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COLLABORATIVE CUSTOMIZATION AND INNOVATION IN BUSINESS NETWORKS: HOW DOES PROXIMITY MATTER?

Abstract:
The success achieved in the past by industrial districts and geographical clusters has shown that spatial proximity matters, especially when referred to subcontracting relationships. However, in the last two decades globalization of production, development and diffusion of ICTs, and growing modularization of products have significantly reduced the traditional advantages of geographical clusters, and, more generally, the importance of spatial proximity to the definition of an efficient and effective management of inter-organizational relationships. It is then appropriate to ask if the geographical proximity can still matter in a globalized world, and the reasons why this happens. The paper analyses the case of a global mid-sized company that has recently activated new relationships with local strategic suppliers at the same time of a growing internationalization. The case study suggests that the choice of increasing spatial proximity derives from a very specific process of customization, which cannot be achieved by adopting the modularity-postponement approach largely analysed in the literature. We propose the concept of collaborative customization to identify a customization process that is based on an intense collaboration between the focal firm and its strategic suppliers.

Keywords: Geographic proximity, supply chain, collaborative innovation, customization

COLLABORATIVE CUSTOMIZATION AND INNOVATION IN BUSINESS NETWORKS: HOW DOES PROXIMITY MATTER?

INTRODUCTION

The success achieved in the past by industrial districts and geographical clusters has shown that spatial proximity matters, especially when referred to the relationships between a firm and its subcontractors.

However, the traditional advantages of co-location – those that Alfred Marshall (1919), the economist who discovered industrial districts – called external economies, have become increasingly weakened with the advance of globalization. More precisely, globalization of production, development and diffusion of ICTs, and growing modularization of products are the three main phenomena that led to a strong development of global value chains at the expence of local value chains, i.e. industrial districts and geographical clusters.

So, in a competitive scenario where spatial proximity is less and less valuable to the inter-organization relationships, it is important to identify those situations where it maintains its value. However, despite the increasing interest about this topic, the research is still limited, and focused on industrial districts (Bocconcelli & Tunisini 2009; Furlan, Grandinetti & Campagnolo 2009).

The aim of this paper is that of contributing to fill this gap. To this purpose we have selected a lead global firm that maintains some subcontracting relationships with near local firms. This lead firm is not localized within an industrial district; moreover, relationships with local suppliers have been recently activated. These elements allow us to exclude both the persistence of residual effects of the "industrial atmosphere" typical of industrial districts, and the existence of an inertial reproduction of past long-lasting relationships. So, the case study contributes to the understanding of why spatial proximity does matters even in a globalized word.

The paper is organized as follows. The next section, based on the literature, illustrates the reasoning that led us to the research question, i.e. why geographical proximity can still matter in a globalized world. The following section, after a methodological introduction, explains in a concise way the history of the firm (Solari) we used to build the case study; in the latest phase this firm is a global player in the markets in which it operates (in particular, public information display systems); nevertheless, it decides to reduce the geographical distance with its mechanical suppliers. This is the reason that makes Solari a case of choise to answer our research question. In section 4 we analyze in more detail the transformation of Solari from a small firm with a domestic market and a local supply chain to a medium firm with a global market and an (almost) global supply chain. In section 5 we present the main findings of the case study while section 6 concludes the paper.

THE ROLE OF GEOGRAPHIC PROXIMITY IN A GLOBALIZED WORLD

In recent years the proximity concept has taken a prominent position in the research on inter-organizational collaboration (Knoben & Oerlemans 2006). Literature has emphasized several dimensions of proximity: besides geographical (spatial) proximity, some authors have studied the concepts of organizational proximity (Meisters & Werker 2004), cultural proximity (Gill & Butler 2003), institutional proximity (Kirat & Lung 1999), cognitive proximity (Noteboom 1999) and technological proximity (Cohen & Levinthal 1990).

Sometimes these proximity dimensions are widely overlapped, so that some authors have suggested unifying selected dimensions in one single concept (Knoben & Oerlemans 2006). For instance, the concept of "organizational proximity" has been proposed to refer to shared routines, values, norms, cultures and relations that facilitate interactions between actors, in this way including the concepts of organizational, cultural, institutional, cognitive and social proximities (Capello 1999; Torre & Gilly 2000; Torre & Rallet 2005). In line with the previous definition, Knoben and Oerlemans (2006) noted that three broad dimensions are relevant for inter-organizational collaboration: spatial (or geographical) proximity, organizational proximity and technological proximity.

Sometimes all these dimensions are present in the same context. For instance Saxenian (1991) described the case of the Silicon Valley where actors are proximate on all three dimensions (spatial, technological and organizational). Furthermore, the literature on geographical clusters and industrial districts[1] have extensively confirmed that geographic, organizational and technology proximities are simultaneously present in these local or regional systems.

Actually, these systems are "geographic concentrations of interconnected companies and institutions in a particular field" (Porter 1998, p. 78). Actors located within them operate in a limited geographic area and share the same business area, so they are spatially and technologically close. Moreover, the intense vertical division of labour induces a continuous interaction between actors within the custer.

Additionally, as Marshall (1919) claimed, the actors of a cluster breathe the same "industrial atmosphere". In line with Marshall, Beccattini (1990) defined industrial districts as "a socio-territorial entity which is characterized by the active presence of both a community of people and a population of firms in one naturally and historically bounded area" (p. 38). Dei Ottati (2003) carried his thought further, introducing the concept of community market: a shared language, and common values, meanings and implicit rules of behaviour. The same elements are the basis of the concept of shared cluster macro-culture proposed by Bell, Tracey and Heide (2009), and of the concept of organizational proximity as proposed by Knoben and Oerlemans (2006).

According to the (geographical) cluster literature, this community dimension impacts on inter-organizational relationships in two ways: 1) it reduces transaction costs, and 2) facilitates knowledge exchange, in particular the exchange of tacit knowledge (Camuffo & Grandinetti, 2006). The second aspect is particular relevant for joint practices of problem solving and innovation, e.g. between a firm and its suppliers (Garofoli 1994; Lorenzoni & Lipparini 1999; Lissoni & Pagani 2003; Grandinetti & Tabacco 2003).

However, in the last two decades relevant phenomena have significantly modified the traditional advantages of geographical clusters, and, more generally, the importance of spatial proximity to the definition of an efficient and effective management of inter-organizational relationships. Those that have been most studied are the following three:

- globalization of production,
- development and diffusion of ICTs,
- and growing modularization of products.

Globalization of production has multiplied the locations of manufacturing plants, because a high number of new countries offering low costs of production (Sideri 1997) has appeared on the scene. All companies are faced with this exceptional opportunity: for example, the lead

[1] In our opinion, industrial districts are a variant of geographical clusters as defined by Porter (1998). The former are characterized "by the active coexistence of an open community of people and a segmented population of firms. Since the community of people and the population of firms live in the same geographical area, they will criss-cross one another. Production activities and daily life overlap "(Becattini 1991, p. 111).

firms of the industrial districts, each with its network of subcontractors traditionally embedded within the local cluster (Corò & Grandinetti 1999); but also multinationals, traditionally characterized by a high vertical integration (Buckley & Ghauri 2004).
ICTs have allowed very distant firms to communicate, interact and exchange even complex information and knowledge at low-cost (Antonelli 2000). Contemporaneously, this new opportunity provides strong incentives to reduce tacit knowledge and increase knowledge codification. In short, ICTs have a strong impact on connected business processes making them independent of geography (Davenport & Short 1990; Carbonara 2005).
Finally, the tendency to design and produce modular products has led the development of the so called "modular production network" as defined by Sturgeon (2002). The lead firm of the network concentrates "on the creation, penetration and defence of markets for end products – and increasingly the provision of services to go with them – while manufacturing capacity is shifted out-of-house to globally operating turn-key suppliers" (p. 451).
Clearly, globalization of production, ICTs, and modularization are interdependent phenomena and this emphasizes their overall impact. In this scenario, the distance between lead firms and their suppliers has raised. On the one hand, lead firms of industrial districts have frequently replaced local suppliers with international supplier, as many studies have already proved (Tattara, Corò & Volpe 2006; Chiarvesio, Di Maria & Micelli 2010). On the other hand, many multinationals have replaced highly integrated value chains with global value networks (Sturgeon 2002; Gereffi, Humphrey & Sturgeon 2005).

THE CASE STUDY

Research method

Why does a global firm increase its geographic proximity with some of its business suppliers? Why is the interaction between the focal firm and its suppliers not managed thought communication technologies, thus reducing the importance of physical interaction? These are the main questions of our empirical research.
To answer these initial questions, a single case-study has been realized. The case has evolved in interaction with the collection of empirical material (Dubois & Gibbert 2010).
We collected, compared and merged multiple sources of empirical material (face-to-face interviews, balance sheets, web-sites) (Alvesson & Karreman 2007). 9 semi-structured interviews were realized: 7 with senior managers of Solari, and 2 interviews with two Solari's suppliers. The interviews were carried out on the base of semi-structured questionnaires. All the interviews were recorded, transcribed and shared within the research team. A longitudinal analysis was conducted.
Three main research steps can be identified (table 1). These steps were characterized by different goals and interviews.

Table 1 around here

In the first step we elaborated the past and the current strategy of Solari. We interviewed the Chief Executive Officer, the Director of the Procurement Department and the Director of Marketing Department. In these interviews we also discovered that Solari considers geographic proximity with local suppliers as strategic.
In the second step the dimension of geographic proximity was analysed. Other four interviews were realized: we interviewed the Director of Procurement Department and the Director of Marketing Department once more; and we met the Director of R&D Department

for the first time. Each of these interviewees identified 2 suppliers that are characterized by high geographic proximity with Solari. Afterwards, we interviewed these suppliers (Supplier A and Supplier B). These meetings enabled to develop a complete vision of the interaction between Solari and its strategic suppliers. Both suppliers (A and B) consider Solari one of their main customers. From the suppliers' point of view the relation with Solari is important not only in terms of turnover but also because Solari is an important stimulus for their learning. In the second phase, at the end of each interview, we explicitly asked to express the personal point of view about the value of geographic proximity. In this step we identify the customization as the key variable that explains why Solari has decided to enhance geographic proximity with its suppliers. Solari follows an approach to customization that cannot be identified with the modularity-postponement approach largely analysed in the literature.
In the third step we sent the case to two Solari's managers (Director of Procurement Department and the Director of Marketing Department), for the validation of the case study. A positive feedback has been received.

Solari di Udine: three phases

In this paper we study an Italian firm, Solari di Udine S.p.A. (from now indicated as Solari) that is a medium firm that in 2009 had a turnover of 37 million euros and about 250 employees.
Solari is a world leader for public information display systems, industrial time-keeping equipment and data collection systems. Two main product types compose its current product-portfolio: standard products (i.e. time-sheet clocks) and the so-called "systems" (i.e. time and attendance terminals for airports). Systems are highly customized products and are mainly sold around the world.
It considers both upstream and downstream interaction as fundamental for its competitive advantage. Especially for customized products the firm frequently interacts with its business customers when they ask for customized or innovative products; it also frequently interacts with suppliers when customization and innovation have to be produced.
Solari exports in more than 60 markets both in developed and emerging countries. Now it is investing into its branch of New York to strengthen its presence in the USA. It has a global supply chain and a relevant international experience that makes international and local relationships equally practicable. In this perspective Solari taps on local suppliers only if they are considered the best option and not because it is unable to find or to manage a global interaction. As for many other manufacturers its supply chain has become more international in the last 15 years. This current level of internationalization is the result of a history that started in 1948.

The main focus of this case study is the analysis of the development of Solari's supply chain in relation to the evolution of its product-portfolio. Three main phases can be identified.

In the first phase Solari's success was based on two technological inventions that had been used to produce innovative products. In this phase two main sub-periods can be recognised. In the first period Solari was the monopolist of time clocks (a standard product) and time and attendance terminals (a customized product) that were based on the invented technologies; the production was almost wholly internal. In the second period Solari had no more the patent protection, so other firms offer similar products; it started to externalize some production's phases to local suppliers, located around Solari, within its region. Overall the importance of standardized and customized products was the same.

In the second phase, Solari redefined its strategy, because its products were considered out-dated and too rigid. While in the past Solari had invented new mechanical technologies, in this period it innovated identifying new application of electronic technologies that were produced elsewhere. For instance, in the production of attendance terminals Solari gradually joined its past patented technology to new electronic technologies (i.e. the technology of led). These decisions influenced Solari's sourcing strategy: the importance of electronic international suppliers grew; mechanical suppliers become national that is they started to be distributed around North and Central Italy. In this phase standardized products represented the most important product type in terms of turnover.
In the third phase Solari invests on systems. Indeed, competitive environment changes induce Solari to bet more on complex systems that are highly customized. From a supply chain point of view, Solari continues to buy standardized electronic components from international suppliers, but decides to increase geographic proximity with some of its mechanical suppliers that return to be local (i.e. within the Italian region of Solari). Indeed, these suppliers are considered strategic for the production of high-customized systems.

In the table 2 we describe the main elements of the evolution of Solari's supply chain.

Table 2 around here

From our point of view, the most relevant aspect is the evolution of the supply chain of mechanical components. While in the first period the supply chain is local, in the second the suppliers are national (North and Central Italy), while in the third phase they return to be local.
The aim of this paper is to understand why in the third phase Solari decides to reduce geographic distance with its mechanical suppliers.

A SMALL LOCAL FIRM THAT BECOMES A GLOBAL MID-SIZED COMPANY

The first phase: the success ground on inventions

Fermo and Remigio Solari, two brothers with a long family background in the production of clock towers and wall clocks, founded Solari in 1948. However, unlike previous generations, they were able to transform the familiar handcraft activity in an industrial firm.
They had different and complementary vocations. Fermo was the inventor: he created two of the most important patented products of Solari. Remigio was an intellectual that was able to successfully manage the firm. The heterogeneity of their competences was really important for the newly born firm: Solari's success was initially fuelled by Remigio's inventions that were exploited thanks to the innovative commercial and marketing strategy, defined by Fermo.

The 50th and 60th had been one of the most successful period of Solari. In these years Remigio introduced two inventions that marked the history of the whole industry of industrial clocks and of public information systems. Remigio introduced an important innovation in the technology of time-sheet clocks, thus becoming a leader in the Italian market. Furthermore, he invented a new technology of the so called "rullo a paletta" (patented in 1956) that was used to produce industrial time clocks, and time and attendance terminals. These terminals were so innovative that were bought by many national and international airports, railway

stations and metros to communicate information to the public. So, Solari became an international leader in the public information industry.
Gradually, two main product areas composed the product portfolio: the standard products (i.e. the time-sheet clocks, industrial clocks) and the customized systems (i.e. time and attendance terminals). Both areas were equally important in terms of turnover. In these years almost all the planning and product activities were internally realized. The firm outsourced only some activities. For instance, Solari asked to a local industrial designer, Gino Valle, to define the design of one clock, "Cifra 3" that used the patented technology. Cifra 3 has been a so successful product that now it is still exhibited in the Modern Museum of Art of New York, as an example of product of design.

In 1964, after some years after Remigio's death, Fermo sold the Solari to a big Italian industrial group, Pirelli Group. In the following years the brand Solari was established itself as a national leader in the time-sheet clock market and as an international leader in the public information systems (i.e. time and attendance terminals). The production was partially outsourced to local suppliers (i.e. a spin-off from Solari). However, despite the positive performances, the firm started to not be able to innovate as in the past. So, gradually, especially in the 80s, the brand became perceived as obsolete. In the late 80s the acquisition by a holding company did not offer the solution to these problems, contrariwise the firm fell into a big financial crisis. In 1994 a regional government merchant bank intervened to sustain Solari. After about one year a private investor bought Solari and a new phase started.

The second phase: a mechanical firm became a software firm

In the second phase Solari started an internal re-organization and contemporary worked to consolidate its relationships with distribution channel intermediaries. Then it invested growing resources on innovation. The transformation of market and of competitive environment forced Solari to a market repositioning. Its brand was perceived as a high quality brand but also as an obsolete brand because it was strongly associated to old technologies invented by Remigio. So, Solari gradually decided to change its technological philosophy: while in the past it had been an inventor of new technologies, now it started to invent new applications of (electronic and electric) technologies invented elsewhere. It started to present itself not more as a mechanical manufacturer but as a partner that offered innovative (standard or customized) solutions for public information problems. So, the R&D activities became more and more important; but above all the hardware and software choices become the most important aspect of R&D. Solari gradually transforms itself into an electronic firm.

Solari gradually focused on R&D and realized internally only some production phases. Its supply chain changed and started to be composed by two main groups: electronic suppliers and mechanical suppliers. The firm started to buy electronic components (the most important components in terms of economic value) from international suppliers, while it bought mechanical components from Italian suppliers.
Solari launched new products with a growing innovative software and hardware content. Furthermore, it also renovated some of its existing products. For instance, it started to produce time and attendance terminals using new visual technologies: not only terminals with the old technology invented by Remigio, but also terminals with led technologies or video displays. In this phase Solari invested both on standard products and on customized systems, but standard products represent the most important area in terms of turnover.

Internal re-organization, the acquisition of some existing firms and above all investments on innovation contributed to re-launch the firm. Positive performances seemed to confirm the correctness of the new strategy. In 10 years (1994-2004) Solari's turnover increased from 12 to 24 million euros.

The third phase: a medium firm with a global / local supply chain

In the last ten years Solari has confirmed investments on innovation. The growth of R&D department highlights it: currently, out of 250 employees 80 work at the R&D department. About 45 of these 80 employees program applicative software, an element that confirms Solari's definitive transformation from mechanical manufacturer into a high-technology electronic firm where core competences are strictly linked to the hardware and software dimensions of the product.

In the last years new products have been introduced both in the standardized products area and in the systems area. However, a growing competition in the standardized products market has brought Solari to invest more and more resources on the second type of products: as a consequence, compared to the past, systems have become more important than standardized products in terms of turnover.
Over the years Solari has reinforced its capacity to offer more and more complete solutions: while in the past it was used to offer micro-systems that solved specific problems of public information management (i.e. time and attendance terminals for an airport), now it tends to propose macro-systems that help the customer to solve more complex problems connected to information management (i.e. a complete airport information management system that deliver real-time air traffic information to passengers and airport staff). Systems are customized on the customer' specific needs. Morever, Solari's capability to create a customized solution is one of its main competitive advantages.

To reinforce this capability to offer high quality customized systems, about 8 years ago Solari has reorganized its supply chain and in particular it has redefined its strategy toward mechanical suppliers. Indeed, on the one hand, it has confirmed the internationality of electronic suppliers; on the other it has selected new mechanical suppliers. More precisely, it has replaced past suppliers with nearer suppliers, thus increasing the geographic proximity with these actors. The selection of these new local suppliers has been positively influenced by Solari's nearness with a region where many high specialized mechanical suppliers operate.

The aim of this paper is just to understand why Solari has decided to reduce the geographic distance with mechanical suppliers to manage the growing importance of systems. More precisely, the aim is to analyse why a global firm as Solari with an international global supply chain has decided to combine a strong international projection of electronic suppliers with a strong geographic proximity with local mechanical supplier. So, in the following paragraph we will focus on this question. We will analyse the relationship between Solari and its local mechanical suppliers.

A GLOBAL MID-FIRM IN SEARCH OF LOCAL SUBCONTRACTING RELATIONSHIPS: MAIN FINDINGS

Solari is a global high-tech mid-company that has gradually focused on its core competences: R&D activities have become more and more important.

It realizes internally only some production phases (i.e. assembly) and outsources other phases to external suppliers. Now, two main groups of suppliers compose its supply chain: global electronic suppliers and local mechanical suppliers.

As mention before, the current portfolio includes standardized products and customized systems for public information management[2]. This distinction is important because it strongly impacts on the type of interaction between Solari and its suppliers.
In both standard and customized products, electronics and software represent the "value added by Solari". In the last 15 years Solari has accumulated a large know-how in these areas which have been internally developed. It realizes software and projects and assembles hardware (i.e. motherboards) by using standard electronic components produced elsewhere.
The role of mechanical components is different. They compose a "box containing and protecting the electronic heart of the product", as Solari's managers explain. This box is not a key, distinctive, part of the product, but nonetheless it is particular critical because it contributes to durability, resistance, safety, respect of certification, etc. For instance, the mechanical box of variable message signs for motorways (an example of a system) or of a pay and display machines (an example of standard product) is important because it has to be safe, waterproof, resistant to weather stress, etc. So, while electronics constitutes the heart of Solari's product and the reason of its success, the mechanical box is crucial because it protects that "heart".

There is a significant difference between electronic and mechanical components: while the former are purchased in the market, the latter are produced specifically for Solari by its suppliers and there is no general market for them. Furthermore, Solari designs its boxes and contracts with suppliers to have them produced. This task becomes particularly critical as regards customized systems, as the customization of the boxes has to be jointly carried on by Solari and its suppliers.

Indeed, the decision to increase geographic proximity with mechanical suppliers is strictly connected with the growing importance of systems within Solari's business. In the past, when standardized products dominated the portfolio of products, the need of interactions with mechanical supplier was lower. Now that systems importance has increased, Solari seeks to reduce geographic distance with its mechanical suppliers.
In the next subsections we will initially describe the typical interaction between Solari and its suppliers for the production of standard products and then we will focus on high customized products. In the latter case we shall discover that customization represents the key to understand the growing importance of geographic proximity. Finally, in the next paragraph we will describe the particular sourcing strategy devised by Solari.

Standard products and global suppliers

Now standard products represent only about the 40% of total turnover, a percentage that results from the growing importance of systems. Although declining, standard products are still a relevant business, where the firm aim at increasing efficiency and at innovating to preserve profitability. The sourcing strategy represents an important lever.

[2] Among standard product we find industrial and civic timekeeping; human resource management products as magnetic band, fingerprint readers and smart cards; traffic lights with led technologies; pay and display machine for public parking areas; etc.). Some examples of typical customized systems for public information management are: solutions for parking management; turnkey solutions for airports, motorways and city information, public transportation, parking management.

Solari buys standard electronic components in the international market[3]. Its purpose is that of guaranteeing itself a regular flow of technologically up-to-date components at the best price. Suppliers' selection is not problematic due to the relatively large number of world class producers operating in the market. Also the selection of electronic components is not particularly tricky because Solari has accumulated a solid competence in this area and also because continuing in-depth analysis of what is required and what is offered allows to chose the electronic components that suit more.
Geographic proximity is not important, because electronic components are standardized, the relation between Solari and its suppliers is purely transactional, periodically repeated, and does not involve the knowledge exchange typically required for producing, customizing or innovating. Only rarely Solari personally interacts with representatives of large electronic manufacturers (i.e. Samsung). This interaction serves to increase the brand visibility of Solari and sometimes is useful to identify together with manufacturers the electronic components that best fits Solari's well defined needs. However, no new component has ever been produced and customized specifically for Solari.

Also regarding mechanical components geographic proximity is not perceived as indispensable. The level of interaction is high only at the initial phases of production when the first prototype has to be defined. Typically a Solari team spends a few weeks at the supplier's premises to promptly adapt the project to the specifics of supplier's machinery and to rapidly solve unexpected difficulties. This is precisely what geographical proximity would allow to do. For thi
s reason we can talk of "temporary proximity" during the phase of prototyping (Gallaud & Torre 2004, 2005; Torre & Rallet 2005). Thereafter, interaction is much less frequent because components have to follow definite designs and specifics, and the production makes use of diecasting tools which reduce potential errors and the need of control. Next each subsequent order does not require face-to-face interaction.

Interaction becomes important once again when an incremental innovation has to be introduced. This is the case, for instance, for a re-design of the box dictated by the need of adapting product aesthetics to new tastes. As usual Solari and the supplier interact during the prototyping phase. Although interaction is intense, it is not under the pressure of short time of delivery.

To sum up, as regards standard products face-to-face interaction is generally irrelevant excepting for the initial phase of prototyping and for incremental innovation.

Collaborative customization and innovation

The high level of customization that characterizes Solari's systems strongly impacts on the need of face-to-face interaction and, in turn, on the demand of greater proximity with mechanical suppliers, the ones who actively participate to the process.

As figure 1 shows, Solari follows two different customization strategies to produce the electronic and mechanical parts that compose a typical system.

Figure 1 about here

[3] According to Solari about 90% of manufactures of electronic components operate in the Far East.

As regards electronic components (i.e. leds, electric resistances, printed circuit boards), the modularization and postponement approach (Feitzinger & Lee 1997) is adopted: Solari purchases standard electronic components from international suppliers and then creates quite sophisticate configurations fitting customer's need.
As for the case of standardized products (see previous subsection), the interaction with electronic suppliers is a pure trading. Solari interacts with these actors by phone, fax or email. Only rarely a face-to-face interaction is necessary.
Hence spatial proximity with electronic suppliers is not an issue, as satisfactory trading outcomes can be reached regardless supplier's location by using standard communication technologies.

Also for mechanical components Solari has undertaken a modular architecture. However, usually a certain number of modules need to be redesigned to meet the demand of the final customer (Brun & Zorzini 2009).
Despite its past experience as a mechanic manufacturer, now Solari lacks cutting-edge mechanical competences and it is not updated about the latest evolution of machineries. So, it needs to collaborate with external consultants and with its suppliers to achieve the delicate task of re-projecting some customized mechanical module.
Interaction between Solari and its supplier starts during the design phase, when Solari may ask advices about the best way to customize mechanical components.
The supplier provides feedbacks to maximize production efficiency, based on its own knowledge of the installed machinery and production processes. Furthermore, sometimes the process of re-design needs to be repeated until when the final costumer is satisfied. Indeed customization requires a really strong and continuous collaboration between Solari and its supplier. Precisely collaboration takes place during the following phases of a typical job order:

- during the design phase that is realized by Solari. Solari interacts with some of its strategic suppliers to define some details of the project. In this case the strategic supplier offers design assistance;
- during the production, when the supplier becomes the key actor. In this phase the strategic supplier frequently needs to interact with Solari to define all details not precisely specified in the project. From its side, Solari needs to control the advancement of the production[4];
- sometimes during the post-sales phase the supplier can help Solari to solve specific technical problems.

Hence customization of the mechanical modules requires a collaborative relationship, especially during the production phase. We define collaborative customization the customization process that is based on an intense collaboration between the focal firm and its supplier.

Proposition 1. Regarding customized products the need of redesigning mechanical modules requires an intense interaction between Solari and its supplier. This type of customization cannot be achieved by adopting the postponement approach.

[4] Indeed both a real-time problem solving and a high quality production process positively impact on the final quality of the product.

A remote-interaction (fax, email, phone) is used, but Solari and the supplier consider that also face-to-face interaction is essential to the cooperation. Both actors indicate tacitness of knowledge as the most important factor explaining the need of face-to-face interaction. Actually, customization will be the result of a combination of both codified and tacit knowledge, but an essential role is played by (technical and relational) tacit knowledge. Both Solari and suppliers confirm it, especially so on certain occasions: for instance, face-to-face interaction is relevant when unexpected difficulties occur.
Moreover, Solari emphasize the importance of controlling on site the advancement of production and the adherence to the project. Typically, Solari technicians need face-to-face interaction to verify whether the product specifics have been met or what is the outcome of the new redesigned module.

Proposition 2. Reagarding customized products the importance of tacit knowledge warrants face-to-face interaction which necessarily requires geographic proximity.

In the last years technology evolution has deeply reduced the impact of tacit knowledge. For instance, the introduction of CAD and CAE and the use of numerical control machines have enhanced knowledge codification. However, tacit knowledge remains important not only because a part of knowledge has not been codified, but also because it remains essential for the interpretation of codified knowledge (Howells 2002). For instance, face-to-face interaction is useful when it is to decide how some project details can be realized by supplier's machinery, to obtain cost reductions or better quality. As Solari's managers say "we do provide a project that aims at being the best representation of the result we want, but we do not oversee all details of the production process". Face-to-face interaction helps to solve the ambiguity of codified knowledge.

Proposition 3.1. Regarding customized products the introduction of ICT has reduced but not eliminated the relevance of tacit knowledge.
Proposition 3.2 Regarding customized products face-to-face interaction can help to solve the ambiguity of codified knowledge.

As mentioned before, Solari has reduced geographic proximity not only to facilitate cooperative relationship, but also to enhance the possibility of controlling its suppliers not only at the end but also during production. Indeed, interaction during production helps to identify and solve together possible problems, thus improving the process of customization. The necessity of frequent controls is strictly connected to the uniqueness of mechanical parts. Summing up, the higher the level of customization and complexity, the higher the necessity of control. The lower the distance, the lower the cost of control.

Proposition 4. Collaborative customization and control are strictly connected. The control of the execution allows Solari to identify (and solve) problems at the early stage throughout collaborative customization.

According to Solari and to its suppliers, lead times much decreased in the last years (in the past the average duration was of six month, while now it is of about 3/4 months)[5]. The reduction of lead time makes the process of customization more and more difficult, thus increasing the opportunity to intensify the interaction.

[5] Solari applies to international tenders with a design proposal. Only when a positive result has been received, Solari starts a "sprint race" to complete the design, to buy or to realized the components, to assembly them, and to deliver the system on time.

Proposition 5. Regarding customized products the reduction of lead time impacts on the relevance of geographic proximity.

Sometimes customized systems introduce incremental innovations that enhance the need of interaction. For instance, the need of respecting new international quality requirements forces to look for new solutions that can bring incremental innovation. When Solari realised a variable message display for a customer of Saudi Arabia, it created a mechanical box that was appropriate to withstand adverse weather conditions typical of hot climates. In this case the innovation was the result of the collaboration between Solari and its supplier, a collaborative innovation that supported the process of customization.

So, also the intensity of innovation impacts on the demand of interaction: the higher the level of innovation, the higher the necessity to increase face-to-face interaction.

Proposition 6 Regarding customized products incremental innovation contributes to the relevance of geographic proximity. Collaborative innovation supports collaborative customization.

Sourcing strategy and new product development

About eight years ago Solari has defined a new sourcing strategy: it has selected a small group of local mechanical suppliers that it taps each time it wins a new job order. Precisely, Solari launches a sort of "internal" tender and ask its suppliers to make an offer for producing the required mechanical modules. Only the lowest bidder (price is the key variable) wins the contract with Solari. All others remain in a short-list and will be invited to respond to future calls.
This sourcing strategy differs from the traditional models. It can neither be defined parallel (Richardson 1993) nor network (Hines 1995), given that in these models the procurer guarantees a certain amount of production to all its selected suppliers, either by sharing the production of an homogenous good or by assigning the production of each variety to one supplier in case of differentiate goods.
It can neither be defined as "triadic sourcing" (Dubois & Fredriksson 2008) because there is not a direct relationship between suppliers. Neverthless, a indirect relationship can be identified and Solari is the "missing link" between them. For instance, a typical process of design and production of a new system can exemplify this "indirect interaction".

As mentioned before, Solari usually interacts with a mechanical supplier during the design process. In this case the interaction enables a knowledge exchange that allows Solari to incorporate the cutting-edge competence of the supplier into the project participating to the tender.
If Solari wins, it launches an "internal tender" between its suppliers and selects the lowest bidder. Not always the winner is the same supplier that has previously collaborate at the design process. In this case the other supplier (the winner) can take advantage of knowledge contained in the project.
So, when Solari interacts with suppliers, it incorporate knowledge that could be used to design a future product or to customize an existing product. In this perspective a process of collaborative innovation involving more suppliers enhances the competence of Solari and that of its suppliers, a capability that can be useful also for collaborative customization.

It is worth noticing that Solari's strategy allows to select each time the best suited supplier, depending of the characteristics of the job order, and, importantly, induces a condition of continuous competition among suppliers, which provides them strong incentives to remain at the efficient frontier. Indeed, on the one hand, a credible threat is permanently active as there will always be a supplier able to replace the winner in case of bad performance; on the other hand, those who have not won have the opportunity to improve their processes and competences and try to succeed in a next tender.
Moreover, this strategy hedges Solari against the risk that the burst of fundamental supplier might paralyze its activity.

To date, two suppliers (supplier A and supplier B) are winning most of the tenders. Despite the stable collaboration which has been created with them, Solari is continuously looking for new suppliers. Often the enlargement of the network occurs when new products have to be developed or when product or process innovations have to be introduced. In the last months, for instance, Solari has defined a link with a new supplier (supplier C) which will provide the ever more required quality certifications, thanks to its usual collaboration with large multinationals.
It is also worth mentioning that Solari selected Supplier A (which can be considered a European market leader) not only because of its large machinery endowment and its high skilled workers, but also because it is strictly connected with a wide dynamic network (Persson & Håkansson 2009) which offers particularly valuable learning opportunities given the high number and heterogeneity of its customers.
This fact is an example of the embeddedness of dyadic relationships (Solari and Supplier C; Solari and Supplier A) in a complex network. It highlights that relationships, and thus the corresponding possible innovations, are heavily dependent on developments which can occur in a broad range of direct and indirect links.

By the way, the adoption of supplier C shows how the continuous search of new potential suppliers is useful to locate and access competences not immediately necessary, but likely to become important in future contracts. Actually, both supplier A and supplier C started to collaborate with Solari during the development of a new product

CONCLUSION AND FURTHER RESEARCH

Globalization, modularization and ICT evolution have deeply modified supply chains. Many studies have noted that these phenoma enable new relationships with international actors that can be very distant (Gereffi, Humphrey & Sturgeon 2005), thus reducing the importance of geographic proximity.
However, some authors claimed that relationships with local actors can be very useful to catch global opportunities and actually the importance of local partners increases for firms that undertake the path to internationalization (Tattara, Corò & Volpe 2006; Bocconcelli & Tunisini 2009). Some authors have demonstrated that internationalized district players often maintain (and develop) relationships with highly specialized neighbouring firms (Furlan, Grandinetti & Campagnolo 2009). Yet, in these cases one cannot exclude that current proximity is the follow up of past proximity, which might be motivated and explained by a past heritage. To exclude this hypothesis we analyse the case of an international firm not belonging to an industrial district, and so not historically settled in a local network, which has explicitly decided to look for more proximate suppliers.

In this case study we discover that the availability of proximate top class suppliers favours internationalization and access to the markets of complex and sophisticated products, because those suppliers are essential players of its ability to customize.
Indeed, in the last eight years the firm has activated new relationships with local suppliers at the same time of a growing importance of customize products. The choice of increasing spatial proximity with mechanical suppliers is due to the need of producing highly complex and customized products. Solari's customization requires a partial redesign of some mechanical components each time a new job order is won. This fact generates a demand for tight collaboration with the suppliers, which must be grounded on a stable face-to-face interaction. Hence, the choice of increasing spatial proximity derives from a very specific process of customization which can not be achieved by adopting the modularity-postponement approach largely analysed in the literature. In this case a collaborative customization is based on a strong face-to-face interaction that becomes more and more important when incremental innovation has to be introduced.
The case study confirms that geographic proximity is strictly connected to the role of space in a network. According to Ford et al. (2008) space is to be considered a crucial dimension of business interaction, because it influences several resource constellations, actor webs and activity patterns. Indeed, the very possibility of interacting and the scope of interaction depend by the relative position of partners in the space (Ford et al. 2008). In this case study we found that the ability to customize and innovate products is deeply influenced not only by a single dyadic relationship between Solari and a sole supplier, but is the result of the whole network that the focus firm has been able to activate.
This study has several limitations that could be enriched through further research efforts. First, Solari's customization approach has to be more deeply analysed to identify what are the precise differences with the modularization and postponement approach analyzed in the literature. Furthermore, also the peculiar sourcing strategy that Solari adopts needs to be further studied. To date, this strategy cannot be classified neither as parallel nor as network sourcing, because it does not guarantee a certain amount of production to all its selected suppliers. Instead, it selects each time the best fitted supplier, depending of the characteristics of the job order, and, importantly, induces a condition of continuous competition among suppliers, launching a sort of "internal" tender. Solari's sourcing strategy can not neither be defined as "triadic" because only indirect relationships exist between Solari and its suppliers. However, also these indirect interactions seem to be crucial to create a more intense competition among suppliers and at the same time to reduce the risk of supply chain break-ups.

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Table 1 - Three main research steps

Steps of the research	**Main contacts**	**Number (and time) of interviews**
1. The past and the current strategy of Solari	CEO Director of procurement department Director of marketing department	1 (2 h) 1 (1 h 30 m) 1 (1 h)
2. The value of geographic proximity	Director of procurement department Director of R&D department Director of marketing department	1 (2 h) 1 (1 h 30 m) 2 (2 h)
	Supplier A: director of procurement and commercial departments Supplier B: entrepreneur	1 (1 h 30 m) 1 (1 h 30 m)
3. An interaction between research team and the focal firm	Director of procurement department Director of marketing department	-

Table 2 - Three main phases and the internationalization level of the supply chain

Phases	**Main product type**	**Spatial extension**		
		of the whole supply chain	***of electronic components suppliers***	***of mechanical components suppliers***
I. The invention phase	standard products and systems	local	-	local
II. The re-launch phase	standard products	global	global	national
III. The system phase	systems	global / local	global	local

Figure 1 - Collaborative customization and innovation for high customized products