

Beyond Local: The Role of National Innovation Networks Within the 4th IR

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Abstract

Within the 4th industrial revolution (IR), firms' linkages to global knowledge are considered key to improving the innovation capabilities and competitiveness of firms embedded in local industrial districts (IDs). So far, most of the analyses have focused on the complementarity and integration between local and global networks, which have somehow over-shadowed the national dimension of production and innovation processes. With special reference to mechatronics producers, recent trends of Italian firms exploit the critical role of national innovation networks for firms within local systems. In this sense, the national dimension plays a key role in defining the quality and direction of the competitive models of ID firms integrating within global value chains.

Keywords: National Innovation Network; Local-Global; Industrial District; Italy; Industry 4.0; Globalization; Global Markets

1. Facing the 4th Industrial Revolution

Within the 4th industrial revolution, large network economies are a fundamental structure for global competition (Brondoni & Zaninotto, 2018; Büchi et al., 20018). They can support the firms' re-organization of the production processes as well as the development of new business models, although they may also reduce the relevance of certain contextual knowledge. In considering recent global and digital challenges, many scholars suggest that firms embedded in local systems should geographically extend their innovation networks in order to be able to maintain long term competitive advantages (Belussi & Sedita, 2012; Chaminade et al., 2019). Firms need to access knowledge capabilities and resources that they may lack within the local system they are embedded in (Bellini, 2015; Cooke, 2005; Gertler & Levitt, 2005, Park, 2005).

The literature investigating clusters and industrial districts has often highlighted the fundamental role of global knowledge linkages as levers to support the growth of firms' cognitive and learning capabilities as well as the development of more systemic innovative capacity (Barzotto et al., 2017; Bathelt et al., 2004; Castellani et al., 2017; Chiarvesio et al., 2010; Corò et al., 2013; De Marchi et al., 2018; Martin et al., 2018).

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Many of the aforementioned studies have provided important insights on local-global dynamics concerning firms' knowledge sharing and diffusion. However the focus on local-global networks has somehow shadowed the role that national innovation networks can play in supporting firms' innovation. Indeed, firms are not only embedded in local production and innovation systems but are also embedded in a national innovation system which provides certain specific «*direction of innovation and competence building emanating from processes of science-based as well as experience-based learning*» (Lundvall et al., 2009, p. 6). The national innovation system sustains a national identity in terms of science, technology and ways to perform work that, when adequately levered, can strengthen the peculiarities of firms' local competitive advantages.

The aim of the paper is to provide some reflections on the role that the national dimension and, in particular, the national innovation networks play for firms' innovation and for the renewal of industrial district competitive advantages. We will provide some illustrations considering the Italian context. The focus of the present study is on firms belonging to an Italian mechatronics Industrial District (ID) which is now facing important challenges in relation to digitization processes. Those processes are fundamental drivers for leading suppliers and customers of this industry towards paths of transformation in line with Industry 4.0 revolution.

2. The Key Role of National Dimension within Local-Global Value Chains

2.1 The Specificity of the Italian Innovation System

Italy has a national innovation system based on a fragmented national industrial structure (Brondoni, 2013). However, this type of industrial structure expresses important potentialities under the label of 'Made in Italy' and the peculiarities of the IDs capitalism (Becattini, 1990):

- It is a system that mobilizes a large range of industrial districts' supply chains, and vital networks of small and medium firms (SMEs). Innovation emerges within those entrepreneurial contexts, often from interpersonal relationships and informal business circuits.
- Thanks to the geographical proximity that firms share in IDs, local firms have a tendency to establish trustworthy relationships with a large number of suppliers and clients that allow them to apply creative ways to respond to specific clients' needs, as well as to enter flexible and adaptive value chains.
- The large presence of micro entrepreneurs in local production systems ensures the development of bottom up production and organization models who leverage skills related to traditional crafts and embedded in local social capital. This constitutes the main core of *the contextual knowledge* that firms can use within their value chains for sustaining the distinctiveness of their competitive advantage.
- The typical model of ID value chains maintains the core of industrial production mainly in peripheral areas (in the countryside or close to small villages). However, the knowledge intensive business service (KIBS) centres and knowledge providers are today more and more centralized in the main

cities and urban areas. The services they provide to firms concern business and marketing functions, high skills consultancy activities, research and development activities, training activities, and so on. They can complement the production and services functions that can be normally found in the IDs, increasing the value of local production.

The features mentioned above are particularly critical for understanding the peculiarities and potential of the national dimension in supporting not only firms' production but also innovation. The firms and the related value chains that characterize the ID capitalism are supported in their business models by the integrative functions and services provided by other firms and organizations that share some '*cultural proximities*' with the ID places, even if they are located outside the boundaries of the IDs. When intercepting the needs of firms located in IDs, other Italian and suppliers, commercial services, KIBS centres, banks, universities, research and training centres are able to operate with firms embedded in those systems since they share a common culture base. Indeed, the large distribution of functions and activities within the national territory allows firms of local productive systems to realize some extra economies of scale and to leverage the use of cognitive and inter-personal skills of the larger national networks to exploit similar contextual knowledge in other national local productive agglomerations. Also, they may access some rare professional skills in urban areas which may be lacking in isolated IDs.

The spreading of firms' presence within different productive places and urban areas of a common identity (a similar entrepreneurial attitude, a similar way to perform and organize work and to establish relationships, and a similar way to express creativity) allows them to go beyond the local circuit of the labour and innovation system.

2.2 The Role of the National Innovation Networks in the Evolution of Manufacturing Value Chains

Today, the diffusion of information and digital technologies meeting a shared national culture related to 'Made in Italy' downplays the relevance of geographical proximity in the manufacturing value chains while it increases the relevance of other types of proximities (Boschma, 2005)¹. In particular, the cultural identity can be a key lever for supporting an evolution of firms in the manufacturing value chain towards more technological, science based, and new intangible aspects of production. Firms willing to place themselves within new innovation circuits to find new ideas, capabilities, and markets can establish relationships of reciprocal specialization with suppliers and clients that operate at a certain geographical distance, but that are able to perform under the same 'Made in Italy' style. Due to the fact that those partners are often competitors or work for competitors, there may be initially some reluctance for firms to open to other firms and suppliers operating in the same sector or field. However, the relationship can also strengthen the alignment between partners on strategies that can be used within global value chains. A transition from local to national level often represents the first step of firms' gradual openness towards new relationships and operations with suppliers and clients at a supra-national scale.

There is plenty of examples of Italian firms born locally but today leveraging their national network to support their business specificity in global value chains. Luxottica, the Italian global leader in the eyewear industry is one of the most well-known examples. The company maintains productive sites in the Belluno ID of origin as well as productive facilities close to its foreign markets. However, its key business centre is in the city of Milan, where it is possible to find numerous professional communities that can support all intangible and technological aspects of ‘Made in Italy’ production. Another example is the IMA group, a leader in the packaging industry, which has its roots in the Emilia Romagna industrial district. In order to strengthen its position in the international market, the group is today integrating, through contractual agreements, mergers and acquisitions, different professional skills and knowledge diffused among other Italian industrial districts and clusters that specialize in the same or related field.

Also many multinationals (MNCs) investing in Italy are following this logic and leveraging the plurality of Italian places and the different Italian ID specializations. Examples of this kind are the international fashion industry famous brands such as Ralph Lauren, Louis Vuitton, Armani, and Gucci, just to name a few. The network these groups and other similar groups can leverage includes suppliers specialized in functions or different phases of the Italian value chain (i.e., products, tests, development or logistic centres, design, business, digital, and marketing services). The networks can also involve universities (such as polytechnics and business schools) and research centres that, operating close to the ‘Made in Italy’ industries, can provide support to new business ideas related to Italian production. The strong connections that MNCs establish between different subsidiaries and suppliers along the national territory extends to the rest of the multinational branches and related supply chains. These can then benefit in turn from the specificity of the competences of the Italian innovation network.

3. A Reflection on Recent Trends within the Mechatronics Industry

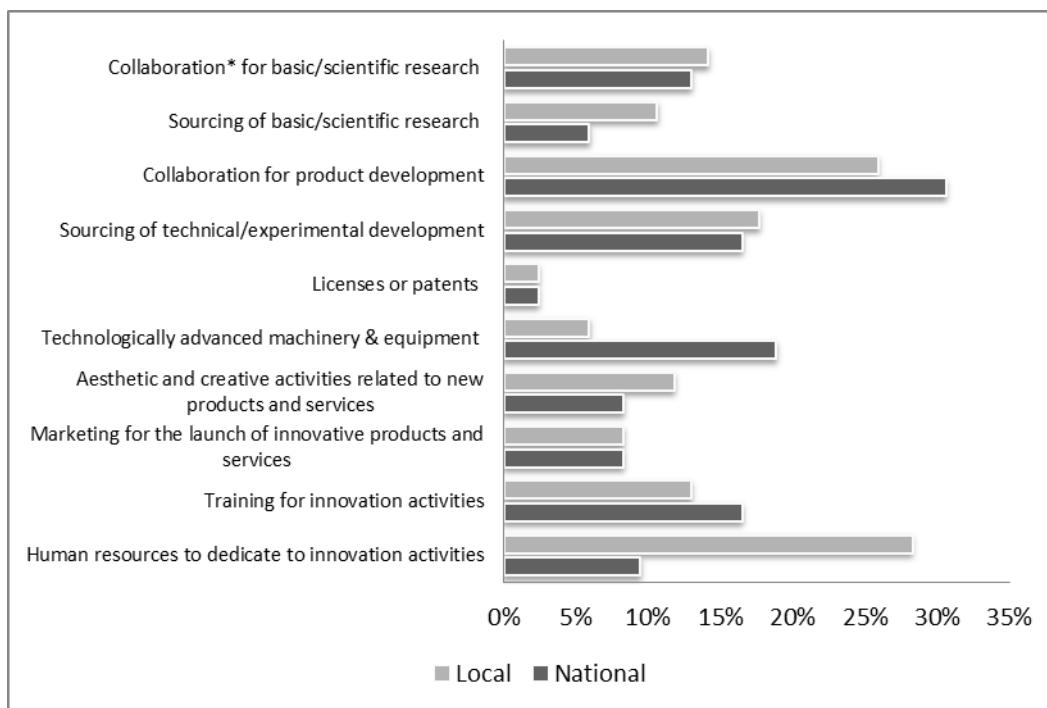
By changing the role and effectiveness of geographical proximity, the Industry 4.0 perspective can encourage firms embedded in industrial districts to establish new relationships at a national level to support joint innovation processes and collaboration. This is particularly interesting with respect to industries such as mechatronics that is today one of the backbones of the 4.0 transformation.

The mechatronics value chain, as other value chains of ‘Made in Italy’ traditional industries, has both local and national roots. While part of the division of labour takes place within the local production systems, network relations with clients, suppliers, and service providers are also commonly established with other national partners. The long Italian tradition related to mechanics has supported the development of many professional competences related to the core knowledge of the mechatronics industry that are diffused throughout the whole national territory. However, when discussing innovation, it remains often difficult to disentangle the role played by the local network from the role played by a more extensive national innovation network. It requires qualitative analysis of firm’s cases or ad hoc statistics which may allow one to capture different aspects of innovation processes

at different geographical levels². With this warning in mind, we provide here an illustration of those innovation networks by means of data collected through an investigation conducted in 2017 on 85 firms belonging to the Vicenza mechatronics ID³. With respect to the 4.0 Industry revolution, different firms of the IDs are today facing important challenges that impact their business models. The information collected allows us to grasp how firms are today using their local and national innovation networks not only to support their innovative processes but also to maintain a certain competitive advantage within global markets.

Figure 1 summarizes and compares the geographical distribution of different local and national sources of knowledge and know-how, and collaboration aimed at innovation of those investigated firms⁴.

Figure 1: Local and National Distribution of Knowledge and Know-how (Year: 2014-2016, n=85, % of Firms)



Source: Authors' data elaboration.

* Collaboration implies not only the acquisition of knowledge but also the reciprocal exchange of knowledge.

As the figure above shows, a large percentage of firms do not rely only on their internal capabilities but today are making use of an extensive number of national knowledge sources and know-how. The national level inputs are particularly important for supplementing the local nourishing of research and development (R&D) activities. More than 10% of the companies have some collaboration at the national level for basic and scientific research. The results show that collaboration for product development at the national level is even higher than collaboration at local level. Indeed, the investigation highlights that firms that already have an internal R&D department resort more frequently to collaboration with national

partners for scientific research than firms that do not have it (this concerns 20% of the former firms with respect to 8% of the latter). Firms lacking internal R&D departments prefer to collaborate locally instead. Some of these firms do not yet have adequate internal professional interfaces which are normally required to link with national partners. The solution for them is to maintain interactions mainly in close proximity and leverage local informal inter-personal relationships.

The figure 1 also highlights that the sourcing of licenses and patents to support their own innovation is not considered particularly strategic by the investigated firms. However, around one fifth of the firms find that access to technologically advanced machinery and equipment acquired from other national firms is key. In general, what emerges from the interviews is that local firms look for the best suppliers of machines that can guarantee them a high standard of performance in terms of output.

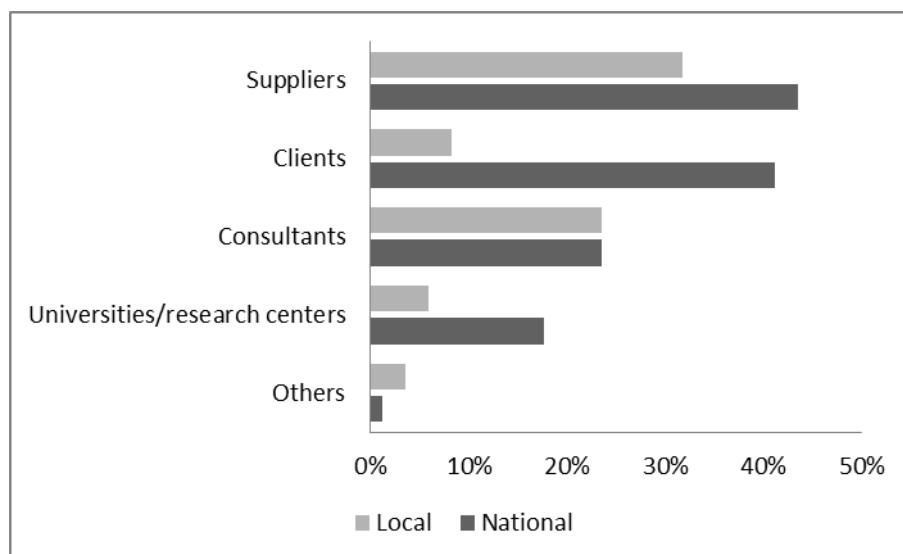
Due to the strong specialization in technical and engineering activities of the investigated firms, the main market for human resources dedicated to innovation activities remains local and it is strongly supported by the professional training of technical schools present in the Vicenza province. However, some firms have started to look outside of the local system for human resources who can support peculiar aspects of innovative processes. This is particularly true when in need for new professionals with digital skills.

National sources for marketing activities which are specifically related to the launch of innovative products and services are exploited by around 10% of the firms. This percentage equals the percentage of firms that source locally. However, the analysis also reveals that firms which consider business and marketing knowledge strategic for building a competitive advantage generally rely more on an extensive national network. This means that if a firm wants to expand its market, it prefers to rely on organizations which are present in the national territory, because that may provide some specific professional services which may not be found at local level. Probably for the same reason, training activities aimed specifically at supporting firm's innovation processes are sourced more from the national level than from the local level. Therefore, national sources of knowledge and know-how seem to play not only a reinforcing but also a complementary role with respect to sources present within the local production system, particularly if aimed at supporting innovative processes.

When looking at which actors at the local and national levels acquire strategic relevance for firms' innovation activities (Figure 2), it is possible to notice that for different investigated firms the value chain that generates competitive advantages is principally national rather than local. A large number of firms consider suppliers and clients at the national level to be more strategic for innovation than suppliers and clients present within the ID. Firms that rely only on local suppliers are mainly firms that still base their main market strategy on traditional advantages, focusing principally on the quality of their production (around 80% of firms with local suppliers). Instead, firms with national suppliers have a more heterogeneous approach to the market. Almost half of these firms have tried to expand their market share by focusing on some novelty of their products or services (20% do that by specifically targeting the international market).

For about one fourth of the sample, national consultants are also assuming a certain significance. Those consultants can be technical specialists, but also KIBS providers. The investigation highlights that while firms that rely only on local consultants have higher propensity to base their activity on technical and engineering knowledge, those with national consultants have higher propensity to rely also on some scientific knowledge. In other words, 35% of the firms with national consultants find scientific knowledge strategic for their business with respect to only 16% of the firms possessing only local consultants. Moreover, to confirm the importance that R&D activities at the national level is assuming for different firms, national universities and national research centres are also considered key for sustaining their own innovation processes by about one fifth of the investigated firms⁵.

Figure 2: Strategic Nodes in the Network for Sustaining Innovation Activities (Year 2014-2016, n=85, % of Firms)

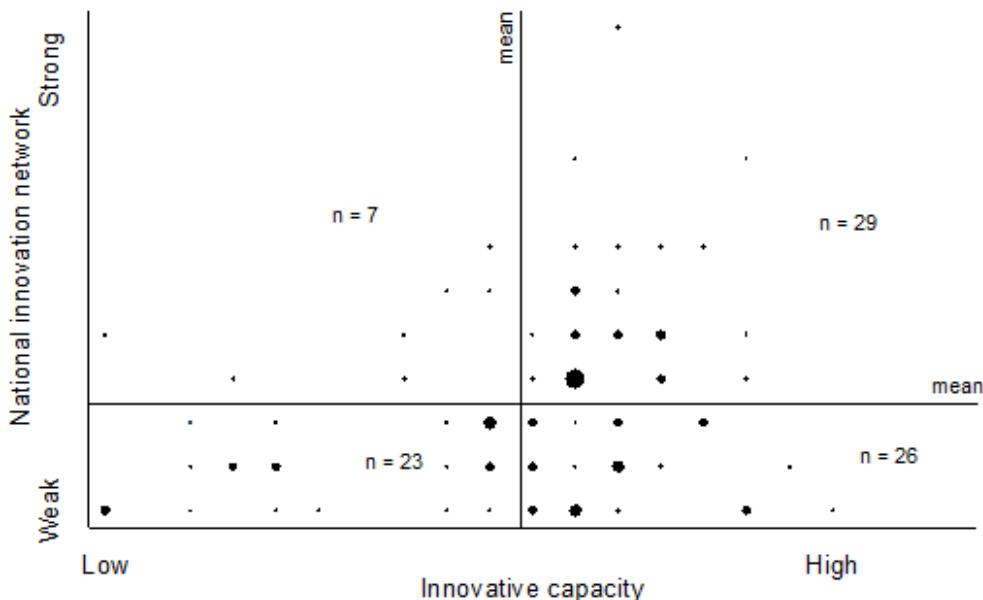


Source: Authors' data elaboration

From the analysis, we see that firms with a strong national network have some key distinct characteristics with respect to the other investigated companies. Figure 3 highlights how firms with a national innovation network above the mean of the sample have in general high innovation capacity (right upper quadrant)⁶. Only a few firms that have a strong national network have innovative capacity under the mean (left upper quadrant). On the contrary, many firms with a weak national innovation network also have low innovation capacity (left lower quadrant). In this quadrant, there are mainly firms that are strongly local or that use only own internal resources⁷. The scatter plot (Figure 3) points out that firms with a strong national innovation network generally have a high chance of developing good innovative capacity. However, it is important to point out that having a strong national innovation network is not an exclusive condition for the support of firms' innovation. In the right lower quadrant, for example, we find firms with a weak

national network having some good innovative capacity. The analysis allows the emergence of a high proportion of firms with international linkages and research and science bases capabilities. This stand out with respect to the group of firms in the left lower quadrant. Those assets seem to compensate for the weak national innovation network.

Figure 3: National Innovation Network and Innovation Capacity



Source: Authors' data elaboration.

n indicates the number of firms in each quadrant. The size of a dot represents the number of firms having the same coordinates.

Disentangling further the firms of the sample we observe that other differences emerge. After classifying firms with a strong national network (i.e. above the mean) as group 1, we decided to distinguish firms with a national innovation network below the mean into two other groups. Group 2 represents firms with a limited national innovation network, while group 3 firms without national innovation linkages⁸. Almost all firms with a strong national innovation network have introduced at least an innovation in the last three years that is above the sector average⁹ (90% of firms of group 1). Instead, the percentage of firms in the groups 2 and 3 that have innovation above the standard sector average is around one third lower (60% for the group 2 and 56% for the group 3). Although the percentage is still high, it may be more related to innovation of incremental nature and in some cases to the presence of other firms' assets. Moreover, after the last financial crisis, 44% of firms of group 1 have increased their competitive capacity at least with respect to other local firms. The percentage decreases to 32% for firms of group 2 and to 28% for firms of group 3. For what concerns the internationalization aspects, those firms without a national innovation network (group 3) do not have so many linkages at the international level concerning innovation aspects (60% of firms in

group 3 do not have any). This percentage diminishes within group 2 (less than half of the firms) and within group 1. In this later case, only 20% of firms do not have any international linkages.

4. Conclusions and Emerging Issues

The paper draws important considerations on how firms belonging to ID sustain their innovation processes by relying on an extensive national network which includes national actors and linkages located outside the boundaries of the ID. This also involves national Industry 4.0 manufacturers and providers of digitalized products and services.

So far, different studies have stressed that global linkages are fundamental to sustain the innovation capabilities of firms and even the renewal of local industrial specializations. However, those linkages can be established efficiently by a limited number of firms embedded in industrial districts. Different firms may lack an adequate openness which allows them to participate more actively in global networks and efficiently exploit global opportunities.

Since the turn of the century, the digital and global transitions have brought important challenges to firms in IDs. However, competitive advantages of IDs organizational models have not completely disappeared, but they just transformed. Many firms still preserve important linkages with knowledge embedded in the ID of origin, but they are also extending their linkages more and more to the national level.

The relational proximity that Giacomo Becattini as well as other ‘districtualist’ scholars have highlighted as a typical successful factor of IDs can find some of its extension at the national level. In particular, the generative knowledge within the traditional IDs innovation model can today overcome the barriers that in the past have often confined it within narrow places, sometimes at the periphery.

The logic of Industry 4.0, which is implemented today by different machine manufacturers and, in general, by actors who operate upstream and downstream of value chains, introduces a discontinuity in the Italian manufacturing system that requires the participation of firms in broader learning networks.

This article supports the idea that within the digital/global new paradigm, the new competitive advantages of Italian firms may rely on knowledge embedded in places and individuals that flows through networks based also on cultural proximity. Using such networks firms can expand economies of scale and scope of the IDs generative knowledge. This knowledge complements the codified knowledge which flows along global value chains in more abstract and less personal ways. Possessing a strong national innovation network may help firms to establish key relations with global partners and avoid the problem that firms embedded in a local system crystallize their key relationships with partners only in close geographical proximity.

National policies which can favour the development of cognitive and innovative networks that match the specificity of a country’s industrial model acquire a fundamental role in the local-global dialectic in most of the industries involved in the Industry 4.0 revolution. This is particularly important in a country like Italy,

which has a peculiar national innovation system whose roots are to be found in ID capitalism.

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Notes

¹ In his work, Boschma (2005) stresses the possibility of developing geographically distant interactions for innovation through other types of proximities (cognitive, social, organizational, and institutional). Cultural proximity can incorporate different aspects of those other types of proximities, but it mirrors, in particular, some institutional proximity (i.e., the presence of common cultural norms and habits).

² For example, statistical information on knowledge sources provided by ISTAT or by the Community Innovation Survey has limitations in distinguishing which different types of sources of knowledge relevant for innovation have local origin or instead national origin (beyond the ID borders).

³ The sample corresponds to around 18.5% of the detected mechatronics population in Vicenza and it is statistically representative of the local ID in terms of firms' size. The majority of firms (almost 80%) are small companies with less than 50 employees, while 3.5% of sample firms are large firms with more than 250 employees. The majority of firms (47%) belongs to the industrial machinery sub-sector, 16.5% to automations, 13.5 % to electrical and electronic appliances and machinery, while 23.5% to less defined sectorial specializations. For more information about the survey and collected data, please see Plecher (2017).

⁴ Although global linkages for innovation are more conducive of radical innovation than national linkages, for now, international sourcing remains mainly limited to the acquisition of some technologies (i.e., sophisticated machinery and equipment) and some development activities. The interviews that have been conducted with the firms have highlighted a negative attitude of different local mechatronics firms to establish some interactions for innovation with geographically distant actors. This is often a matter of cultural closure and institutional distance that firms embedded in a ID may have with respect to international partners.

⁵ The department of Management and Engineering of Padua University is located in Vicenza and it has a strong mechanics and mechatronics focus. It represents an important source of R&D knowledge for local firms. However, interviews conducted with some of the firms have highlighted the necessity for different firms to link to other national universities and research centres which have different specializations than the local ones or that may help to differentiate their own products and services from what is the standard offered at the local level. For example, one of the firms has

discussed the important relationships that they have with the University of Pisa, an example of Italian excellence in robotics.

⁶ The strength of the national network of firms has been measured on the basis of a series of answers that firms have provided in relation to the geography of sources of knowledge and know how, collaboration networks related to innovation, and actors that during the three-year period 2014-2016 had a role in supporting firm's innovative processes. The measure of the innovation capacity has been built by weighting the number and degrees of innovations which firms have developed during the targeted period.

⁷ Only 20% of the firms in this quadrant compensate for the lack of a domestic network with some activities of sourcing and collaboration pursued at international level.

⁸ 36 firms of the sample belong to group 1, 31 to group 2 and 18 to group 3.

⁹ The firms' innovations have been evaluated considering product, processes, organizational, or marketing aspects of what is normally considered standard innovation within the sector.