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Market structure and innovation: a theoretical model and its operationalisation

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Abstract: This paper contributes to the debate on the relationship between supply network configuration and innovation by presenting a conceptual model and an operationalisation. This model aims to shed light on a relational capability: the lead firm's capability to sustain synchronously multiple types of innovation by leveraging the supply network configuration. The relationship between network attributes and multiple innovations is specified with respect to the fashion industry. Several hypotheses are presented in order to explore the influence of both the diversity and density of the lead firm's supply network on the firm's stylistic and process innovations. This framework departs from the current dominant logic of analysing each innovation type separately and explores the network configurations enhancing the joint generation or adoption of multiple innovation types.

1. Introduction

The study of the relationship between the configuration of a firm's supply network and its innovation capability is an outstanding management issue (Pittaway *et al.*, 2004). The positive impact of inter-firm networks on

innovation has been traced back to the potential of collaboration to facilitate knowledge sharing and interactive learning processes among cooperating firms (Powell *et al.*, 1996).

Recent findings on the topic confirm two interesting key points: (1) the supply network structure and its impact on innovation and competitiveness depends on the distinctive set of relational capabilities for network management of the lead firms (e.g., Capaldo, 2007); (2) all network structure constantly change and adapt, depending on the strategic requirements of partners and the context within which the network operates (e.g., Kash and Rycroft, 2002).

Researchers tend to consider the relationships between network characteristics and specific typologies of innovation (e.g., product or process innovation), addressing that the supply network configuration differs according to the different forms of innovation required by the lead firm (Liao, 2007). The tendency to consider types of innovation as distinct phenomena is a consequence of 'analytic' thinking (Ackoff, 1999) and also reflects the dominance of an industrial organisation perspective in the studies of innovation (Tirole, 1988). As empirical findings only partially support this perspective – also occasionally providing inconsistent results (Fritsch and Meschede, 2001) – recent works advocate a deeper analysis of the relationships between network structure and firm-level innovation capability (Damanpour, 2010).

This study aims to fill this gap by proposing a theoretical framework investigating the relational capabilities of the lead firms to sustain synchronously multiple types of innovation by leveraging their supply network configuration. The study also proposes an operationalsation of the model to facilitate a further empirical test of the assumptions. To deepen the analysis, we have chosen to concentrate on a specific industrial setting: the fashion industry.

The fashion industry seems an interesting research setting for two main reasons: on the one hand, 'the very survival of the fashion industry depends on regular style changes. Annually or seasonally a substantial portion of consumers must be persuaded or must freely choose to replace older fashions neither worn nor functionally obsolete' (Sproles, 1981: p. 118); on

the other hand, fashion firms are constantly engaged in process innovation as they try to improve the efficiency of the development, launch and delivery of new collections in order to face market volatility, intense competition and changing customer requirements, actually with no accelerating technological change (Sharifi and Zhang, 1999; Christopher *et al.*, 2004). Moreover, the innovative performance differential of fashion firms is a function of the firm's ability to internally build new capabilities but is also largely dependent on the firm's ability to leverage the supply network as an important source of product and process innovations (Lorenzoni and Lipparini, 1999).

Building on this insight, we investigate how fashion lead firms shape the structure of their supply networks to sustain multiple innovation exercises. A theoretical model and hypotheses are presented to answer two major research questions: (1) How does supply network structure impact on the innovation capability of the lead firm?; (2) Which configuration of the lead firm's supply network impacts synchronously on multiple typologies of innovation?

These contributions share a knowledge-based perspective (e.g., Grant, 1996) according to which supply networks are created and managed by lead firms that leverage network-wide knowledge access, transfer and creation to generate competitive advantage based on superior innovation (Capaldo, 2007). The knowledge-based perspective also suggests shifting emphasis on single innovation types, as innovative organisations are those that can combine multiple sources of innovation in new ways to maintain the firm's competitive advantage.

The paper is organised as follows. The second section addresses the specificities of the fashion industry, focusing on two different typologies of innovation: stylistic and process innovation. The third section presents the theoretical model developed to explore the relationship between specific network attributes (i.e., network functional diversity and density) and the stylistic and process innovation capabilities of fashion lead firms. The fourth section presents an operationalisation of the model while the final section contains conclusions along with suggestions for further research.

2. The specificities of the fashion industry

Fashions can be defined as temporary cyclical phenomena, adopted by consumers for a particular time and situation (Sproles, 1981) and 'fashion knowledge is commonly understood as an aesthetic knowledge, and as an unstable and constantly changing form of knowledge that promotes incessant change without progress' (Weller, 2006, p. 3).

From a supply chain management perspective, the most relevant characteristics of fashion markets are: short life-cycles; high volatility; low predictability; and high impulse purchasing (Christopher *et al.*, 2004). Such characteristics create a turbulent market where the turbulence is not something fashion companies are trying to suppress. Instead, they induce high volatility in the demand for new collections to defend their position and to differentiate them from unbranded offerings from low-cost manufacturers.

The characteristics of the fashion demand influence the required supply network configuration. Functional products satisfy basic needs, do not change much over time, and face a stable and predictable demand with long life cycles. On the other hand, innovative products are related to consumers' changing demands and life style and therefore face a quite unstable and unpredictable demand with a short life cycle. Functional products – as in the case of non-fashion clothing and apparel – can be supported by physically efficient supply networks targeting cost minimisation, while innovative products – as in the case of fashion items – need to be supported by market-responsive supply networks where flexibility is essential.

The major challenge in the fashion industry is the need to launch every season thousands of new models, renewing on average more than 80% of their collections. The nature of the fashion production process gives ample scope for variety in the organisation of production and the division of labour (Cerruti and Delbufalo, 2009). Frequently, production is arranged in a network of vertically disintegrated firms, where each firm specialises in one phase of the production process. Vertical disintegration usually results in superior flexibility and is very effective for the production of small lots with frequently varying design specifications. In other cases, production is

vertically integrated within a single firm (i.e., the lead firm) in order to take advantage of economy of scale and reduced transaction costs.

2.1 Stylistic and process innovation in the fashion firms

In order to gain a sustainable competitive advantage, fashion firms generally try to combine two types of innovation: stylistic and process (Cillo and Verona, 2008).

Stylistic innovation refers to changes in the aesthetic form and/or symbolic value of products and is the innovation that typically represents the fashion industry (Müller *et al.*, 2009). It deals with the changes in aesthetic design and symbolic value of new products so that fashion products carry intangible value in addition to their functional attributes (Tran, 2010). Developing new products in the fashion industry is generally associated with style. New fashion products or collections with changes in style and design are, by definition, product innovation (Stone, 2005). Thus, to study new product development capabilities in the fashion industry is to study how stylistic innovation is developed in this context.

Fashion firms generally accompany stylistic innovation capabilities with process innovation efforts. Process innovations are defined as new elements introduced into a firm's production or service operation to produce a product or render a service (Damanpour and Gopalakrishnan, 2001). While stylistic innovations change what the organisation offers to the customers, process innovations change the way the organisation produces and delivers those offerings (Bessant *et al.*, 2005). Process innovation capabilities are oriented towards the efficiency or effectiveness of operations and may result in a decrease in the cost of production (Schilling, 2005).

A number of studies recognise a circular relationship between process innovation and outsourcing and/or off-shoring strategies (e.g., Camuffo *et al.*, 2006). As stylistic innovation generally is more dependent on individual firms' capability endowments and/or from specialised partners (e.g., external designers), process innovation in fashion firms may require the combination of multiple contributions from different partners, even those localised in different geographic contexts where costs or resource differentials exist

(Frost, 2001). Thus, on one hand the search for process innovations may drive the fashion firm to extensive outsourcing and off-shoring strategies (Camuffo *et al.*, 2006). On the other hand, off-shoring strategies may enhance the process innovation capabilities of fashion firms as they allow firms to absorb 'localised expertise' that may be embedded and further developed within the production process (Frost, 2001).

3. Network structure and innovation in the fashion industry

Recent reviews (e.g., Pittaway *et al.*, 2004) assert that networking is critical for the development of firms' innovation capabilities. As product becomes increasingly modular and knowledge is distributed across organisations, firms recognise an increasing requirement to collaborate with other firms both formally and informally (Fischer and Varga, 2000). Indeed, the locus of innovation is no longer the individual or the firm but, increasingly, the network in which a firm is embedded (Powell *et al.,* 1996).

The literature recognises that networking contributes to: (1) obtaining access to new markets and technologies (Gereffi, 1999); (2) pooling complementary skills (Bartmess and Cerny, 1993); and (3) acting as a key vehicle for obtaining access to external knowledge (Capaldo, 2007). There is evidence from the literature that firms which do not cooperate and do not formally or informally exchange knowledge, limit their knowledge base on a long-term basis and ultimately reduce their ability to develop innovations (Pittaway *et al.*, 2004).

However, research has not yet clearly demonstrated which network configurations most affect innovation in particular contexts. In addition, most studies tend not to clearly define different network attributes, thus not providing convincing explanations of the phenomenon. Following Phelps (2010), we consider two specific attributes of supply network configuration: (1) supply network functional diversity, and (2) supply network density.

Network functional diversity refers to the 'types of actors in a network characterized in terms of their stable traits, features, or resource endowments' while network density refers to the 'pattern of relationships

that exists among a set of actors' (Phelps, 2010: p. 890; Wasserman and Faust, 1994). Thus, we propose a theoretical model for fashion industry examining the influence of the diversity and the density of a lead firm's supply network on its stylistic and process innovation capabilities. This model could be useful to shed light on a single relational capability, namely the lead firm's capability to sustain synchronically multiple innovation efforts by creating and managing the structure of its supply network.

3.1 Network functional diversity and innovation

Diversity refers to 'the extent to which a system consists of uniquely different elements, the frequency distribution of these elements, and the degree of difference among the elements' (Stirling, 2007: p. 709). Thus, we define supply network diversity as the extent to which the competences and skills owned by a firm's partners are different from one another and from those of the lead firm (Phelps, 2010).

Thanks to the network diversity, the lead firm can rely on multiple different sources to access various skills and mobilise heterogeneous competences as well as to learn new knowledge (Grant and Baden Fuller, 2004). Here, when learning occurs, the lead firm's absorptive capacity is enhanced, thereby increasing the organisation's capability to innovate. In addition, the company's attractiveness towards both existing and potential partners is improved, creating fertile ground for further network development (Cohen and Levinthal, 1990).

Diversity affects the relative novelty of knowledge available in a network and the ease with which a firm can recognise, assimilate, and utilise this knowledge. The 'value of variance' (Mezias and Glynn, 1993) is that though it increases the complexity of network management – increasing risk of failures – it also increases the number of highly novel solutions. In the fashion industry, a network composed of different typologies of actors provides the lead firm with dissimilar knowledge that is essential both for continuous stylistic and process innovation (Tran, 2010).

Although network diversity provides benefits for a firm's innovation capabilities, it also poses significant absorptive capacity costs (Lane and

Lubatkin, 1998). As the functional distance among partners increases, their ability to recognise, assimilate, and apply each other's knowledge declines. A firm must apply greater effort and resources to understand and integrate dissimilar knowledge (Cohen and Levinthal, 1990; Fiol and Lyles, 1985). This can manifest in costly, excessive, and inconclusive experimentation as well as in information overload, confusion and diseconomies of scale in innovation efforts. Additionally, integrating novel knowledge from highly diverse sources often requires changing existing patterns of communication and social exchange, which is difficult in established organisations (Kogut and Zander, 2001). Thus, as a firm's network diversity increases, its costs of absorbing and utilising this knowledge greatly increase and the chance of knowledge recombination into useful innovations declines, with excessive diversity reducing innovation (Phelps, 2010).

Given these benefits and costs, we expect network diversity to exhibit a curvilinear effect on a lead firm's stylistic and process innovation capabilities. At low levels of diversity, a firm has a high degree of relative absorptive capacity in its portfolio of partners, but the knowledge to which it has access provides little novelty. At high levels of network diversity, absorptive capacity costs are likely to outweigh the benefits of highly novel knowledge. At a moderate level of network diversity a firm's stylistic and process innovation efforts benefit from a balance of access to a moderate degree of novel knowledge and moderately efficient relative absorptive capacity.

Thus, some degree of diversity is valuable for stylistic and process innovation; too much can be detrimental.

Hypothesis 1a. The functional diversity in a lead firm's supply network has an inverted U-shaped relationship with the firm's stylistic innovation capabilities in the fashion industry.

Hypothesis 1b. The functional diversity in a lead firm's supply network has an inverted U-shaped relationship with the firm's process innovation capabilities in the fashion industry.

3.2 Network density and innovation

Although a supply network provides access to a partner's knowledge and capabilities, it does not guarantee the effective detection, transfer and assimilation of these benefits. The tacit and embedded nature of fashion design and manufacturing know-how makes it difficult for a partner to transfer and assimilate, reducing the potential for successful recombination.

The extent to which a firm's partners are densely interconnected mitigates the costs and amplifies the benefits of the network for innovation. Dense networks are those in which the lead firms build and develop strong ties (i.e., long-lasting, repeated, and socially dense relationships) with their partners (Granovetter, 1973). Strong inter-firm ties can offer steady flows of new ideas, technological innovation, and operational support (Larson, 1992). It is also suggested that strong ties encourage reciprocity, a long-term perspective, and joint problem-solving arrangements (Uzzi, 1997).

Dense networks facilitate the building of trust and reciprocity among firms, which decrease exchange hazards, increase cooperation, and mitigate absorptive capacity problems (Gulati *et al.*, 2000). Recent literature argues that network architectures with a core of strong ties exert a positive impact on the innovation capability of the lead firm (Capaldo, 2007).

Considering the context of analysis, we propose to distinguish different degrees of density with regard to two sub-networks the lead firm builds and manages: (a) key-component suppliers, and (b) design firms.

(a) Key-component suppliers. Building strong ties with suppliers is considered to be one of the factors leading to frame-breaking innovation (Romijn and Albu, 2002).

The value of including suppliers in multiple innovation processes (i.e., both in product and process innovation) has been widely documented in the supply chain literature (e.g., Hyun, 1994). Firms having strong ties with suppliers report higher levels of productivity than those reporting weak relationships over time (Perez Perez and Sanchez, 2002). The review conducted by Pittaway *et al*. (2004) shows that the effective integration of suppliers in innovative processes can: (1) have a significant impact on cost,

quality, speed and responsiveness of lead firms (Ragatz *et al.*, 1997); (2) help manufacturers identify process improvements that are necessary for them to remain competitive (Lincoln *et al.*, 1998); (3) enable firms to develop wider expertise during the new product development process (Romijn and Albu, 2002); (4) help reduce concept-to-customer cycle time, costs and reduce quality problems (Ragatz *et al*., 1997); (5) assist with improvements in the overall design effort (Conway, 1995); and (6) create easier access to supplier knowledge and expertise in the longer-term (Lorenzoni and Lipparini, 1999).

However, the benefits that strong ties bring to the innovation processes deserve further systematic analysis. In fact, Uzzi's (1997) notion of 'overembeddedness' suggests that networks composed mostly of strong ties may threaten innovation, rather than enhance it. Capaldo (2007) suggests that the distinctive and somewhat complementary roles of weak and strong ties within the same network would guarantee superior firm-level innovation. Expanding this perspective, we advance the idea that only the strong ties which the lead firm builds with key-component suppliers may influence its innovation capability (Lorenzoni and Balden-Fuller, 1995). In manufacturing industries, key-component suppliers are the partners used for the sourcing of products that are strategic in terms of both complexity of the supply market and importance to the organisation as defined by Kraljic (1983). We suggest that both stylistic and process innovation capabilities are positively influenced by high degree of density (i.e., strong inter-firm ties) between the fashion lead firm and key-component suppliers.

H2a. High degree of density of the lead firm – key component suppliers relationships positively affects the stylistic innovation capabilities of the fashion lead firm.

H2b. High degree of density of the lead firm – key component suppliers relationships positively affects the process innovation capabilities of the fashion lead firm.

(b) Design firms. In the fashion industry, instead of relying exclusively on internal design departments, frequently lead firms are used to drawing

new product ideas and specialised technical skills from external independent designers and consulting fashion design firms, both of which in turn may be collaborating simultaneously with other manufacturers operating in the same industry.

This leads to an intricate pattern of interconnected networks that increases the creativity of external designers, by broadening their exposure to knowledge flows, and offers manufacturers a wider spectrum – both in term of quantity and variety – of stimuli on the aesthetic, functional and technical aspects of innovation (Capaldo, 2007).

Fashion design firms are usually small – employing no more than five or six individuals – and highly specialised. These firms pivot on their promoting partners (well-known fashion designers) whose creativity, technical know-how, long-lived relationships with the lead firms and personal reputations are a major part of the organisation's asset base (Tran, 2010).

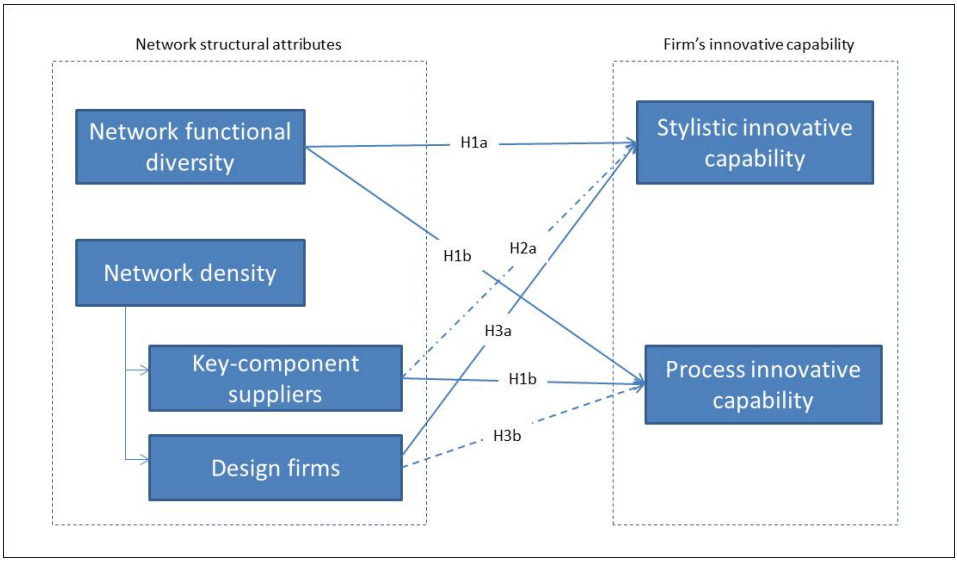
A number of empirical evidences show that design firms (or independent designers) significantly contribute to the lead firm's stylistic innovation, governing the creative sensing and the processes of idea development and stylistic orchestration. Their contribution is important also in enabling fashion firms to develop thinking that steps outside their particular business system (Liyanage, 1995). The empirical evidences demonstrate that design firms tend to be most essential in boosting stylistic innovation, even if external designers may contribute to the process innovations by proposing new solutions that improve the efficiency or the effectiveness of the production process (Arndt and Sternberg, 2000). Thus:

H3a. High degree of density of the lead firm – design firms relationships positively affects the stylistic innovation capabilities of the fashion lead firm.

H3b. High degree of density of the lead firm – design firms relationships positively affects the process innovation capabilities of the fashion lead firm.

Figure 1 summarises the theoretical model developed in this study.

Fig. 1. The theoretical model



4. Operationalising the model

This section proposes an operationalisation of the model. This can be useful to clarify some of the constructs adopted as well as to facilitate a further empirical test of the framework. This study also adds to the innovation literature suggesting a novel constructs' operationalisation of stylistic and process innovation in fashion industry, a still underexplored context in management literature. This could be of any help for further analysis in this interesting topic.

Stylistic innovative capability. We defined the first outcome variable of the model as the lead firm's stylistic innovative capability. Following previous studies (e.g., Ahuja, 2000; Capaldo, 2007), in the operationalisation we can employ the lead firm's stylistic innovative performance as a proxy

for the firm's stylistic capability to innovate. To incorporate all the complexity of the construct, we propose to consider both the internal and external perspective on the stylistic innovative performance of the fashion firms. This leads to consider two indicators.

As far as the inside perspective is concerned, we suggest to consider the firm's product innovation output, measured as the number of new products launched onto the market each year. Given the fashion context, we suggest to distinguish between products completely new (for the aesthetic form and/or symbolic value) and "refresh" products (i.e., product launched previously which have been significantly re-styled).

From the outside perspective, we suggest to consider the market feedback as it is especially relevant to express the innovation capability and the creativity of fashion firms. We suggest to capture the market feedback on the stylistic innovation of fashion firms through the sales per new product.

Process innovative capability. We defined the second outcome variable of the model as the lead firm's process innovative capability. Following previous studies (Damanpour, 2010), we operationalise this variable using the firm's process innovative performance as a proxy. Considering the fashion context, with a specific question we propose to collect from the lead firms details about the process innovations (number per year) they have been able to develop. Interventions where 'the technology for production or the supply of goods and services have been significantly improved or completely renewed' are considered as process innovations (Kraft, 1990: p. 1032). Examples of process innovations developed by fashion firms are new manufacturing cycles, quality control system, lead-time monitoring, manufacturing automations, etc. To tap all the complexity of the construct, we propose an additional item (i.e., 7-points Likert scale) to rank each process innovation effect on the production lead-time, quality and/or production costs of the products (from very low impact to very high impact).

Network functional diversity. To measure the network functional diversity we propose to employ Rodan and Galunic's (2004) measure of knowledge heterogeneity. By knowledge heterogeneity we refer to "the

variety of knowledge, know-how, and expertise to which [a firm] has access through [its] network" (Rodan and Galunic, 2004, p. 545). This measure incorporates information about the functional distance between a focal firm and each of its partners as well as the distances among the partners. Starting at the dyad level, we propose to measure the functional distance between pairs of firms using an adaptation of Jaffe's (1986) index. For each firm-year, we measure the distribution (in percent) of a firm's activities across specific functional classes developed using the 4-digit Ateco classification code[1]. This distribution locates a firm in a multidimensional functional space, captured by a k-dimensional vector ($f_i = [f_{i1} \ldots f_{ik}]$, where f_{ik} represents the fraction of firm *i*'s activities that are in functional class *k*). This approach rests on an assumption that the distribution of a firm's activities across classes reflects the distribution of its technical/functional knowledge. The functional distance (*d*) between firm *i* and *j* in year *t* was calculated as:

$$d_{ijt} = 1 - \left[\sum_{k=1}^{K} f_{ik} f_{jk} \Big/ \left(\sum_{k=1}^{K} f_{ik^2} \right)^{1/2} \left(\sum_{k=1}^{K} f_{jk^2} \right)^{1/2} \right].$$

This measure is bounded between 0 (complete similarity) and 1 (maximum diversity) and it is symmetric for the two firms. Following prior studies (e.g., Phelps, 2010), we propose to use these pairwise distance values to construct annual distance matrices (D_t) which reflect the functional distances between all possible pairs of firms considered.

Subsequently, we propose to compute the uniqueness of the functional profile[2] of each partner *j* in firm *i*'s supply network in year *t*. The uniqueness of firm *j* is a function of the uniqueness of its partners, *k*, and firm *j*'s

[1] The Italian activities classification code is named Ateco. Ateco is defined by ISTAT (the Italian national statistics authority) as a revised version of the European NACE classification.

[2] Rodan and Galunic (2004) explain why this step is necessary: "[…] suppose A has two contacts, B and C, each of whom have very different knowledge than A. The range of knowledge available to A will depend not only on A's knowledge distance from B and C but also on B's distance from C, that is, on the degree to which these two contacts' knowledge differs [...] thus we began by calculating a value of the 'uniqueness' of knowledge for each member of a [firm]'s immediate network" (p. 549).

distance from them. Following Rodan and Galunic (2004), we can define the uniqueness of firm j (u_j) as:

$$\lambda u_j = \sum_k d_{jk} \times u_k.$$

The uniqueness of each firm is found in the solution of the Eigen equation ($\lambda U = DU$). The vector U is an eigenvector of D and λ is its associated eigenvalue. The elements of U are the uniqueness values for each firm, and D is the matrix of pairwise functional distances.

Finally we can measure the functional diversity available to firm i in its (ego) network (NFD_{it}) of supply partners in year t as:

$$NFD_{it} = \frac{1}{N} \sum_{j=1}^{N} d_{ij} \lambda u_j,$$

where d_{ij} is partner j's distance from i and λu_j is j's uniqueness score computed for i's N partners. The $1/N$ term compensates for the fact that lambda increases linearly with network size. This measure increases linearly with the distances among i and its partners (Rodan and Galunic, 2004, p. 550).

Network density. To develop two different measures of density for each sub-networks (i.e., key-component suppliers and design firms), we propose to consider each cluster separately and start at the dyad level. As dense networks are those characterised by strong ties among actors (Granovetter, 1973), we consider the strength of ties between pair of firms. The analysis includes the dyadic relationships among the lead firm and its partner as well as all the possible tie strength among the partners (respectively key-component suppliers and design firms). The strength of ties can be measured as the number of contacts per year among each pair of firms. The number of contacts represent the frequency of interaction between firms and has been widely adopted and validated as a proxy for the strength of interorganizational as well as interpersonal relationships (e.g., McEvily and Zaheer, 1999; Nelson, 1989). This frequency of contact measure is also symmetric for the two firms.

We can use these pairwise strength of tie values to construct annual density matrices (DE_t) which reflect the strength of tie between all possible pairs of firms considered in each sub-network. Next, we propose to compute the uniqueness of each partner *j* in firm *i*'s supply network in year *t*. The uniqueness of firm *j* can be found using the same approach described above for the network diversity measure and developed by Rodan and Galunic (2004). Finally we can measure the supply network density available to firm *i* in year *t* (DS_{it}) as:

$$DS_{it} = \frac{1}{N}\sum_{j=1}^{N} t_{ij}\lambda u_j,$$

where t_{ij} is partner *j*'s tie strength with *i* and λu_j is *j*'s uniqueness score computed for *i*'s *N* partners. The $1/N$ term compensates for the effect of network size. This general measure increases linearly with the increase in supply network density (Rodan and Galunic, 2004). As we considered two different sub-networks, from the general measure we can derive the degree of density for the key-component supplier network (DSs_{it}) and the design firm supply network (DSd_{it}).

5. Discussion and conclusions

This paper contributes to the debate on the strategic management of knowledge-intensive supply networks. The theoretical framework presented here proposes an integrative view, examining the conditions under which network configuration impacts on the innovation capabilities of the lead firm in the fashion industry.

This framework departs from the current dominant logic exploring network configurations that enhance the joint generation or adoption of multiple innovation types. This study develops a theoretical model around two propositions.

P1. The fashion lead firms combine internal and external resources and capabilities to synchronously pursue stylistic and process innovations.

The rationale for this perspective posits that the firm's innovative performance depends on how well multiple innovation types work synchronously together, not on how each innovation contributes independently. In the fashion industry, the combination of stylistic and process innovations in new ways is essential to maintain competitive advantage and achieve performance goals (Tran, 2010). The full potential and benefits of one type of innovation (i.e., stylistic or process innovation) cannot be realised unless the other type becomes an integral part of its development or adoption process.

This study also share a knowledge-based perspective according to which the lead firms leverage the network-wide knowledge access, transfer and creation to generate competitive advantage based on superior innovation (Capaldo, 2007). Essential for this reasoning is the notion of relational capability for network management. This capability consists of routines specifically devoted to leverage the knowledge set up outside the firm's boundaries and to integrate them with the knowledge developed inside the firm. Thus the second proposition is:

P2. Fashion lead firms shape the structural attributes of their knowledge-intensive networks to sustain their stylistic and process innovation capabilities.

Overall, the framework advances the idea that both network functional diversity and density – as specific attributes of the supply network – impact synchronously on the stylistic and process innovation capabilities of the network's lead firm. Thus, the main contribution of our integrated model is the identification of the specific relationships linking the network characteristics and the multiple types of innovation. Emphasising these distinct linkages, it is at once more detailed and comprehensive than the existing models of networking and innovation relationships in the fashion industry.

The model needs testing and refinement by empirical research in order to verify the validity of our hypotheses in concrete situations. We also suggest evaluating the model by considering different segments based on business

models and design strategies adopted by fashion firms. Tran (2008) distinguishes between the identity-driven and the market-driven segments. The first one is the segment in which operate fashion firms whose product innovation is driven by designers and brand's stylistic identities. The value creation of this business model is the reaping of high margins from a limited number of high quality products. The market-driven segment includes fashion firms that build their business model around flexible responses to market demand. Here, the competition is about prices, frequent collection updates and extensive distribution chains. Interesting insights could emerge from the testing of our hypotheses in these two settings.

The relationship between supply network structure and innovation capability can be considered as a part of the broader debate on how the supply network can contribute to the competitiveness of the lead firm. Within such a broad theme many other variables could be taken into account, including the effects of governance mechanisms (i.e., formal or informal) designed by the lead firm to facilitate network leverage. Such governance mechanisms may have a moderating effect on the relationship between supply network structural attributes and a firm's innovation capabilities.

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