (or negative) perception of a certain chain partner is more important for enhanced innovation capacity than other relationship directions. This might be explained by the different ways suppliers and customers approach their network (Lu et al., 2008). In contrast to customers, suppliers do not rely only on interpersonal trust, but also invest human and physical resources into the relationship. In our case it is mainly the perception of the supplier by its food manufacturer and vice versa. Thus, we can confirm the results of Weaver (2009) that firms benefit from participating in networks but depend on its partner's choices and perceptions. Nevertheless, generalization of our results to the whole traditional food sector in Europe need to be done with care as we investigated only three European countries and a small share of traditional food chains.

For further future research, we suggest to explore how different national situations shape different cultural conditions and infrastructure for networking and innovation in the direct chain. Furthermore, the complexity of the studied system should be gradually increased from a chain of three members to more complex chains and even larger networks. Finally, since we investigated the case of traditional food products, which comprise several specific characteristics, we propose to test our novel approach in other food sectors, e.g. in the functional food sector which is known as highly innovative.

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Annex 1: Sample description

COUNTRY: PRODUCT N (TOTAL CHAINS) N (TOTAL RESPONDENTS)	TOTAL PER CHAIN PARTNER	TOTAL PER SIZE CATEGORY AND CHAIN PARTNER
ITALY: Hard and half-hard cheese	16 S	10 micro, 6 small suppliers
16 Chains	16 FM	13 micro, 2 small, 1 medium food manufacturers
48 Respondents	16 C	11 micro, 5 small customers
ITALY: Ham	14 S	3 micro, 5 small, 6 medium suppliers
14 Chains	14 FM	6 micro, 7 small, 1 medium food manufacturers
42 Respondents	14 C	2 micro, 6 small, 4 medium, 2 large customers
HUNGARY: Bakery products	14 S	2 micro, 7 small, 5 medium suppliers
14 Chains	14 FM	7 small, 7 medium food manufacturers
42 Respondents	14 C	8 micro, 3 small, 3 medium customers
HUNGARY: Dried and fermented sausage	11 S	2 micro, 2 small, 7 medium suppliers
11 Chains	11 FM	2 micro, 3 small, 6 medium food manufacturers
33 Respondents	11 C	1 micro, 3 small, 7 medium customers
HUNGARY: Processed white pepper	5 S	3 micro, 1 small, 1 medium suppliers
5 Chains	5 FM	1 micro, 2 small, 2 medium food manufacturers
15 Respondents	5 C	4 micro, 1 small customers
BELGIUM: Hard and half-hard cheese	15 S	7 micro, 4 small, 2 medium, 2 large suppliers
15 Chains	15 FM	11 micro, 2 small, 2 medium food manufacturers
45 Respondents	15 C	4 micro, 5 small, 2 medium, 4 large customers
BELGIUM: Beer	15 S	4 micro, 7 small, 1 medium, 3 large suppliers
15 Chains	15 FM	8 micro, 5 small, 2 medium food manufacturers
45 Respondents	15 C	9 micro, 5 small, 1 large customers
TOTAL	90 S	31 micro, 32 small, 22 medium, 5 large suppliers
90 Chains	90 FM	41 micro, 28 small, 21 medium food
270 Respondents	90 C	manufacturers
		39 micro, 28 small, 16 medium, 7 large customers

Annex 2: Items used for measuring innovation capacity

Human innovation efforts (Frequency of spending time for improving human resources – 7-point frequency scale)	
Courses and trainings Self-study (reading professional literature) Seminars Fieldwork (e.g. study tours visiting other companies) Experimental trials Other (Please specify):	**Adapted from:** (Batterink et al., 2006; Gellynck & Kühne, 2008; Gellynck et al., 2007; OECD, 2005)
Financial innovation efforts (Structuredness of spending financial resources – 4-point scale with: 1) None, 2) According to needs, 3) Distinctively budgeted on project base, 4) Distinctively budgeted on yearly base)	
Product development Process development Market research Organizational development	**Adapted from:** (Gellynck et al., 2007; Noronha Vaz et al., 2004; OECD, 2005; SMEs-NET, 2005-2006)
Innovation activities (Yes-No-Non applicable for introduction of innovation activities)	
Our company improved the packaging of our traditional product Our company improved the quality of our traditional product (through selected ingredients, raw materials, better uniformity of the product etc.) Our company improved the convenience of our traditional product Our company entered new geographical markets for our traditional product Our company improved marketing activities for our traditional product Our company introduced new management tools Our company improved management practices of research and development Our company increased participation in networks	**Adapted from:** (Avermaete et al., 2004a; Gellynck & Kühne, 2008; Gellynck et al., 2007; Lundvall, 1995; Noronha Vaz et al., 2004; OECD, 2005; SMEs-NET, 2005-2006)
Innovation results (Extend of significant contribution of applied innovation activity to business success -7-point Likert-scale)	
Improving the packaging of our traditional product Improving the quality of our traditional product (through selected ingredients, raw materials, better uniformity of the product etc.) Improving the convenience of our traditional product Entering new geographical markets for our traditional product Improving marketing activities for our traditional product Introducing new management tools Improving management practices of research and development Increasing participation in networks	**Adapted from:** (Gellynck et al., 2007; Noronha Vaz et al., 2004)
Collaboration for innovation (Joint activities for research and development – yes/no)	
Innovation collaboration of food manufacturer with supplier* Innovation collaboration of food manufacturer with customer* Innovation collaboration of supplier with food manufacturer* Innovation collaboration of customer with food manufacturer*	**Adapted from:** (Batterink et al., 2006; Noronha Vaz et al., 2004; OECD, 2005)

*Indicates the collaboration for innovation between two chain members, whereby the first mentioned is answering whether he/she collaborates with the second mentioned, e.g. 'food manufacturer with supplier' refers to the answers of the food manufacturer towards his/her supplier

Annex 3: Chain relationship quality statements, measured on 7 point Likert scale

Trust	
Our supplier/ customer keeps promises Our company has high confidence in our supplier/ customer We believe that the information our supplier/ customer provides us is correct Our supplier/ customer considers how its decisions/ actions may affect us	**Adapted from:** (Batt, 2004; Doney & Cannon, 1997; Ganesan, 1994; Jonsson & Zineldin, 2003)
Economic satisfaction	
Our business relationship with our supplier/ customer significantly contributes to our profitability Our business relationship with our supplier/ customer is very attractive because of getting fair prices	**Adapted from:** (Batt, 2004; Geyskens & Steenkamp, 2000; Jonsson & Zineldin, 2003; Mohr et al., 1996)
Social satisfaction	
Our supplier/ customer hardly considers our arguments when changing prices[#] Our supplier/ customer leaves our company in the dark about what we ought to know[#]	**Adapted from:** (Batt, 2004; Dwyer, 1980; Geyskens & Steenkamp, 2000; Mohr et al., 1996)
Dependency	
Our company is not significantly dependent on our supplier's/ customer's resources (e.g. raw materials, packaging machines, transport facilities)[#] Our company is significantly dependent on our supplier's/ customer's capabilities (soft skills, such as expertise) Our company can easily replace our supplier/ customer[#]	**Adapted from:** (Batt, 2004; Ganesan, 1994; Skinner et al., 1992)
Non-coercive power	
Our company receives benefits from our supplier/ customer when we regularly meet their needs /requirements (technical support/ free advice/ financial support/ market information etc.) Our supplier/customer rewards our company without requiring specific behavior in return (technical support/ free advice/ financial support/ market information etc.)	**Adapted from:** (Geyskens & Steenkamp, 2000; Jonsson & Zineldin, 2003; Mohr et al., 1996; Skinner et al., 1992)
Coercive power	
We can be sure that our supplier/customer will not retaliate our company when we do not accept our suppliers' / customers' business proposal (keep back important information / terminates contract, press down price, etc) [#] We can be sure that our supplier / customer will not neglect our interests even if we fully meet the conditions detailed in the contract with our supplier / customer (keep back important information / terminates contract, press down price, etc) [#]	**Adapted from:** (Anderson & Narus, 1984; Batt, 2004; Geyskens & Steenkamp, 2000; Jonsson & Zineldin, 2003; Skinner et al., 1992)
Reputation	
Our supplier/ customer is well-known for caring about its business partners Our supplier/ customer is well-known for its expertise Our supplier/ customer is well-known for its accuracy	**Adapted from:** (Doney & Cannon, 1997; Ganesan, 1994; Jonsson & Zineldin, 2003)
Conflict	
We disagree with our supplier/ customer on critical issues Our business interest doesn't match with that of our supplier/ customer	**Adapted from:** (Anderson & Narus, 1984; Mohr et al., 1996; Skinner et al., 1992)
Integration[*] Our business relationship with our supplier/customer can be characterized as:	
Spot market Non-contractual relationship with non-qualified partner Non-contractual relationship with qualified partner Contractual partnership Relation-based alliance Equity-based alliance Vertical integration	**Developed by:** (Gellynck & Molnár, 2009)

[*] Seven-point scale representing the degree of integration 1= not at all integrated, 7= fully integrated

[#] reversed scores in analysis