Communication and knowledge in six Western European industrial clusters

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Abstract
By relocating both multinational corporations subsidiaries and small-medium enterprises between territorial systems globalization and digitalization are driving a substantial restructuring of world economy. Despite its expected disappearance, incumbent territorial systems are witnessing a time of deep transformations due to industrial relocation processes from Western to Eastern geographical areas. Such industrial relocation processes often determine the birth of new specialized territorial systems, like industrial clusters or districts, in the destination countries. Accordingly to the socio-cognitive view of industrial clusters, various forms of knowledge creation and transfer are involved as determinants and consequences of these processes. Industrial relocation implies also the relocation of different types of knowledge, which occurs through different "vectors": people (entrepreneurs, managers, employees, consultants), documents (handbooks, codes, procedures, patents, licences, etc.), and goods. In order to well understand causes and effects of industrial relocation, the economic, technological and knowledge aspects should be jointly examined. In the socio-cognitive perspective, the competitiveness of territorial systems is largely due to factors others than costs of labour or material, especially when technological complexity is at a medium or high level. Besides institutional and social factors, knowledge creation, transfer and access are considered fundamental, and among the various types (and sources) contextual tacit knowledge is supposed to be particularly crucial. Knowledge requires communication means to be used, transferred and shared, and this is particularly true when concerning tacit forms, which are largely channelled through people's mobility among cluster firms and personal networks. Hence, in order to explain clusters competitiveness and evolutionary patterns as relocation processes it is necessary to analyze also the types of firms communication means, and to understand its effects on firms strategic behaviour and absorptive capacity. The field research of this study concerns 163 firms distributed over 6 industrial clusters in three Western European countries (Germany, Italy, and UK). Specific distinctions and hypotheses regard firms in terms of: size, proximity degree, type of internationalization, and digitalization degree. The methodology prevalently employed is hypothesis testing through both standard and multi-dimensional statistics. The main findings confirm the digital divide between small and large companies, the crucial role played by technological complexity and communication means, and the opportunity to distinguish small and medium sized firms because of its rather differentiated performance. Besides these results, it emerged that internationalized firms perceive the relevance of knowledge in a way more correlated to organizational than technological knowledge, and to the human-embodied rather than other types of knowledge. Moreover, there is a significant correlation in knowledge perception between small and high proximity firms on one side, and large and low proximity firms on the other side. Conversely, other results cast some doubts on the socio-cognitive view of industrial clusters, because all firms assign surprisingly low values to local sources of knowledge.

Keywords: communication media, digitalization, industrial clusters, knowledge relocation, territorial systems.

JEL code: D83, L22, L23, L6, M15, R3.

1. Introduction

Under the pressure of globalization, digitalization and technological innovation territorial systems are turning (Pitelis *et al.*, 2006; Schmitz, 2004). The greater ease of movement of capital and persons, together with greater capacity for distance communication and more widespread distribution of innovations induce companies to assess more attention and welcome the opportunity to move their activities. Industrial relocation is one of the effects of those three forces, and in turn becomes the cause of a recursive process of change. Companies located within territorial systems are no exception, and in fact the phenomenon of industrial relocation no longer concerns only the

subsidiaries of large multinational companies but also medium and small size. Depending on a number of factors and sectoral context companies move from point of origin and goes to locate elsewhere, often in another existing territorial system or triggering the emergence of a new one.
Explaining the causes and effects of these phenomena is very difficult for a number of reasons. Firstly, the huge variety of territorial systems supports a corresponding variety of processes and effects of relocation, both in sources and destination places. Secondly, this variety has difficulty yet to be fully recognized and studied in ways particularly appropriate. Thirdly, empirical evidence is extremely fragmented and generally very late on days when things happen. The research presented here does not escape the latter point, but at least tries to take account of the first two. It helps to understand some of the phenomena involved and focuses mainly on how to use information and communication technologies, and the importance given to technological and organizational knowledge external to firms, but found in their specific territory. These are companies that operate within six industrial clusters in Western Europe: three in Italy, two in the United Kingdom, and one in Germany. In particular, by some statistical methods of multi-dimensional analysis, a number of assumptions about the following issues are tested and discussed: types of communication, knowledge, and relocation, and degree of geographical proximity. Data are derived from some field surveys conducted under a European research project on the theme of relocation in 15 clusters in Europe.
The paper is structured as follows: theoretical issues are introduced over the next two sections, respectively recalling the socio-cognitive perspective on the analysis of industrial clusters and binding it to the determinants of relocation processes. Next section defines firms' categories and assumptions research against whom they will be tested. The fifth section describes the sample and some results, while in the following one results are shown. Finally, in section seven key findings are recalled and compared with the literature.

2. The socio-cognitive perspective on industrial clusters

The problem of the causes and effects of relocation is within the more general question of the transformation processes of territorial systems induced by globalization, digitalization and technological innovation. Despite a level of attention quite high on these issues, there are (still) no conclusive results because the variables involved are many and because there is no agreement yet on the categorisation of territorial systems. It has been several proposals, including (to name a few) those of Markusen (1996), Paniccia (2002), Porter (1990, 1996, 1998a, 1998b, 2000a, 2000b) and Storper (1995), but they are all fairly incomplete, questionable, and above all rather vague in defining and especially in parametrization of variables used for each categorization. Given the large amount of potentially significant variables, like the economic, technological, psycho-social, cognitive and social, institutional, and geographical ones, it seems really hard to work out only by using empirical data. Compared with the variety of territorial systems, in fact, each empirical investigation is almost always unsatisfactory for extension or depth, and generally incomparable with one another because of different methods of detection (Brenner and Mühlig, 2008). I believe that, as indeed is beginning to do (Albino et al., 2003, 2006; Brenner, 2004; Ciarli and Valente, 2005; Fujita and Thisse, 2002; Merlone and Terna, 2007) the only way to improve is to try out various theories and categorizations within simulation models.
Waiting to get a future effective indications and build on them empirical investigations, I use here the very broad definition of territorial systems (Giner and Santa Maria, 2002; Morgan, 2004), defined as areas of high industrial specialization and density, and with a high degree of interchange between companies. Assuming that inter-firm exchange can be of products or services and possibly personnel, and regardless of the degree of technological innovation in this wide definition fall more or less all forms studied. Only for lexical convenience (but basically this is what happens even in a good part of international literature) I will indiscriminately use the name "cluster" or "territorial system." In any case, other definitions as local production systems (Crouch *et al.*, 2001) would be equally good and provide other defects. What we need in this work is that they were not too

restrictive, like those usually employed for Italian industrial districts (Becattini, 2004; Becattini *et al.*, 2003).
One more warning indicates, if possible, other problems for analysis and further induces caution in interpreting the results of this and other researches. Although experts in the field have been quite aware, only relatively recently is emerging that, besides being very different between types of clusters, its structure can be very different too, and not only in terms of firms size distribution. In other words, companies of a same cluster can access in a very different way and amount cognitive, productive and financial resources, and this tends to the creation of organizational networks between companies, institutions and research centres (Biggiero and Sammarra, 2008; Giuliani, 2006; Tallman *et al.*, 2004; Sammarra and Biggiero, 2008).
In addition it is also emerging quite clearly that the old category "small and medium enterprises" is too broad, because the medium, small and very small features enhance very different competitive capabilities. In this perspective, territorial systems are very complex networks-of-networks (Biggiero, 1999), because many types of relationships exist between many types of nodes with many different attributes. This also makes very clear why we can not fully understand the structure and evolution of industrial clusters without the use of network analysis (Scott, 1991; Staber, 2001; Wasserman and Faust, 1994).
The issue of relocation between territorial systems immediately raises the question of which firms tend to relocate, and its effects on the destination and origin places. The idea is that, other things being equal, cluster firms compare, more or less carefully and consciously, the convenience to move one or more or all of the activities according to many different criteria. The results, as well as the causes of relocation, are very different depending on the type of cluster, its life cycle, and strategies, resources and abilities of individual firms. In general, it is reasonable to expect that the higher the density of inter-firm exchange, and especially of local knowledge circulation, and cluster competitiveness, the less strong is the tendency to relocate. This creates a mechanism of reinforcement, which can obviously be positive or negative. Enterprises of a cluster in crisis indeed look more interest in the relocation, and this will accelerate the crisis.
At first glance globalization and digitalization of the economy would seem to erode the advantages of geographical proximity and thus encourage a less concentrated distribution of world production, but this has not (yet) occurred. For a more accurate, we can identify two types of outcomes (Biggiero, 2006a; Sammarra, 2005; Sammarra and Belussi, 2006):
i) The geography of displacement of territorial systems is radically redrawn, because some disappear and others are born in different places. In this case we are faced with massive relocation, which determines the substantial disappearance of the source cluster or its restructuring to other sectors. When you experience these outcomes the social and economic impact on the territory of origin is extremely negative, because it inevitably loses employment, skills, social cohesion, and of course income;
ii) The adjustment is partial, because only certain activities or certain types of businesses are relocated. In this case we can talk about selective relocation, which requires coordination and strategic behaviours. When this strategy is pursued by large companies, it may set the trend towards the formation of clusters linked by stable relations between large companies, as seems to happen in some hi-tech sectors such as aerospace. In these cases, the global industry -or at least his pieces, like the one on the European territory- acquire the form of so-called "small world" (Barabasi, 2003; Watts, 2003), where local clusters are nodes of a single global network. Larger firms, being more capable of operating on the global market, would constitute the "bridges" between clusters, channelling also international transfer of knowledge, as it has happened for example in the biomedicals district of Mirandola (Biggiero, 2002).
Wondering what factors can steer toward one or the other alternative, as mentioned earlier they (can be very many. Here we focus on the economic and cognitive ones, neglecting the technological and institutional ones. As well knows, prevailing explanations of the benefits of territorial concentration had been sought in external economies, especially in studies of economics disciplinary matrix. This

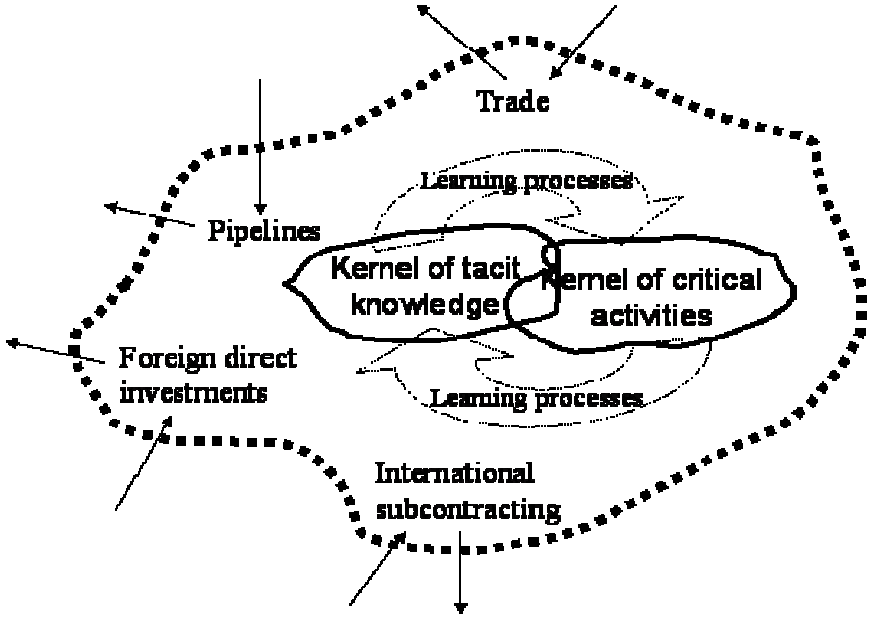
way of seeing was consistent with a theory of the firm that had privileged almost exclusively economic variables (Biggiero, 1999).
Thus the issue of competitive advantages of location are resolved in the economies of agglomeration (Gordon and McCann, 2000), and possibly in the positive effects that a social climate of cooperation and solidarity has in the reduction of transaction costs (Iammarino and McCann , 2006). The latter effect makes it less costly the use of subcontracting and therefore enhances more advantages in terms of product variety and flexibility than the final demand: the famous flexible specialization. Compared to this vision over the last 20 years has been given increasing prominence to the role of non-economic resources, particularly of knowledge and capability to use its own and others' knowledge. In this perspective companies build agreements of various kinds according to the opportunities of access to new knowledge that such agreements could allow (Argote and Ingram, 2000). Thus, territorial systems become large networks (Pilotti, 2001) between profit organisations (companies) and between them and non-profit (research centres, local institutions, etc..) organizations (Karlsson *et al.*, 2005; Tallman *et al.*, 2004). They evolve according to various types and mechanisms of interaction exchanging goods, services, people and knowledge (Belussi, 2003; Belussi *et al.*, 2003; Boschma and van der Val, 2007; Dahl and Pedersen, 2004; Giuliani *et al.*, 2005; Keeble and Wilkinson, 1999; Malmberg and Maskell, 2002; Malmberg and Maskell, 2005; Maskell, 2001; Pinch *et al.*, 2003). Models such as the Triple Helix show very well the potential of this approach, because they take into account the typically nonlinear interactions and its effects between industry, universities and local government (Biggiero, 1998; Leydesdorff, 2000).
In this perspective two other theoretical developments have been included. One stresses the contextual and not codified nature of a large part of knowledge creation and transfer (Belussi, 2003; Maskell, 2001b). This enhances the crucial role of such knowledge in the competitive capacity of individual companies and their networks (Carley, 1999). These two entities are seen as systems of distributed knowledge and skills (Carley, 1999; Tsoukas, 1996), where most of the knowledge is tacit and therefore not reified in codes, databases, etc., which occur and produce their effects through more or less routinized practices. Because of these characteristics such knowledge is embedded in people and especially in their interactions whose density is often addressed through the concept of social capital (Inkpen and Tsang, 2005). This knowledge is transferable mainly in two ways: by transferring the persons who embody it, and by contagion (imitation through interaction) (Monge and Contractor, 2004).
The other relatively new theoretical aspect is that it attaches great importance to non-economic aspects and to exchange relations and processes of collaboration and dissemination of knowledge (even those relatively codified). They include all those aspects that may be included in the socio-cognitive and psycho-social variables, depending on how they are dubbed by the disciplinary fields, which developed them. We are referring to trust (Dei Ottati, 1994; Lane and Bachmann, 1996; Lorenzen, 2002), to citizenship behaviour (Hogg and Terry, 2000), identification processes (Ashforth and Mael, 1989, 1996; Hogg and Terry, 2000; Peteraf and Shanley, 1997), and reputation mechanisms (Zyglidopoulos *et al.*, 2006). Again we moved from a field of study rather advanced if referred to individual companies towards extending the level of analysis to clusters which, although still in its infancy, is already producing a number of interesting results (Alberti, 2006; Biggiero and Sammarra, 2003; Sammarra and Biggiero, 2001).
According to the socio-cognitive perspective these factors are needed to explain the processes of relocation, and more generally the structure and processes of growth, development and decline of territorial systems. The common trait of the just mentioned issues resides in fact very strongly on the role played by non-economic relations between enterprises and their members. The creation and exchange of knowledge -especially but not only the tacit one- requires shared practices and behaviours (Amin and Cohendet, 2004; Brenner, 2007; Brown and Duguid, 1991; Gertler, 1995; Gertler and Levitte, 2005; Malmberg and Power, 2005; Tallman *et al.*, 2004), and these in turn require common languages, values and cognitive models (Lombardi, 2000; Rullani, 2003; Turvani,

2003). In this perspective industrial clusters are examples of communities of practice and even epistemic communities (Haas, 1992), that is, places where trust and interpretations are highly consistent among the key players, or at least between experts (Amin and Roberts, 2008; Hakanson, 2005; Lissoni, 2001).
Of course, territory competitiveness also depends on other factors, among which stands out the level of schooling, the type of industry, technology and geography of the place. These too work always as recursive reinforcement processes: the more favourable are the conditions to evolve in the sense of community and the easier those conditions consolidate and develop. For example, among technological factors the degree of complexity and modularity could have a very strong role (Henry and Pinch, 2006).

3. Determinants and models of relocation

The socio-cognitive perspective on industrial clusters helps making assumptions about the determinants and models of relocation. In particular gives a very strong emphasis on personal relationships and clusters cultural, social and behavioural context, because they affect in a decisive way knowledge circulation and therefore individuals' access to a substantial part of key resources. The advantages of geographical proximity consist exactly in this, because these types of relationship require intense and repeated face-to-face (F2F) interactions. Practices, languages and cognitive models not otherwise form. And although the information and communication technologies transmit many types and almost any amount of information, they are often unable to replace this type of interactions (Chiarvesio *et al.*, 2004; Gertler, 1995, 2003; Storper and Venables, 2004). Or at least, as argued in some studies (Walther, 1992, 1995) on the determinants and effects of computer-mediated communication (CMC), similar results to F2F interaction can be obtained only if CMC is preceded and occasionally accompanied by F2F during a not negligible time frame.
A theoretical perspective that integrates traditional with socio-cognitive variables can make a decisive contribution to understanding relocation processes. It can be assumed that within cluster able to resist massive relocation competitive advantages of location do exist (Fig. 1). These are the activities characterized by high added value and key knowledge, which largely and likely correspond to the tacit type. On the other hand is fairly shared the idea that the quantity and relevance of tacit knowledge is positively correlated with the complexity of activities.
It is in these, in fact, that you get the advantages of geographical proximity, which passes through the personal relations. Tacit knowledge is embedded in people and their frequent interactions, and moves with them. For this reason, relocation is likely to be particularly destructive for businesses that remain: if skills migrate, and whether these skills are key, the cluster loses its competitive capacity. What must be stressed is that geographical proximity is a condition that facilitates but not determines knowledge circulation. For this to occur is necessary that: i) (of course) first of all knowledge is created; ii) it is also considered as an essential factor of competitiveness; iii) knowledge can not be completely and conveniently self-produced by each enterprise; iv) there are no institutional or social-cognitive obstacles to social interaction. There is no guarantee a priori that these four conditions are met in the presence of high geographical proximity. Indeed, some cases discussed below (in the fifth paragraph) show that the absence of one or more of these four conditions destroys the social and cognitive advantages of geographical proximity.

Fig. 1



There is an important point to be stressed respect to tacit knowledge, namely the fact that they may represent two opposing forms of knowledge: very simple and very complex. Indeed, codified knowledge almost always requires -and especially if it uses information technology- a certain degree of development and skills. Conversely, tacit knowledge can be seen as the one sent through F2F because it is extremely simple and exchangers do not have high capacity and are not familiar with CMC. And that -as it is clear from the data of this and other studies (Chiarvesio *et al.*, 2004; Di Maria and Micelli, 2008)- it is certainly the case with many small companies especially in Italian industrial districts. However, knowledge is tacit even when it is extremely complex, so complex that it can not be codified, e.g. is the case of high managerial skill. Outside the manuals of cheap, there is in fact the manual perfect CEO or things like that.

This polarization of tacit knowledge between the least and most complex types fully reflects the similar problem of teamwork that in fact may characterize both the artisan (the most simple) and the international research workgroup (the most complex). This ambivalence is also reflected in analyses of researchers who see in the dissemination of tacit knowledge a sign of backwardness or vice versa very advanced organisational skills. This implies that, in order to make correct and not ambiguous analysis, it is necessary to distinguish properly between the two.

Obviously it is not by chance that those who stress the complex nature of knowledge and identify it with its tacitness adopt the view of practices against the traditional view of knowledge as objects. The juxtaposition reminds to the contrast between epistemology of practice vs. epistemology of possession (Amin and Cohendet, 2004; Brown and Duguid, 1991; Wenger, 1998). The former perspective is, more or less explicitly and eventually with different languages, supported into the socio-cognitive approach to territorial systems (Belussi, 2003; Gertler, 1995; Maskell, 2001b; Morgan, 2004; Rullani, 2003; Storper and Venables, 2004; Tallman *et al.*, 2004; Zook, 2004).

This leads to the distinction between tacit knowledge because not yet codified but in principle codifiable and that which is not codifiable (Gertler, 2003). Those who see it in the first form found it in small businesses and interpret it as a backward form of knowledge, while those who see in the second form interpret it as the real advantage of geographical proximity and as a shield against the relocation. The first type, however, clearly does not protect either way by globalisation or by digitalization. The idea proposed here is therefore referred to the second form.

Relocation is not necessarily a bad thing, either because it depends on the forms in which it is implemented or because it can also be passive. If relocation is total for the individual company, in the sense that it moves all of its activities, and if it covers a considerable number of companies and/or core businesses, then certainly relocation becomes synonymous with decline and

unemployment. If it is selective in the sense that businesses relocate only that portion of activity that is economically and strategically convenient to be produced elsewhere, then relocation can be a lever to increase competitiveness and possibly also to guide cluster transformation. The increase in productivity may be intended to improve cluster competitive position and reinvest to change production mix or to promote technological innovation.

Selective relocation strategy often takes the form of outward processing trade, namely the temporary export of components often semi-processed in its own subsidiary or by a subcontractor, which are then imported and taken to the terminal stages of processing, and marketed in the place of origin. In any case, this type of relocation involves the development of selective capacity for enterprises internationalization. This fact, especially for small and medium firms, is a good one and develop entrepreneurial and managerial skills.

Even when relocation strategy is massive and involves damage and an early cluster decline it is not said that ultimately it ends up with its destruction. This depends on the one hand on the scale of the phenomenon and the other by the reaction capability of the local system. Psycho-social variables, such as trust, solidarity mechanisms, cooperative attitude, and policy interventions, which can be activated by local institutions may be relevant in an attempt to transform the structure and production mix of the cluster. The existence of research centres or a good level of development of secondary and tertiary education, especially in the interest of local production can be a very strong leverage in strategies to convert the cluster.

In summary, the basic assumption is that if the cluster has a strong core in terms of knowledge and practices in which the competitive advantages rest, then it is able to resist the pressure to relocation exerted by globalisation and by digitalization. Of course, these are relative advantages in two senses. First, in the sense of costs, namely we must see how, other things being equal, strong are advantages in costs (labour, raw materials, fiscal, exchange rate, etc.) respect to alternative territories. The more these benefits the greater will be the size and solidity of the nucleus to avoid de-destructive types of relocations.

Secondly, and even more difficult to study, is the unequal distribution of these benefits within the cluster. We have previously stressed that clusters do not have a homogeneous structure, and therefore some companies may find greater convenience of others to move part or all of its activities. Since the organizational networks which are the clusters are quite dense and presumably the density increases for networks that revolve around key companies, if one of these advantages were to move it would be a drag on other businesses and a significant harm to cluster integrity and to its structure of relations. Indeed one reason given most frequently to explain the relocation is that this is led and often also suggested and encouraged by those who have already moved. These considerations explain why, in many cases, in order to understand relocation processes, it can not be exempt the analysis of individual companies, relational topology, and the distribution of competitive advantages of economic and information within the cluster.

From a methodological point of view this work is at a level of analysis, which might be called meso, because it is located between the micro of individual case studies and the macro of thousands of cases. Its advantage is to extend to a significant number of cases a fairly high degree of detail of the individual themes, which in the case of this essay relate in particular to types of communication and knowledge sources. Another element of methodological interest of this work is the fact that it uses statistical techniques of multi-dimensional analysis and, within certain limits, typically quantify qualitative variables. For a long time, in fact, industrial clusters have been studied only with a "narrative" approach, supported by a quantitative analysis of context, and with case studies more often than not comparable with each other.

Another thing is testing hypotheses using both quantitative and qualitative data, as realized in this work. And it is possible to replicate it on a larger scale and combine with econometric analysis (Bagella and Becchetti, 2000). This approach can accompany those based on social network analysis, which in recent years are already producing results (Cantner and Graf, 2006; Giuliani, 2006; Sammarra and Biggiero, 2008; Sorenson *et al.*, 2006), and agent-based simulation models,

which are surfacing recently (Albino *et al.*, 2003, 2006; Brenner, 2004; Ciarli and Valente, 2005; Fujita and Thisse, 2002; Merlone and Terna, 2007). Indeed, in order to settle the key question of what are the parameters and their threshold values for distinguishing between the various types of territorial systems and exit by the state of confusion in which research on territorial systems rest (Martin and Sunley, 2003), the only true way is to build appropriate simulation models subjected to validation by empirical researches. In all other cases it is always impose parameters and values-threshold very arbitrary.

4. Categories and research hypotheses

On the basis of the socio-cognitive perspective it is possible to make some assumptions that apply to both internationalized and non-internationalized firms. As will be seen, some of these assumptions and also some general results do not support clearly the expectations associated with that prospect, but this will be discussed in paragraph seven. Before setting out the various hypotheses to be tested I proceed to explain what types of communication and knowledge are detected and categories that on them and on other variables have been identified. Issues that concern the structure of empirical research and description of aggregated data are discussed in the next paragraph, while the details of applications submitted to the interviewees is into methodological appendix.

Clusters analyzed here are as follows:

- three Italians: Montebelluna (various types of sports shoes and (marginally) even sports clothing, Verona (shoes) and Val Vibrata (clothing);
- two English: West Midlands (car manufacturing) and Scottish (information and communication technologies (ICT));
- one German: AZM Saxony (supply of components and accessories for automobiles).

Thus, these clusters are placed in four sectors: shoes, clothing, automobile, ICT. On the basis of geographical distance, namely the dispersion of firms in each cluster I distinct:

* high geographical proximity firms (hpf): Montebelluna and Verona;
* medium geographical proximity firms (mpf): Val Vibrata and West Midlands;
* low geographical proximity firms (lpf): Saxony, Scottish.

Based on the size (in terms of number of employees) have distinct:

- under 21 employees;
- Between 21 and 50;
- between 51 and 100;
- over 100.

Based on the type of relocation, I distinguished:

- foreign direct investment (symbol: WID-FDI), namely the ownership of all or part of an enterprise;
- various forms of international non-proprietary (symbol: WID-LIGHT-INT): licensing, franchising, management contracts, projects turn-key, etc..

In summary, there are 6 cases of clusters spread over 4 sectors, and in 3 categories of geographical proximity. Further, they are divided into 4 categories by size and 2 in terms of type of internationalization. For reasons of space, out of these 19 categories, I will comment here only those related to the geographical proximity, class size, and type of relocation, for a total of 9 categories. Based on the media and addressed to the communication I have instead identified the 6 following categories:

- Type 1: companies that are strong communicators between organizational units (functions, departments, branches, etc..), via email or other types of CMC, as intranets, Internet, video-conferencing, etc.);
- Type 2: companies that are strong communicators by CMC with other companies (suppliers, customers or competitors);
- Type 3: enterprises that, although familiar with CMC (why use it internally), for communication with other companies choose instead F2F, and relatively little CMC. This distinction between those who prefers to communicate F2F but is familiar with the use of communication via CMC is very important because otherwise we risk the lack of alternatives confusing with a genuinely deliberate choice;
- Type 4: firms that, although familiar with CMC, for communication with other companies choose other traditional means of communication, such as letters, fax, telephone, and instead tend to limit the F2F;
- Type 5: firms that, although familiar with CMC, for communication with other companies choose traditional means of communication irrespective of whether or not F2F;
- Type 6: not digitized firms, namely those not familiar at all with CMC[i].

If you add these 6 enterprise groups to the previous 9 you get a total of 15 categories. Local knowledge is instead been separated between the technological and organizational, each with its own articulation. With regard to the technological one are the following distinct forms of knowledge:

a) embodied into experts engaged in the (local) market labour;
b) arising from interactions with customers and suppliers;
c) deriving from cooperation with competitors;
d) acquired through imitation of products;
e) intrinsically linked to technology, in the form of patents and licences, etc.;
f) generated through interactions with public institutions such as universities, public research centres, local governmental institutions, etc.;
g) arising from interactions with semi-public institutions such as chambers of commerce, industry associations, trade unions, etc.;
h) deriving from interactions with consultants and private research centres;
i) acquired through fairs and other public sources, such as documentation, etc.;
j) other.

The organizational knowledge was distinguished in the following sources:

a) brought by new employees;
b) acquired by interacting with customers and suppliers;
c) deriving from cooperation with competitors;
d) generated through interactions with public institutions such as universities, public research centres, local government institutions, etc..;
e) arising from interactions with semi-public institutions such as chambers of commerce, industry associations, trade unions, etc..;
f) deriving from interactions with consultants and private research centres;
g) acquired through trade fairs and other public sources, such as documentation, etc..;
h) other.

The various types of knowledge indicate rather different characteristics in terms of tacit vs. explicit, interaction-based vs. other forms, and finally institution vs. non-institution-based. Types a, b, and c are characterized by mixed tacit and explicit knowledge, but there is also the tacit par excellence because embedded in people and transmitted only through their transfer. Some types are particularly related to the interaction with customers, suppliers, competitors and consultants, while other types, such as imitation products, patents and licenses, and participation in fairs or retrieval of documents

are quite unhooked from a personal relationship, and thus less suitable to produce and convey tacit knowledge. Instead sources of knowledge related to interactions with public or semi-public institutions, namely that we can define institution-based, have an intermediate position between the two previous groups.
The following research hypotheses concern the 2 types of knowledge with its articulations, and are tested against 15 categories of aggregation of firms across clusters, namely the 6 types of communication, the 3 types of geographical proximity, the 4 size classes, and finally the 2 modes of internationalization. First, it is good to keep in mind that the data relate to the subjective perception that an authoritative representative (presumably generally a manager or owner) of a company has expressed about the importance that a certain source of knowledge has for that company. In addition I want to clarify that will be offered three types of assumptions, which from a methodological point of view are tested by different methods.
The first type concerns quantitative importance assigned to various types of knowledge on the part of each category. To verify this type of assumptions were used averages of responses. The second type of assumptions deals with the way in which the (characteristics of) various categories are related to the types of knowledge expressed by a certain common use: e.g. if and how the various articulation of technological knowledge are correlated. To test this hypothesis has been used the principal components analysis, which is multi-dimensional statistical methodology. Finally, the third type of assumptions refers to the similarity or difference between different categories in terms of their degree of correlation with the types of knowledge expressed by a certain component. Even in this case was used the principal components analysis too.
As mentioned above, the first group of assumptions concerns the importance assigned to the various types of knowledge. Many studies indicate that the ability to absorb knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002) depends on the degree of development of managerial, technological and market skills (Dosi *et al.*, 2000; Sammarra and Biggiero, 2008; Simonin , 1999; Teece *et al.*, 1997), and these in turn are quite related to technology complexity and firms size. The degree of digitalization of enterprises is also another factor that indicates the ability to exchange knowledge and the degree of development of managerial and technological skills. It is therefore reasonable to expect that on average:

H1a: largest firms allocate a relatively higher value to knowledge.

H1b: most digitalized firms allocate a relatively higher value to knowledge.

H1c: firms working in relatively high-tech clusters allocate a relatively higher value to knowledge.

In addition, the forms of tacit knowledge must be perceived as the most important resources in clusters with high geographical proximity, because in them F2F relationships is more frequent or at least more facilitated. It is difficult to determine the relationship of cause and effect between the geographic and socio-cultural factor in the sense that the high proximity facilitates F2F or conversely that ease F2F facilitates the development of commercial relations with neighbours rather than distant interlocutors. Certainly there is a recursive reinforcement process, which is sensitive to changes in economic, technological and social (e.g. migratory flows) characteristics. The tradition of Italian parochialism of small towns is illuminating in moderating the positive assessment of the effect of geographical proximity and even the strong territorial identification, because many municipalities in the south possess in abundance both traits, but never developed competitive capacity nor created and transferred tacit knowledge. Therefore, the argument that the geographical proximity facilitates the exchange of local knowledge suggests that:

H1d: companies with greater geographical proximity allocate a relatively higher value to knowledge.

It is of a certain interest to carry out a verification of the grouping logic described above for knowledge articulation: tacit mainly based on the interactions with customers, suppliers, competitors and consultants, while explicit with products imitation, patents and licenses, and participation in fairs or retrieval of documents are quite unhooked from a personal relationship, and institution-based those instead related to interactions with public or semi-public institutions. Then I assume that the principal components analysis proved that the values on the perception of knowledge behave as follows:

H2a: sources of tacit knowledge, and especially human-embodied, are highly correlated.

H2b: sources of more de-personalised knowledge, that is less interaction-based, are highly correlated.

H2c: sources of knowledge-based institution are highly correlated.

Since the high geographical proximity is considered a condition that promotes the exchange of tacit knowledge and especially those embedded in people and then transferred through recruitment of new staff and especially with labour mobility between companies, we can suggest the following assumption:

H3a: how high geographical proximity perceive the importance of the various types of knowledge is highly correlated to sources of tacit knowledge, and especially to that human-embodied.

Conversely, it can be assumed that in the absence of high geographical proximity behaviour of companies should make greater use of knowledge derived from sources more institutional or less attached with F2F relations. Therefore it can be assumed that:

H3b: how low or medium geographical proximity firms perceive the importance of the various types of knowledge is highly correlated to institution-based sources of knowledge, and especially to the most codified ones.

Almost all empirical investigations complain about the fact that small and medium enterprises (but especially small) have great difficulty in accessing codified knowledge and related interactions with public or semi-public institutions. However, regardless of the perceived value of knowledge that, as mentioned above, may suffer from some degree of underestimation due to a lack of awareness especially typical of small businesses, the way in which companies perceive the importance of the various types of knowledge may depend on their size. Recalling that small and medium enterprises are considered less able to use, and often even less able even to notice the existence of knowledge held by institutions or embedded in products and technologies, but are more able to access and rely on knowledge related to personal relationships, which often are also parental type, the following assumptions can be raised:

H4a: the way in which small and medium enterprises perceive the importance of various sources of knowledge is strongly correlated to tacit knowledge.

H4b: the way in which large firms perceive the importance of various sources of knowledge is strongly correlated to institution-based or codified knowledge.

The study of knowledge creation and transfer and dissemination of innovations has always placed the focus on technological knowledge, leaving in the second floor, and very often completely

ignoring organizational knowledge. However in recent years, largely thanks to the study of territorial systems and more generally about the various types of inter-organizational relations, the importance of these two kinds of knowledge has balanced. Some authors in particular underline the fact that relations between companies are based on a crucial due to the ability to interact, on tacit knowledge, and on learning by interacting (Lipparini and Sobrero, 1994). In these processes the prominent role is played by work practices, human interactions, and by the knowledge embedded in people. Here it is necessary to distinguish between light (WID-INT-LIGHT) and heavy (WID-FDI) forms of internationalization, because they require key capabilities in different managerial skills. Light internationalization, which I have identified with licensing, franchising, etc. (see Appendix 1), implies mostly the ability to interact with local institutions, in order to implement the right contractual forms and safeguards, and to study market characteristics. Conversely, heavy internationalization, that is represented by the various forms of FDI (see Appendix 1), grounds on the ability to establish new ties, in particular with local clients and suppliers, and only secondarily with local institutions. Knowledge coming from local labour market and product imitation matters only as technological complexity, and particularly its tacit knowledge forms, are considered relevant. Hence, the following assumptions can be advanced:

H5a: firms doing light and heavy types of internationalization are differently correlated with the perception of the various forms of technological knowledge sources.

H5b: the way light internationalised firms perceive the importance assigned to the various sources of knowledge is more closely related to institution-based knowledge (component 1).

H5c: the way heavy internationalised firms perceive the importance assigned to the various sources of knowledge is more closely related to that coming from interactions with local clients and suppliers (component 2), and secondarily with local institutions (component 1).

As argued by recent studies on Italian industrial districts and even more generally on Italian Industry structure and performance (Foresti *et al.*, 2008; Signorini and Omiccioli, 2005), small and medium sized firms perform in a rather different way, so that the standard category of SME (small and medium enterprises) should be distinguished as most as possible. Here we keep this assumption and further we suppose that the small and the large firms have perceptions of the importance of knowledge highly correlated respectively with high and low proximity firms, while the medium ones do not show any marked correlation with geographical proximity. Hence, it is possible to formulate the following hypotheses:

H5d: the small and the medium firms have uncorrelated positions respect to the importance assigned to knowledge sources.

H5e: the small and the high proximate firms have very correlated perceptions of the importance of knowledge.

H5f: the medium-large and the low proximate firms have very correlated perceptions of the importance of knowledge.

The sixth group of assumptions concerns the identity of companies that make up the 6 categories constructed on the basis of media and recipients of communication. The vast literature on territorial systems and in particular on the information and knowledge management systems, and that of management and organization indicate that the strong preference for F2F depends on the medium-small size, which prevents a proper investment on CMC systems. Often this factor is seen as an obstacle to the ability of small-medium enterprises to act effectively in low density territorial

systems. Conversely, medium and large enterprises are considered capable of investing in information technology and communication, and therefore be less sensitive to geographical proximity. This suggests the following four assumptions:

H6a: the category of firms that communicate preferably F2F is made up of small firms to a greater extent than what happens to the other categories.

H6b: the category of firms that communicate preferably F2F is composed primarily of companies with high geographical proximity.

H6c: the category of digitized firms is composed of medium-large size firms to a greater extent than what happens to the other categories.

H6d: the category of digitized firms is composed of firms, which do not have a prevailing characterization in terms of geographical proximity.

We should distinguish between companies, however, that communicate F2F mainly because they are not digitized and those who do really by choice while being scanned. This is particularly important for the thesis of the connection between close geographical proximity, communication F2F, and circulation of tacit knowledge. The following assumptions can be made:

H7a: the four categories including digitized firms and those who prefer not F2F form a group with highly correlated behaviour both as regards the sources of technological and organizational knowledge.

H7b: the category of non-digitized and those who prefer F2F form a group with highly correlated behaviour both as regards the sources of technological and organizational knowledge.

If the previous assumptions were confirmed, then we might further suppose that:

H7c: the two previous groups (not scanned and digitized more F2F) are diametrically opposite related in terms of both technological and organizational knowledge.

In the preceding section has been stressed that the importance of tacit knowledge and especially F2F tends to be overestimated because it may simply reflect the absence of digitisation of companies rather that F2F superiority in terms of contribution to competitive capacity. This assumption may be tested as follows:

H7d: the group of digitized companies assigns great importance to all types of technological knowledge.

H7e: the two groups of non-digitized firms and/or firms preferring F2F assign relatively minor importance to codified knowledge and to that deriving from interactions with public or semi-public institutions.

5. The empirical research

The survey was conducted between 2000 and 2003 and covered 8 clusters of Western Europe and 7 of that Central and Eastern Europe. Within the first were then identified 72 companies that relocated in a strong (the ownership type) and weak way, which are grouped in categories respectively WID-FDI and WID-LIGHT-INT. As shown by the following table, the clusters are of different sizes and this is more correct to define clusters (or territorial systems) and non-industrial districts. The

database covers about 384 companies distributed over 15 clusters. The questionnaire is divided into 10 sections and notes both quantitative as the number of employees, turnover, the share of R&D, etc., and qualitative variables, such as reasons to relocate, the type of knowledge used, access to information, etc.. For qualitative data were prevalently used five values scales, plus other values for not available data.

Tab. 1

RIS-IC-ID	*COUNTRY*	*GEOGRAPHICAL SCALE (KM²)*		
Herford Kitchen furniture	Germany	Sub-regional	Small	450
Saxony automotive	Germany	Region/Land	Very large	18,413
Verona Shoes	Italy	Sub-regional	Small	625
Montebelluna sportwear	Italy	Sub-regional	Small	553
Vibrata-Tordino-Vomano	Italy	Sub-regional	Small	628
Rome film[1]	Italy	Sub-regional	Medium	1,290
West Midlands automotive	UK	Regional	Large	13,000
Scotland ICT	UK	Regional	Large	5000/8000
Mlada Boleslav automotive	Czech Republic	Sub-regional	Medium	1,058
Liberec automotive	Czech Republic	Sub-regional	Medium	~ 925
Praga Film	Czech Republic	Sub-regional	Small	496
Kalwaria-Zebrydowska kitchen furniture	Poland	Sub-regional	Very Small	75
Banat-Crisana clothing	Romania	Regional	Very large	23,995
Banat-Crisana shoes	Romania	Regional	Very large	23,995
Slovenia Automotive	Slovenia	Country-region	Very large	20,273
Slovenia Furniture	Slovenia	Country-region	Very large	20,273

In this work, the assumptions have been tested only on certain cluster of Western Europe, because more attention was paid to how the types of communication and knowledge have influenced the phenomenon of active relocation, and not the passive one that characterizes the clusters of Eastern Europe. In addition, for reasons due to methodological significance of some cases (too high firms size and/or too few cases), were excluded two clusters: the audiovisual Rome and the German production of kitchens (symbol: Mach1/Mach2). The resulting sample is structured as follows (Table 2): 20614 employees working in 163 enterprises, 37% of which are in a state of high geographical proximity. The prevalent class (33%) is that up to 20 employees, while the smallest (3%) is that over 500 people. Those intermediate have the same weight in terms of number of enterprises. Companies that relocated in a more or less strong mode of entry are 44% of the total. In essence this is a sample fairly balanced in terms of size, geographical proximity and relocation.

Tab. 2

			Number of firms per size and category												
	Employees		**1-20**		**21-50**		**51-100**		**101-500**		**>500**		**total**		**size**
hpf	4598	22%	18	33%	13	38%	14	40%	15	43%	0	0%	60	37%	77
			11,04%		7,98%		8,59%		9,20%		0,00%		36,81%		
mpf	11882	58%	24	44%	10	29%	13	37%	9	26%	4	80%	60	37%	198
			14,72%		6,13%		7,98%		5,52%		2,45%		36,81%		
lpf	4134	20%	12	22%	11	32%	8	23%	11	31%	1	20%	43	26%	96
			7,36%		6,75%		4,91%		6,75%		0,61%		26,38%		
Tot	20614	100%	54	100%	34	100%	35	100%	35	100%	5	100%	163	100%	126
			33,12%		20,86%		21,47%		21,47%		3,08%		100,00%		

WID-FDI	6036	29%	3	6%	9	26%	9	26%	20	57%	1	20%	42	26%	144
			1,84%		5,52%		5,52%		12,27%		0,61%		25,77%		
WID-LIGHT-INT	4469	22%	5	9%	6	18%	10	29%	8	23%	1	20%	30	18%	149
			3,07%		3,68%		6,13%		4,91%		0,61%		18,40%		
WID (all)	20614		54		34		35		35		5		163		126
			33,13%		20,86%		21,47%		21,47%		3,07%		100,00%		

In the same research (Sammarra, 2003; Sammarra and Belussi, 2006) it is argued that within the same country and even with structural not too different features two clusters can trigger very different relocation processes. Indeed, albeit with a prevalence of small and medium enterprises, with high geographical proximity and strong local roots, and even with a very close age (both developed since the mid-60 years), and finally shifting its activities to the same destination country (Romania), the Montebelluna district shows a pattern of selective relocation while the Verona (shoes) and especially the Val Vibrata (clothing) district followed a process of massive relocation. The reasons are the poor innovative capacity of suppliers and some socio-cognitive aspects: weak capacity cooperative, no citizenship behaviours and low social capital. On the contrary, the sportswear Montebelluna district is characterized by strong innovative capacity and a high degree of cohesion and social capital .

The analysis indicates that there are very different forms of relocation, and these in turn reflect the diversity of clusters in which they are implemented. On the one hand there is that districts represented by Italian footwear Val Vibrata and Verona, which takes shape in a context of low innovation capacity and low CMC use. Companies implementing this process of relocation go to Romania to exploit cheap labour costs and a growing domestic market. These companies had not previously developed special managerial skills or business, and were not able to go back, if not in small part, the fruits of experience abroad. The net effect in the cluster of origin is a decline in employment, a reduction in the density of the network of trade and an obvious sense of mistrust that inevitably accompanies the decline of a territorial system.

On the other hand there is the German model of selective relocation, which operates building a network of formal relations with existing companies and those generated from scratch in the Czech Republic. These undertakings the motor vehicle sector, with good managerial skills, well in hand with the digitisation, and that in its network of inter-company relations tend to induce a growth of managerial skills. In the midst of these two models there's sportswear cluster of Montebelluna. Into the German, and to a certain extent into the Montebelluna cluster, you can guess the existence of a hard core of high value-added activities and strong knowledge content, whose presence tends to be preserved with the pursuit of a selective relocation model. In these clusters local knowledge is considered very important and is well correlated to the presence of agreements.

With regard specifically to the relocation, the other clusters of Western Europe studied within the same research project and analysed in this work show the following general features:

• the West Midlands cars cluster is subjected to passive internationalization, both in the strong sense of foreign direct investment both in the sense of production, R&D and marketing agreements;

• the Scottish cluster of ICT also suffers passive internationalization processes, but even active relocation that, unlike the Italian and German districts, flows more towards the Asian countries and instead of Eastern Europe. These processes are kind of selective and not massive, and this is again due to the innovative capacity of enterprises, which to a significant extent are supported by local institutions of industrial policy;

• finally, the Saxon cluster has achieved a selective active relocation type towards the region of Bohemia (Czech Republic). Even in this cluster a strong innovative capacity is accompanied by a high capacity of suppliers coordination.

6. The main findings and hypotheses testing

The perceived importance of external knowledge. The first set of results regards the extent of the perception of the importance of external knowledge sources drawn from the local system. This figure is distinct for each category, and for technological and organisational knowledge. The most general and also quite surprising result concerns the very low average value attributed by all categories for almost all types of knowledge (Table 3rd and b): no category reaches even the only average. The lowest values (between 1.6 and 1.8) of technological knowledge are expressed: by those enterprises which give priority to F2F or not digitized at all (Type 3 and 6); by those included in mature sectors (clothing and footwear) or located into the clusters of Val Vibrata and Montebelluna; by those who are in high spatial proximity; and finally by those who have an average size between 51 and 100 employees. Conversely, the categories that recorded the highest values (> 2) are those consisting of companies heavily digitized from those included in the automotive and ICT sectors, with their corresponding cluster of West Midlands (but not the German Saxony) and Scotland. They are also the categories with medium or low geographical proximity and average size over 100 employees.
With regard to organizational knowledge, the situation is even worse in the sense that there is a lot of categories whose values are equal to or even below 1.6: enterprises which give priority to F2F or not at all digitized (Type 3 and 6); those in the fields of clothing and footwear and the corresponding clusters of Val Vibrata, Montebelluna and this time also of Verona and Saxony; those with high geographical proximity; and finally those with average size under 20 or between 51 and 100 employees. At the opposite extreme, the categories which have an average value greater than 2 are only 3 are just the clusters of ICT Scotland and West Midlands, and firms with average size greater than 100 employees. In summary: i) organizational is perceived as less important than technological knowledge, and paradoxically, this occurs precisely into the sectors-clusters with minor technological content, such as clothing and footwear ii) knowledge of both types is more important for digitized companies; those located into English clusters; those with low geographical proximity, and finally those with the largest average size.
Although it is very likely that the perception underestimates the real importance of external knowledge, because it is possible that companies tend to give less importance to the contribution of others, however, the data are rather significant and clear in indicating that, with rare exceptions, geographical proximity is not perceived as a factor that increases the importance of external sources and that instead it increases with the complexity of technology, company size and degree of digitalization. If you descend to the level of analysis of individual sources of technological knowledge, only the following cases assign a higher level of importance or at least equal to the average: knowledge coming from the interaction with customers and suppliers of digitized companies (Type 1, 2 and 4), ICT, the cluster of Verona, Scotland and the West Midlands, and average size businesses with more than 100 employees. With regard to the same analysis, but referring to organizational knowledge, the only case that exceeds the average value is relative to knowledge incorporated in the new staff in the cluster ICT-Scotland.

Tab. 3

External (but local) technological knowledge

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
mean	2.12	2.16	1.73	2.07	1.97	1.79
Std. dev.	0.57	0.53	0.39	0.47	0.47	0.39
coeff. of var.	0.27	0.25	0.23	0.23	0.24	0.22

	clothing	footwear	automotive	ICT
mean	1.61	1.76	2.18	2.25
Std. dev.	0.51	0.43	0.54	0.60
coeff. of	0.31	0.24	0.25	0.27

var.				

	Val Vib	Verona	Scottish	Saxony	Montebelluna	West Mid
mean	1.61	1.89	2.25	1.85	1.62	2.43
Std. dev.	0.51	0.54	0.60	0.51	0.39	0.75
coeff. of var.	0.31	0.29	0.27	0.28	0.24	0.31

	hpf	mpf	lpf	wid-fdi	wid-light-int
mean	1.76	2.02	2.00	1.97	1.89
Std. dev.	0.43	0.59	0.45	0.44	0.46
coeff. of var.	0.24	0.29	0.23	0.22	0.24

	<20	21-50	51-100	>100
mean	1.86	1.87	1.78	2.16
Std. dev.	0.45	0.42	0.35	0.60
coeff. of var.	0.24	0.22	0.20	0.28

Tab. 3b

External (but local) organizational knowledge

	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
mean	1.96	1.96	1.43	1.93	1.80	1.55
Std. dev.	0.36	0.28	0.20	0.35	0.31	0.18
coeff. of var.	0.18	0.14	0.14	0.18	0.17	0.12

	clothing	footwear	automotive	ICT
mean	1.31	1.62	1.84	2.45
Std. dev.	0.27	0.22	0.33	0.57
coeff. of var.	0.21	0.13	0.18	0.23

	Val Vib	Verona	Scottish	Saxony	Montebelluna	West Midlands
mean	1.31	1.63	2.45	1.44	1.60	2.23
Std. dev.	0.27	0.25	0.57	0.21	0.36	0.35
coeff. of var.	0.21	0.16	0.23	0.15	0.22	0.16

	hpf	mpf	lpf	wid-fdi	wid-light-int
mean	1.62	1.72	1.78	1.97	1.77
Std. dev.	0.22	0.32	0.35	0.33	0.38
coeff. of var.	0.13	0.18	0.20	0.16	0.21

	<20	21-50	51-100	>100
mean	1.50	1.61	1.54	2.20
Std. dev.	0.23	0.35	0.28	0.31
coeff. of var.	0.15	0.22	0.18	0.14

The data just commented allow a verification of the first group of assumptions, which suggests that the following types of companies assign the highest value to knowledge: those of greater size (H1a); the most digitized (H1b); those operating in cluster most technologically complex (H1c); and those with greater geographical proximity (H1d). The results of Tables 3a and 3b fully confirm the hypothesis H1a, H1b and H1c for both technological and organizational knowledge. Therefore we can say that, even taking into account that the average absolute are all below the average (i.e. less than 3), they are higher for firms of largest size, more digitized and in the case where these characteristics are combined with technological level and geographical proximity.
Instead, considering separately the latter two, the corresponding assumptions are confirmed only partially or even discarded. Indeed, among the clusters with higher technological complexity, though German Saxony regards car manufacturing as that of the West Midlands, it does not assign the same high values to knowledge as do the clusters of cars and ICT (Scotland). Thus the hypothesis H1c is confirmed only partially. In addition, high geographical proximity firms are precisely those which give less importance to both technological and organisational knowledge, and then the hypothesis H1d must be rejected in full. This result depends substantially by the fact that, except precisely the cluster of Saxony, the other technologically complex cluster are characterized by medium or low geographical proximity, but all those with high geographical proximity adopt simple technologies, such as footwear and apparel. This indicates that, between the two aspects of geographical proximity and technological complexity, the second one counts most in the perception of external local knowledge.

The principal components analysis. The principal components analysis of external sources of technological knowledge generates four components. In the first have greater prominence the following types of knowledge, which are typically those institution-based, namely (Table 4): interaction with public or semi-public institutions, consultants and private research centres, fairs and other public sources, as documentation, etc.. In the second are especially important the knowledge sources related to interactions with customers, suppliers and competitors, which we interpret as a mixture of tacit and explicit knowledge, and even those who are most coded because intrinsically linked to technology, in the form of patents, licences, etc., and finally in a negative form other non specified types of knowledge. However, it is clear that the greatest contribution comes precisely from the interactions with customers and suppliers. In the third component enter the sources of knowledge built into the new personnel hired in the local market, which includes the tacit par excellence but also codified, plus one arising from cooperation with competitors, which is also largely tacit, plus (in a negative relationship) residual unspecified sources of knowledge. In this group the main weight is covered by knowledge embedded in new recruited personnel. The fourth component brings together the typical forms of codified knowledge, namely those incorporated in products and technologies (patents, licenses, etc.)..

Tab. 4
Contributions of the various sources of knowledge to the constitution of components of technological knowledge

Main types of knowledge in each component	value
Component 1 – Knowledge coming from the interactions with public or semi-public institutions	
interactions with public institutions	0,82
interactions with semi-public institutions	0,76
Interactions with consultants or private research centres	0,74
Fairies or other sources of data and information	0,62

Component 2 – Knowledge coming from cooperation and technology	value
interactions with clients or suppliers	0,85

interactions with competitors	0,49
technology-embodied (patents, licences, etc.)	0,5
others	-0,49

Component 3 – Human-related knowledge	value
Embodied in newly recruited staff	0,86
interactions with competitors	0,57
others	-0,52

Component 4 – Codified knowledge	value
Product-embodied	0,87
Technology-embodied (patents, licences, etc.)	0,55

The principal components analysis of organizational knowledge instead generates 2 components. In the first one all the types of knowledge are significant minus the one corresponding to unspecified sources. Conversely, in the second component only this one and that incorporated in new staff, but this time with a negative value, are significant. As you see, unlike the technological organizational knowledge sources are all highly correlated, and thus the analysis of a single type holds for everyone else.
The same analysis provides the reference against which to assess the degree of correlation of the various categories of 163 companies analysed. This assessment is used to test all groups of assumptions from 2 to 7. To do this it was necessary to project the centroid of the various categories on the axes representing components, and on that scale the degree of correlation (Fig. 3-8) is indicated. To test the various hypotheses was then proceeded to examine both individual and relative positions of the different categories respect to each component. The first of these two operations generates an interesting general result (Table 5): except a few cases the six categories based on communication means and recipients and the nine of economic and structural categories obtained transversely respect to clusters, namely those identified on the basis of geographical proximity, class size and type of internationalization, have never a high degree of correlation with the various components. The only exceptions are formed by English and German clusters and by the Italian cluster of Verona, with respect to some components have rather high correlations. However, as mentioned above, in this paper due to space not analyse the individual cluster.

Tab. 5 Synthesis of projections of firms categories on principal components

Tab. 5a External (local) technological knowledge

	Components			
Categories	1	2	3	4
hpf	B-	B-	M-	M+
mpf	B-	B+	B+	B-
lpf	B+	B-	M+	M-
1-20	B-	B-	B+	B+
21-50	B+	B-	B-	B+
51-100	B-	B-	B-	B-
>100	B+	B+	B+	B-
wid-fdi	B+	B-	0	0
wid-light-int	B-	B-	M+	0

	Components			
Categories	1	2	3	4
type 1	M+	M+	B+	B-
type 2	M+	M+	B+	B-
type 3	B+	B+	0	0
type 4	B+	B+	0	0
type 5	B-	B-	B-	B+
type 6	B-	B-	B-	B-

Tab. 5b External (local) organizational knowledge

	Components	
Categories	1	2

	Components	
Categories	1	2

hpf	0	M+
mpf	B+	B-
lpf	B-	B-
1-20	B-	0
21-50	0	0
51-100	B-	0
>100	M+	B-
wid-fdi	M+	B+
wid-light-int	B-	M-

type 1	B+	B-
type 2	B+	B-
type 3	B+	B-
type 4	B-	B+
type 5	B+	B-
type 6	B-	B+

The analysis of mutual positions of the various categories respect to the various components allows discovering their possible similarity in terms of the perception of the salient knowledge. In other words it tells us if there is a similar perception between categories. To study this aspect I analysed the degree of dissimilarity between categories on each component and I got three dissimilarity matrices, one for each combination of components, namely one for the first two components of technological knowledge, another one for the two seconds components, and the third one for organizational knowledge. Since this creates a huge mass of data it is impossible to make a systematic comment, which would produce a large amount of results in excess respect to those required to test the assumptions here discussed. Therefore I will limit it to two general results.
The first one is that there is a big difference between the combination of components 3 and 4 (respectively the human- and the things-embodied knowledge) of technological knowledge and other two combinations, namely that of components 1 and 2 (respectively institution- and cooperation-based knowledge) and that of organizational knowledge. The first combination provides a coefficient of similarity almost double the other two: 45% vs. 29% and 28%. Thus, the (various categories of enterprises) estimate quite similarly the importance of knowledge embedded in people, products and technologies. And in any case, these assessments resemble much more than it is for all other types of knowledge.
The second result refers to the identification of categories that have the largest number of high similarity assessment on all the types of knowledge. These companies are as follows:
• firms for little or no digitized (Type 5 and 6), which record respectively 32 and 33 cases of high similarity;
• firms sized between 21 and 50 employees, whose category shows 27 cases of similarity;
• companies that are strong communicators by CMC with other companies (Type 2) and those that have less than 20 employees, which record respectively 21 and 20 cases of high similarity.

Testing assumptions about the correlation between types of firms and types of knowledge. Based on the principal components analysis it is possible to check the second group of assumptions, which concerns precisely the appropriateness of knowledge categories, that is the consistence of the hypothesized knowledge categorization. All the three assumptions of the first group (H2a, b, c) are widely confirmed for technological knowledge, because:

- in the first component the various forms of institution-based are grouped;
- in the second component there are sources of knowledge that in fact do not have a very strong vocation whether tacit or explicit, and therefore it is reasonable to expect that they are together, because the characterization in one direction or another depends on the specific interactions,
- in the third component the source of tacit knowledge for excellence, that is that incorporated into the experts engaged in the local market, plus the one arising from cooperation with competitors are gathered;
- in the fourth component there are essentially codified forms.

It seems that organisational knowledge has very little differentiation in the perception of business that (negatively) distinguishes only those residual and not well identified (the "other sources"). Therefore, regards to organisational knowledge the second group of assumptions is not verified, and this is probably due to its generally and indiscriminately underestimation. Indeed data (Table 3b) show that, among all categories, mean and standard deviation of this type of knowledge are much lower compared to technological knowledge.
To check the other assumptions we projected on the components (Fig. 3-8) the three categories relating to geographical proximity (hpf, mpf, lpf), the two on types of internationalization (wid-fdi, wid-light-int), the four referring to the size classes (<20, 21-50, 51-100,> 100), and finally even the six categories based on communication media and recipients. There were also projected categories corresponding to the individual clusters and industrial sectors, but these, because of lack of space and time, were not subject to assumptions in this work. However, I have found that showing them was a useful contribution.
The third group of assumptions concerning the degree of correlation between geographical proximity and the various sources of knowledge. With regard to both types (technological and organizational) of knowledge the degree of correlation is low in all cases of geographical proximity (Table 5a and 5b). Therefore, both the hypothesis H3a that H3b should be discarded.
The fourth group of assumptions concerns the degree of correlation between class size and the various sources of knowledge. This is the same situation the previous couple of assumptions, and then you can draw the general result that, as discussed above for tables 5a and 5b, the categories constructed across clusters, namely combining their structural characteristics, show no significant correlation with the perception of the value of local external technological and organisational knowledge.

Fig. 3 Projection of the 20 economic and structural categories on the first two of the four components concerning the local external sources of technological knowledge

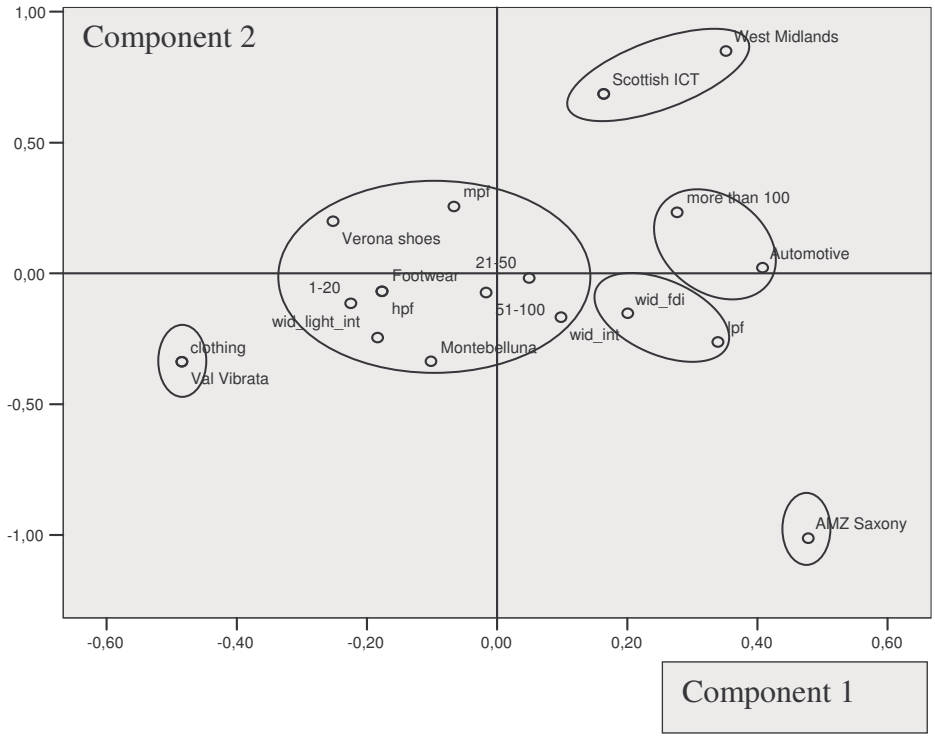


Fig. 4 Projection of the 20 economic and structural categories on the third of the fourth components concerning the local external sources of technological knowledge

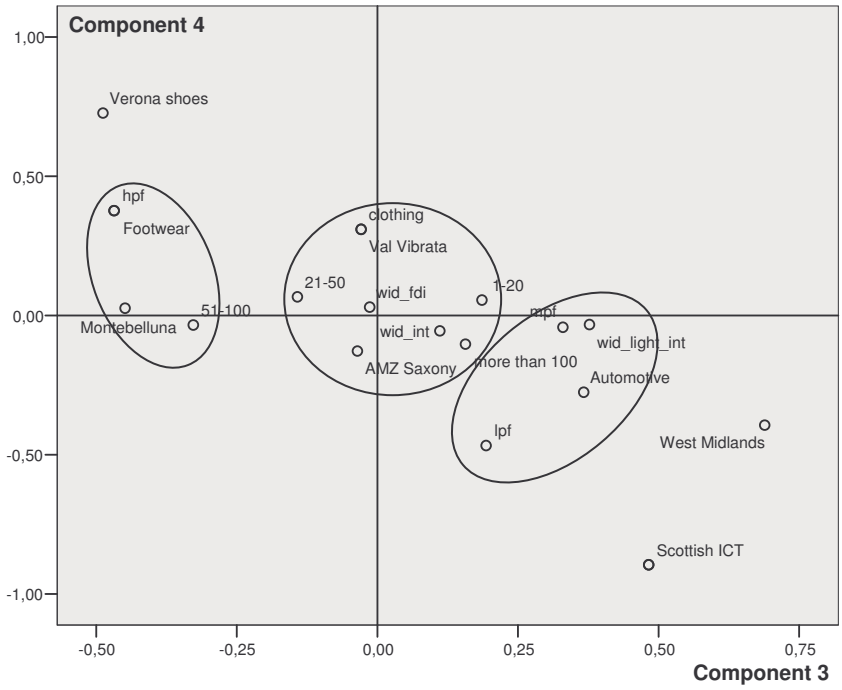
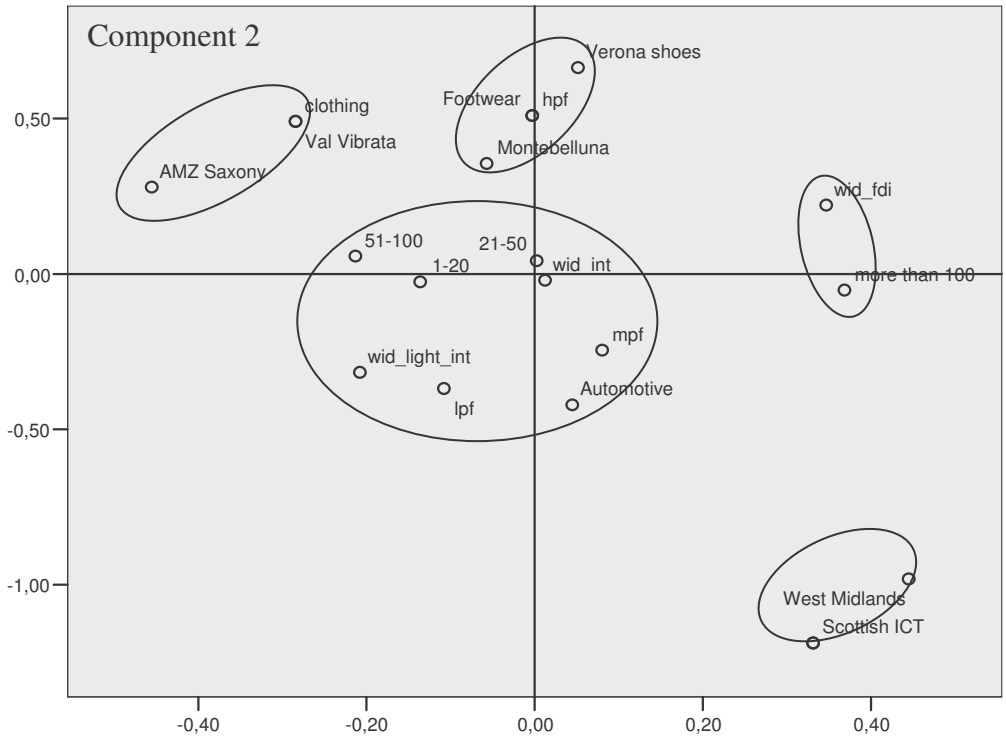


Fig. 5 Projection of the 20 economic and structural categories on the two components concerning the local external sources of organizational knowledge



As concerning the fifth group of hypotheses, the two types of internationalized firms have a perception of knowledge relevance quite uncorrelated (tab. 6 and fig. 3-5), and hence hypothesis H5a is confirmed. Conversely, the two following hypotheses are both rejected, because the only relevant component is the third one instead on the first two, and it holds only for the light internationalized firms. The perceptions of relocating firms is not correlated with any of the knowledge aggregations represented by the four components of technological knowledge. It is just moderately correlated with the two components of organizational knowledge. Hence, the only sources of knowledge with which the perceptions of internationalized firms are correlated are those embodied into new personnel and that coming from the cooperative interactions with competitors.

Tab. 6 Correlation of internationalized firms

	Technological knowledge				Organizational knowledge	
	Components				Components	
Categories	1	2	3	4	1	2
LIGHT-INT	B-	B-	M+	0	M-	B-
FDI	B+	B+	0	0	M+	M+

Scores legend: H (high), M (medium), L (Low)

As concerning size classes, fig- 3-5 show that small, medium, and large firms perceive the salience of knowledge sources in a very different way, and hence the hypothesis H5d is confirmed. Such a differentiation holds also considering the correlation between size and proximity (tab. 7): there is a marked difference between the two medium classes (21-50 and 51-100) and the two extreme classes (<20 and >100 employees). In fact, excepted for the second component of organizational knowledge, there is no any other case of coincidence of correlations between size and proximity when considering the extreme and its closest class.

Small firms have perceptions correlated with those in high proximity as concerning the first two components, that is knowledge deriving from interactions with institutions, other firms (clients, suppliers, and competitors), and with technological possess. There is no any similarity of

perceptions as concerning the other two components, which have also negative correlations. The two medium classes are very different each other and show generally a rather low correlation with geographical proximity. Thus, hypothesis H5e is partially confirmed.
Large firms have perceptions highly correlated with low proximity firms only as concerning the first ad the third component, that is that related to personnel-embodied and cooperation-based sources of knowledge. The other two components of technological knowledge show a medium level of correlation, one of which with a negative sign. There is instead no any correlation when concerning components representing organizational knowledge. Hence, hypothesis H5f is partially confirmed too. In conclusion, only the institution-based knowledge seems to confirm the relationship between firms size and proximity, which holds for both small and large classes. In all other cases it would be necessary to investigate more deeply at the level of single knowledge source instead of its aggregation into components.

Tab. 7 Correlation between firm size and geographical proximity in knowledge perception

Correlation with high firms proximity (HFP)

	Technological knowledge				Organizational knowledge	
	Components				Components	
Categories	1	2	3	4	1	2
1-20	H+	H+	L-	M-	M-	M+
21-50	M-	H-	M+	M+	H+	M+

Correlation with low firms proximity (LFP)

	Technological knowledge				Organizational knowledge	
	Components				Components	
Categories	1	2	3	4	1	2
51-100	M+	H+	L-	M-	H+	L-
>100	H+	M-	H+	M+	L-	L-

Scores legend: H (high), M (medium), L (Low)

Testing assumptions about communication means and recipients. To test the two successive groups of assumptions is necessary to first analyze the six categories based on communication means and recipients (tab. 8), its logical grouping, and then, always bearing in mind that these categories are not mutually exclusive, to project them on the components of technological and organizational knowledge. As you can see, these six categories, and in particular the first and the last one, have some marked differences compared with some parameters: the most digitized firms (the first four types) are characterized by an average size 3-4 times greater than that of less or not digitized. Obviously this difference is reflected in the weight of prevailing classes: into the first type it is very significant that over 100 employees and not that under 20, and vice versa for the sixth category. Somewhat surprisingly, into the first three categories enterprises with a high degree of proximity are approximately 50%, while in the other three categories that percentage drops below 40% and in the category of non-digitized firms (the type 6) it decreases below 30% .
These figures are quite consistent with those provided by Chiarvesio *et al.* (2004) on 557 firms in 29 and Carbonara (2005) on 51 Italian industrial districts, both collected approximately the same years of this research. Even in those samples most firms were medium-sized and operated mainly in the areas of fashion. As in this case, the growing use of email for internal and external communications does emerge: here percentages range between 41 and 69%, there between 50 and 76%.

Tab. 8

Types of firms according to communication means and recipients

Types	1	2	3	4	5	6
n of firms	67	51	92	112	96	86
% on tot	41	31	56	69	59	53
average size	239	265	206	177	58	54
hpf	36	27	43	43	33	24
% on tot	22	17	26	26	20	15
% on type	54	53	47	38	34	28
mpf	16	14	20	35	44	38
% on tot	10	9	12	21	27	23
% on type	24	27	22	31	46	44
lpf	15	10	29	34	19	24
% on tot	9	6	18	21	12	15
% on type	22	20	32	31	20	28
wid-fdi	27	22	35	36	18	21
% on tot	17	13	21	22	11	13
% on type	40	43	38	32	19	24
wid-light_int	19	15	23	26	11	14
% on tot	12	9	14	16	7	9
% on type	28	29	25	23	11	16
<20	11	9	14	24	43	37
% on tot	7	6	9	15	26	23
% on type	16	18	15	21	45	43
21-50	16	13	23	26	21	21
% on tot	10	8	14	16	13	13
% on type	24	25	25	23	22	24
51-100	12	9	21	28	19	16
% on tot	7	6	13	17	12	10
% on type	18	18	23	25	20	19
>100	28	20	34	34	13	12
% on tot	17	12	21	21	8	7
% on type	42	39	37	30	14	14

The sixth group of assumptions concerns the composition of digitized and not digitized firms, where this parameter is defined on the use of various forms of CMC both within and between companies. The first two assumptions -H6a and H6b respectively- suggest that not digitized companies are comprised mostly of businesses placed in small and medium-small size classes, and are characterized by high geographical proximity. The first hypothesis is fully verified, because businesses with fewer than 50 workers are 67% and indeed the average size is less than half than that of the sample (54 against 126). Instead, as we noted earlier, these companies are not characterized by high geographical proximity.
Similarly, more digitized firms, which correspond to the first three categories, are characterized by the medium size class (around 60% of companies) and do not show low geographical proximity. Therefore, hypothesis H6c is confirmed while H6d rejected.
The last group of assumptions concerns the degree of correlation between the six categories and the types of knowledge, and the similarities between different types of company in relation to the types of knowledge. The first hypothesis of this group (H7a) suggests that the four types of digitized firms and those who prefer not F2F form a group with highly correlated behaviour as regards of both technological and organizational knowledge. This hypothesis is fully confirmed, as can be seen in the figures 6-8. The second hypothesis (H7b) supposes that the category of non-digitized firms and those who prefer F2F form a group with highly correlated behaviour as regards of both technological and organizational knowledge. Then this hypothesis is fully confirmed too. In addition, the third hypothesis of this group suggests that the two groups of companies (digitized and

not digitized) are diametrically opposite related to the types of knowledge. This hypothesis is fully confirmed too, in particular with regard to organisational knowledge.
The final two hypotheses (H7d and H7e) respectively assume that: i) respect to other groups digitized firms allocate (on average) higher values to technological knowledge, while ii) not digitized and/or F2F oriented firms assign relatively minor importance to codified knowledge and to knowledge related to interactions with public or semi-public institutions. To test these two assumptions we should return to the tables 3a and 3b, and we will see that they are confirmed.

Fig. 6 Projection of the six types of firms according to its communication means and recipients on the first and second components concerning the local external sources of technological knowledge

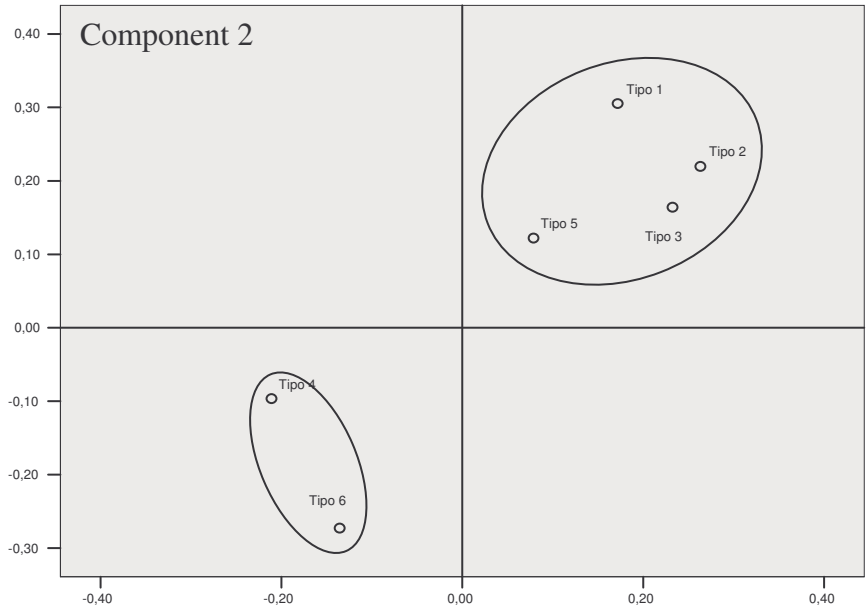


Fig. 7 Projection of the six types of firms according to its communication means and recipients on the third and fourth components concerning the local external sources of technological knowledge

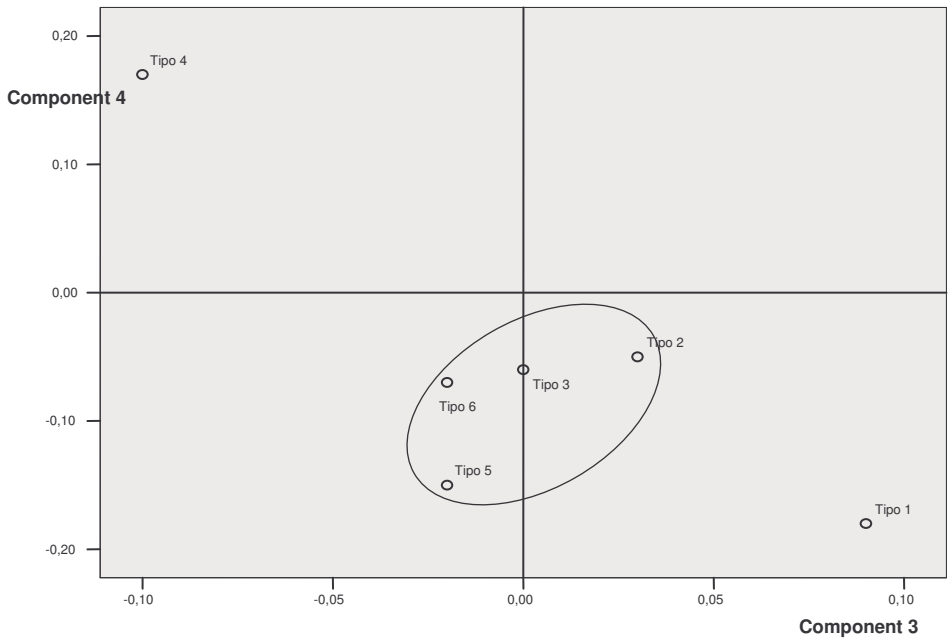
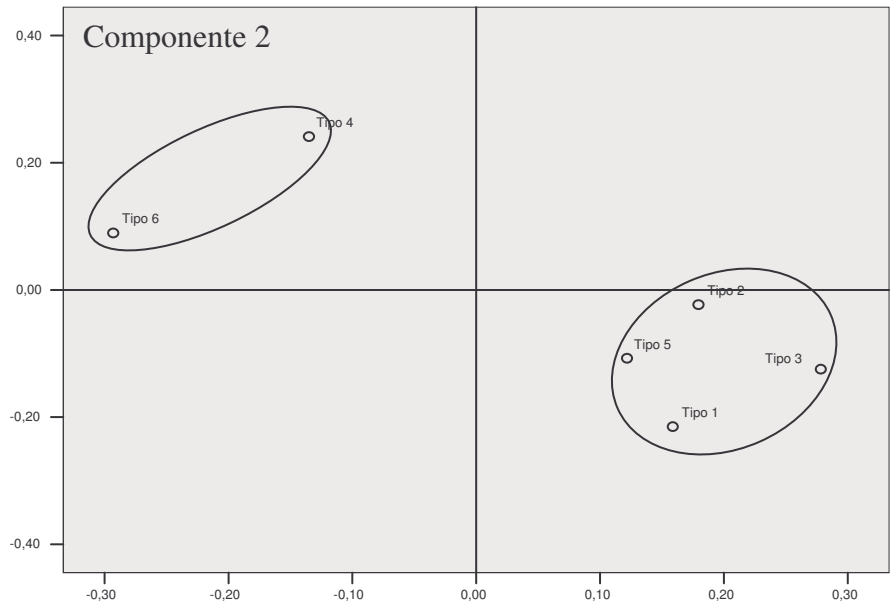


Fig. 8 Projection of the six types of firms according to its communication means and recipients on the two components concerning the local external sources of organizational knowledge



7. Discussion of the main findings

Among the amount of data and results outlined above is a fact that stands out among all: the low perception that almost all companies have respect to the importance of all the types of local knowledge. While taking into account that such perceptions may underestimate the reality, this figure deals a severe blow to socio-cognitive approaches that see local knowledge in the competitive strength of industrial clusters. It is likely that in this figure count in particular the

perceptions of small businesses cluster in low-tech sectors such as clothing and footwear. However, it also includes evaluations by medium enterprises in clusters of cars and ICT, which actually not differ greatly from those levels. Although limited to only 163 companies, this is a result that makes us think, because it refers not only to Italian but also to British and German companies in sectors with an average of complex technology and with a good level of intra-and inter-firm digitalization.
The second figure refers to the even lower perception that almost all companies have respect to the value of organizational knowledge in the local economy. It also contrasts strongly with the idea fairly widespread and growing that most innovations are organisational and informal. Even in that case you might think that it is the result of under-assessments due to the fact that, even more than for technological knowledge, this knowledge is often difficult be disentangled from a specific individual or a specific innovation. At least with respect to small enterprises in the Italian districts that under-evaluation is perfectly consistent with the well-known focus of managerial skills on production, at the expense of marketing and organisation. Moreover, one usually tends to underestimate what is not well known. But it seems (Guelpa, 2008) that many medium-sized enterprises have grown steadily in recent years to correct some of these weaknesses and develop an effective marketing strategy.
We could then give credit to the existence of a strong distorted perception of firms about the importance of local knowledge. This would seem consistent with other data of self-perceptive type enough surprising, but also found in other clusters: the one that concerns the sense of belonging. While researchers and policy makers have ideas (albeit sometimes questionable) usually fairly accurate on borders and on the number and identity of the members of a certain cluster, these same members often do not feel such. This is the case for example of many firms in the Val Vibrata cluster. Other times this perception is clearer, but it often depends more on the local institutions that literally "build" the identity of the cluster rather than on firms mutual recognition. One might think that if companies are not even aware of belonging to the same cluster, it becomes quite plausible that they can give scarce importance to knowledge obtained locally.
Finally, it is possible that the very way of data collection has negatively influenced this perception, in the sense that a more relational detection and timely, such as "who comes from and how will the knowledge exchanged" could induce more realistic assessments. However, results reported here raise some doubts about the socio-cognitive analysis of industrial clusters. At the very least they suggest to dig in more depth on the problem and to distinguish more precisely between clusters. Those knowledge-based, for example the technology-based districts of Storper (1992), and those cost-based, meaning those who based their ability to compete on costs low, and in particular on labour costs, are supposed to assign rather different values to local and likely also non-local sources of knowledge. It is likely that the latter, if still resist in Italy or in the new location places like Romania, India and China, give less emphasis to other local knowledge and in particular those organizational.
By shifting attention to the categories of firms, research shows clearly that the importance given to local knowledge is greater for the largest firms, the most digitized and those operating in most technologically complex areas. This at least confirmed expectations. Instead a very interesting result, but again problematic respect to current literature, is the low degree of correlation between different types of knowledge and different ways to combine the companies in the cluster. In this regard, data seem to say two things. Firstly, they suggest that cross-clusters aggregations explain little, as they do not identify consistent behaviours, at least in relation to the present variables (the perceptions of the importance of local knowledge). Indeed, the correlations with clusters construed as units of analysis, which in this work are only displayed and not analyzed, show degrees of correlation that, in some cases, are significantly higher (Fig. 3-5). This leads us to believe that actually a "cluster effect" holds, and that it also supports the explanations provided on understanding the low absolute values of these perceptions.
Another interesting aspect is that, apart from the fact that they are considered less important, the various types of organizational knowledge are not perceived differently, while those technological

give rise to four groups. Moreover, the distinctions are quite consistent with those between tacit and codified knowledge between knowledge arising from interaction with institutional and private sources, and finally between human- and things-embodied knowledge.
A further interesting aspect is suggested by the occasionally low degrees of correlation reported by firms grouped in terms of individuals clusters, which lead directly to the concepts of knowledge kernel discussed in section three (Fig. 1). In essence, it seems to confirm that geographic proximity is no guarantee that we can build a contextual strong knowledge kernel, capable of defending the advantages of proximity space and then possibly to prevent massive and drive towards selective relocation. Proximity should convey key-knowledge in terms of added value, otherwise no any core builds up.
The analysis of communication and digitalization confirms results coming from other similar studies (Carbonara, 2005; Chiarvesio *et al.*, 2004), and provides many interesting and, in many ways, worrying ideas. In fact, it acknowledges a strong digital divide between large and small firms, and the salience of clusters technological advancement. The first and second category of these two groups have highly correlated behaviours, and allocate respectively greater and lesser value to codified knowledge and to that coming from interactions with public or semi-public institutions. This result suggests two observations. The first one is that that part of small firms that still has not passed the digital divide really seems destined to disappear under the influence of globalization, because cost advantages are quickly disappearing and then determine failure or massive relocation. Indeed, even this second alternative requires a certain degree of development, because a successful relocation requires a certain level of managerial skills. This is testified by a number of companies that go back or fails in the new sites. In addition, the benefits of the mark, to which it seems that midsize businesses are moving successfully, need a strong ability to manage information and communication technologies. So not digitized firms cut off even from this strategy.
The second point concerns the key role of digitisation for absorptive capacity (Cohen and Levinthal, 1990; Zahra and George, 2002). To effectively use knowledge companies should have the capability to recognize, use, and possibly turn them into innovation. In this sense information and communication technologies play, along with some other factors that determine the development of managerial skills, a very important role, because their variety allows developments in rather different directions. There are types of ICT that build and develop local knowledge and types that instead point in other directions. It is necessary to distinguish between commodity and project-based technologies: the first are inexpensive and easy to use, such as email, internet, intranet, and typically web applications, that is based on the use of Internet pages in the network; the second one instead shall consist of the varied world of systems for enterprise resource planning (ERP) and groupware, that is, all those systems to support and coordinate operational decisions. In turn, these two categories include technology dedicated to coordination and decision support, or the management of the steps in the production process, or even knowledge management (Carbonara, 2005). How do note Chiarvesio *et al.* (2004), while email is spreading project-based technologies are still almost entirely absent.
This fact leads to a crucial point of interest for the future development of territorial systems: if the competitive advantage of geographical proximity is in "what can not be conveniently carried outside the local context" and if this thing is the tacit knowledge, then what reduces the rationale for tacit knowledge is a threat. However, it is plausible to assume here -but it would need further sophisticated studies- is that part of tacit knowledge is not really such, and will be more or less rapidly codified by the spread of commodity technologies and the introduction of project-based technologies. This would be an advantage for each initial local system, because it would facilitate the coordination of its inner activities. However, the diffusion of these systems sooner or later would make it easy also inter-cluster coordination of transactions (Eng, 2004).
The questions then become how much tacit knowledge is necessary for these technologies and what activities of the territorial and global value chain they will likely transform and re-allocate. The first question leads to a very interesting debate, whose outcome still rather uncertain in the social

psychology and information systems (Orlikowski *et al.*, 1995; Postmes *et al.*, 1998; Spears *et al.*, 2001). Many argue that the development of CMC bears no way to reduce F2F, and therefore tacit knowledge. Or at least it would only modestly and for simpler tasks occur (Biggiero *et al.*, 2004; Biggiero, 2006b). The supposed substitution effect between F2F and CMC would be very doubtful, instead of what actually happened for other traditional means of communication, such as letters, phone and fax. It could be another resounding wrong prediction of the effects of information technology, as it was for the predicted collapse of demand for paper from office. Moreover, many of these studies point to the fact that the development of information technology for coordination, and even more the way they are actually used, are strongly influenced by psycho-social and institutional context. Hence, it would be again the ability to interact easily and cooperatively to promote the dissemination of those technologies while maintaining the competitive advantage of geographical proximity.

The other question leads directly to technological trajectories that cross the global value chains in which each territorial system is inserted. Here the problem is the degree of modularization and standardization of information technology (Henry and Pinch, 2006; Sanchez and Maloney, 1996): the higher these degrees the easier becomes non-local coordination of activities. If a certain module and its interface with the rest of architecture is sufficiently standardized, then (ceteris paribus) it becomes convenient to look for potential producers outside the cluster. As in the previous question, this phenomenon could turn in some cases to the decline and the disappearance of the local system, while in others to its transformation through selective relocation.

Conclusions

The analysis conducted on 163 companies in the sample restricted to certain clusters of Western Europe confirms some of the assumptions, and in particular provides a further confirmation of the strong difference in the degree of digitalization between small and large businesses, the role it plays in development processes of territorial systems. A result useful for methodological aims is that the threefold knowledge categorization works well: tacit vs. codified, institution vs. private interactions, cooperative vs. other sources of knowledge. These categories revealed to be effective in grouping knowledge, because companies clearly perceive their difference.

Some other assumptions are not confirmed or provide results somewhat problematic, especially with regard to Italian cluster and generally the evaluations provided by high geographical proximity firms. Indeed, the analysis shows that, when taken as a category, these firms do not give great importance to local knowledge, let alone to those incorporated in recruiting new staff on the local market. This suggests that the hypothesis of a close relationship between these variables can not cope with a high degree of generality, in the sense that other context-specific variables, such as the degree of complexity and modularity of technology, the actual creation of knowledge and the absence of strong local institutional and psycho-social impediments to knowledge circulation. In summary, the socio-cognitive approach to territorial systems is not leaving fully confirmed nor rejected, but certainly problematized.

References

Alberti, F. 2006. The decline of the industrial district of Como: recession, relocation or reconversion? *Entrepreneurship & Regional Development*. 18: 473-471.

Albertini, S. e Pilotti L. 1996. *Reti di reti: apprendimento, comunicazione e cooperazione nel nordest*. Padova: Cedam.

Albino, V., Carbonara, N. and Giannoccaro I. 2003. Coordination mechanisms based on cooperation and competition within industrial districts. Journal of Artificial Societies and Social Simulation. 6(4). http://jasss.soc.surrey.ac.uk/6/4/3.html.

Albino, V., Carbonara, N. and Giannoccaro I. 2006. Innovation in industrial districts: an agent-based simulation model. *International Journal of Production Economics*. 104: 30-45.

Amin, A. and Cohendet, P. 2004. *Architectures of Knowledge: Firms, Capabilities, and Communities*. Oxford: Oxford UP.
Amin, A. e Roberts J. 2008. Knowing in action: beyond communities of practice. *Research Policy*. 37: 353-369.
Arcuri, L. and Flores D'Arcais B. 1974. *La misura degli atteggiamenti*. Torino: Giunti Barbera.
Argote, L. and Ingram, P. 2000. Knowledge transfer: a basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*. 82: 150-69.Ashforth, B.E. and F.A. Mael 1989. Social Identity Theory and the Organization. *Academy of Management Review*. 14: 20–39.
Ashforth, B.E. and F.A. Mael 1996. Organizational Identity and Strategy As a Context for the Individual. In L.L. Cummings and B.M. Staw (Eds.) *Research in Organizational Behavior*. Greenwich, CT: JAI Press. Vol. 13 (pp. 17–62).
Bagella, M. and Becchetti L. (Eds.) 2000. *The competitive advantage of industrial districts*. Berlino: Springer.
Barabasi, A.-L. 2003. *Link*. Plume; Reissue edition.
Becattini, G. 2004. *Industrial districts: a new approach to industrial change*. Cheltenham (UK): Edward Elgar.
Becattini, G., Bellandi, M., Dei Ottati, G. and Sforzi F. 2003. *From industrial districts to local development: an itinerary of research*. Cheltenham (UK): Edward Elgar.
Belussi, F. 2003. The generation of contextual knowledge through communication process. The case of packaging machinery industry in the Bologna district. In F. Belussi, G. Gottardi e E. Rullani (Eds.) *The net evolution of local systems: knowledge creation, collective learning, and variety of institutional arrangements*. Amsterdam: Kluwer (pp. 341-365).
Belussi, F., Gottardi, G. and Rullani, E. (Eds.) 2003. *The Technological Evolution of Industrial Districts*. Amsterdam: Kluwer.
Biggiero, L. 1998. Italian Industrial Districts: A Triple Helix Pattern of Problem Solving, *Industry & Higher Education*, Special Issue, agosto. 227-234.
Biggiero, L. 1999. Markets, Hierarchies, Networks, Districts: A Cybernetic Approach. *Human Systems Management*. 18: 71-86
Biggiero, L. 2002. The location of multinationals in industrial districts: knowledge transfer in biomedicals. *Journal of Technology Transfer*. 27: 111-122.
Biggiero, L. 2006a. Industrial and knowledge relocation strategies. *Entrepreneurship & Regional Development*. 18: 443-471.
Biggiero, L. 2006b. The impact of email on system identity and autonomy: a case study in self-observation. In Minati, G., Pessa, E. and Abram, M. (Eds.) *Systemics of Emergence: Research and Development*. New York: Springer, pp. 551–568.
Biggiero, L. and Sammarra, A. 2003a. Organizational identity and identification processes. enriching theoretical tools to study industrial districts. In Belussi, F., Gottardi, G. and Rullani, E. (Eds.) *The net evolution of local systems: knowledge creation, collective learning, and variety of institutional arrangements* (Amsterdam: Kluwer) pp. 205-232.
Biggiero, L. and Sammarra A. 2003b. The biomedical valley: structural, relational, and social psychological aspects. In Belussi, F., Gottardi, G. and Rullani, E. (Eds.) *The net evolution of local systems: knowledge creation, collective learning, and variety of institutional arrangements* (Amsterdam: Kluwer) pp. 367-388.
Biggiero, L., Sammarra, A., Muzzi, C. and Dandi, R. 2004. Organizational consequences of e-mail adoption and diffusion: theoretical issues and empirical results. In Cunningham, P. and Cunningham, M. (Eds.) *Adoption and the Knowledge Economy: Issues, Applications, Case Studies.* Amsterdam: IOS Press, pp. 134–140.
Boschma, R. A. and ter Wal, A. L. J. 2007. Knowledge networks and innovative performance in an industrial district: the case of a footwear district in the South of Italy. *Industry and Innovation*. 14: 177–99,

Brenner, T. 2004. *Local industrial clusters: existence, emergence and evolution*. London: Routledge.
Brenner, T. 2007. Local Knowledge Resources and Knowledge Flows. *Industry and Innovation*. 14: 121-28.
Brenner, T. and Mühlig A. 2008. Factor and mechanisms causing the emergence of local industrial clusters: a meta-study of 159 cases. Papers on Economics & Evolution. Max Planck Institute of Economics. N. 0723.
Brown, J.S. and Duguid, P. 1991. Organizational learning and communities of practice: toward a unified view of working, learning and innovation. *Organization Science*. 2(1): 40-47.
Cantner, U. and Graf H. 2006. The network of innovators in Jena: an application of social network analysis. *Research Policy*. 35: 463-480.
Capello, R. 1999. Spatial transfer of knowledge in high technology milieux: learning versus collective learning processes. *Regional Studies*. 33: 353-65.
Carbonara, N. 2005. Information and communication technology and geographical clusters: opportunities and spread. *Technovation*. 25: 213-222.
Carley, K.M. 1999. On the evolution of social and organizational networks. *Research in the Sociology of Organizations*. 16: 3-30.
Chiarvesio, M., Di Maria, E. and Micelli, S. 2004. From local networks of SMEs to virtual districts? Evidence from recent trends in Italy. *Research Policy*. 33: 1509-1528.
Cohen, W. M. and Levinthal, D. A. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*. 35: 128–52.
Crouch, C., Le Gales, P., Trigilia, C. and Voelzkow, H. (Eds.) 2001. *Local Production Systems in Europe: Rise or Demise?* Oxford: Oxford UP.
Ciarli, T. and Valente M. 2005. Firms interaction and industrial development: a simulation model. In Giuliani, E., Rabellotti R. and van Dijk M.P. (Eds.) *Clusters facing competition: the importance of external linkages*. Aldershot: Ashgate, pp. 259-290.
Dahl, M.S. and Pedersen, C.Ø.R. 2004. Knowledge flows through informal contacts in industrial clusters: myth or reality? *Research Policy*. 33: 1673-1686.
Dei Ottati, G. 1994. Trust, Interlinking Transactions and Credit in the Industrial Districts. *Cambridge Journal of Economics*. 18: 529-546.
Di Franco, G. 2001. *EDS: Esplorare, descrivere, sintetizzare i dati*. Milano: Angeli.
Di Maria, E. and Micelli S. 2008. SMEs and competitive advantage: a mix of innovation marketing and ICT. The case of "Made in Italy". "Marco Fanno" Working Paper n. 70.
Dosi, G., Nelson, R.R. and Winter, S.G. (Eds.) 2000. *The Nature and Dynamics of Organizational Capabilities*. Oxford: Oxford UP.
Doz, Y. L. and Hamel, G. 1998. *Alliance Advantage*. Boston (MA): Harvard Business School Press.
Eng, T.-Y. 2004. Implications of the internet for knowledge creation and dissemination in clusters of hi-tech firms. *European Management Journal*. 22: 87-98.
Foresti, 2008. *L'industria*.
Fujita, M. and Thisse J.-F. 2002. *Economics of agglomeration. Cities, industrial location, and regional growth*. Cambridge: Cambridge UP.
Frudà, L. 1989. *Le scale di atteggiamento nella ricerca sociale*. Roma: La Goliardica.
Gertler, M.S. 1995. Being there: proximity, organization and culture in the development and adoption of advanced manufacturing technologies. *Economic Geography*. 71(1): 1-26.
Gertler, M.S. 2003. Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of Economic Geography*. 3: 75-99.
Gertler, M.S. and Levitte, Y.M. 2005. Local nodes in global networks: the geography of knowledge flows in biotechnology innovation. *Industry and Innovation*. 12: 487-507.
Giner, J.M. and Santa Maria M.J. 2002. Territorial systems of small firms in Spain: an analysis of productive and organizational characteristics in industrial districts. *Entrepreneurship and Regional Development*. 14: 211-228.

Giuliani, E. 2006. The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of Economic Geography*. 7: 139-68.
Gordon, I.R. and McCann P. 2000. Industrial clusters: complexes, agglomeration and/or social networks? *Urban Studies*. 37: 513-532.
Gulati, R. 1998. Alliances and networks. *Strategic Management Journal*. 19: 293-317.
Gulati, R. 1999. Network location and learning: the influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal*. 20: 397-420.
Haas, P. 1992. Introduction. Epistemic communities and international policy coordination. *International Organization*. 46(1): 21-26.
Hagedoorn, J. 1993. Understanding the rationale of strategic technology partnerships. *Strategic Management Journal*. 14: 371-85.
Hagedoorn, J. 1995. Strategic technology partnering during the 1980s: trends, networks, and corporate patterns in non-core technologies. *Research Policy*. 24: 207-31.
Hagedoorn, J. and Schakenraad, J. 1994. The effect of strategic technology alliances on company performance. *Strategic Management Journal*. 15: 291-309.
Håkanson, L. 2005. Epistemic communities and cluster dynamics: on the role of knowledge in industrial districts. *Industry and Innovation*. 12(4): 433-463.
Henry, N. and Pinch S. 2006. Knowledge and clusters. In Pitelis, C., Sugden R. and Wilson J. (Eds.) 2006. *Clusters and globalisation. The development of urban and regional economies*. Cheltenham (UK): Edward Elgar, pp. 114-132.
Hogg, M.A. and Deborah J. Terry D.J. (Eds.) 2000. *Social identity processes in organizational context*. Philadelphia : Psychology Press.
Howells, J., James, A. and Malik, K. 2003. The sourcing of technological knowledge: distributed innovation processes and dynamic change. *R&D Management*. 33: 395-409.
Iammarino, S. and McCann, P. 2006. The structure and evolution of industrial clusters: transactions, technology and knowledge spillovers. *Research Policy*. 35: 1018-1036.
Inkpen, A.C. and Tsang, E. W. K. 2005. Social capital, networks, and knowledge transfer. *Academy of Management Review*. 30: 146-66.
Karlsson, C., Johansson, B. and Stough R.R. (Eds.) 2005. *Industrial clusters and inter-firm networks*. Cheltenham (UK): Edward Elgar.
Keeble, D. and Wilkinson, F. 1999. Collective learning and knowledge development in the evolution of regional clusters in high technology SMEs in Europe. *Regional Studies*. 33: 295-303.
Giuliani, E., Rabellotti R. and van Dijk M.P. (Eds.) 2005. *Clusters facing competition: the importance of external linkages*. Aldershot (UK): Ashgate.
Lane, C. and Bachmann, R. (a cura di) 1998. *Trust within and between organizations*. Oxford: Oxford UP.
Leydesdorff, L. 2000. The Triple Helix: an evolutionary model of innovations. *Research Policy*. 29: 243-255.
Lipparini, A. and Sobrero, M. 1994. The glue and the pieces: entrepreneurship and innovation in small-firm networks. *Journal of Business Venturing*. 9(2): 125-140.
Lissoni, F. 2001. Knowledge codification and the geography of innovation: the case of Brescia mechanical cluster. *Research Policy*. 30: 1479-1500.
Lombardi, M. 2000. The cognitive approach to the study of local production systems. In Belussi, F. and Gottardi, G. (Eds.) *Evolutionary Patterns of Local Industrial Systems*. Ashgate: Aldershot (pp. 71–87).
Lorenzen, M. 2002. Ties, trust, and trade. *International Studies of Management & Organization*. 31: 14-34.
Malmberg, A. and Maskell, P. 2002. The elusive concept of localization economies: towards a knowledge-based theory of spatial clustering. *Environment and Planning A*. 34(3): 429-449.
Malmberg, A. and Maskell, P. 2005. Localized learning revisited. DRUID Working Paper No. 05-19.

Malmberg, A. and Power, D. 2005. (How) do (firms in) clusters create knowledge? *Industry and Innovation*. 12: 409-431.
Markusen, A. 1996. Sticky places in slippery space: a typology of industrial districts. *Economic Geography*. 72: 293-313.
Martin, R. and Sunley P. 2003. Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*. 3: 5-35.
Maskell, P. 2001a. Towards a knowledge-based theory of the geographical cluster. *Industrial and Corporate Change*. 10: 919-41.
Maskell, P. 2001b. Knowledge creation and diffusion in geographical clusters. *International Journal of Innovation Management*. 5: 213-237.
Merlone, U. and Terna, P. 2007. Population symbiotic evolution in a model of industrial districts. In Rennard J.P (Eds.) *Handbook of Research on Nature Inspired Computing for Economics and Management*. Hershey (Pa): Idea Group Reference, pp. 301-316.
Monge, P.R. and Contractor N.S. 2003. *Theories of communication networks*. Oxford: Oxford UP.
Morgan, K. 2004. The exaggerated death of geography: learning, proximity and territorial innovation systems. *Journal of Economic Geography*. 4: 3-21.
Mowery, D. C., Oxley, J. E. and Silverman, B. S. 1996. Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal*. 17: 77-91.
Mussino, A. 1997. *Lezioni di statistica sociale*. Roma: Centro Stampa Ateneo.
Orlikowski, W.J., Yates, J., Okamura, K. and Fujimoto, M. 1995. Shaping electronic communication: the metastructuring of technology in the context of use. *Organization Science*. 6: 423–444.
Paniccia, I. 2002. *Industrial Districts: Evolution and Competitiveness in Italian Firms*. Cheltenham (UK): Edward Elgar.
Peteraf, M. and M. Shanley 1997. Getting to Know You: A Theory of Strategic Group Identity. *Strategic Management Journal*. 18: 165–186.
Pinch, S., Henry, N., Jenkins, M. and Tallman S. 2003. From industrial districts to knowledge clusters: a model of knowledge dissemination and competitive advantage in industrial agglomeration. *Journal of Economic Geography*. 3: 373-388.
Pitelis, C., Sugden R. and Wilson J. (Eds.) 2006. *Clusters and globalisation. The development of urban and regional economies*. Cheltenham (UK): Edward Elgar.
Porter, M.E. 1990. *The competitive advantage of nations*. London: Macmillan.
Porter, M.E. 1996. Competitive advantage: agglomeration economies, and regional policy. *International Regional Science Review*. 19: 85-94.
Porter, M.E. 1998a. *On competition*. Harvard Business School Press.
Porter, M.E. 1998b. Clusters and the new economics of competition. Harvard Business Review. Novembre. 77-90.
Porter, M.E. 2000a. Location, clusters and company strategy. In Clarck G.L., Feldman M e Gertler M. (Eds.) *Oxford Handbook of economic geography*. Oxford: Oxford UP (pp. 253-274).
Porter, M.E. 2000b. Location, competition and economic development: local clusters in the global economy. *Economic Development Quarterly*. 14: 15-31.
Postmes, T., Spears, R. and Lea, M. 1998 Breaching or building social boundaries? SIDE-effects of computer-mediated communication. *Communication Research*. 25: 689–715.
Rullani, E. 2003. The industrial district as a cognitive system. In Belussi, F., Gottardi, G. and Rullani, E. (Eds.) The Net Evolution of Local Systems: Knowledge Creation, Collective Learning, and Variety of Institutional Arrangements. Amsterdam: Kluwer (pp. 63–87).
Sammarra, A. 2003. Case study report on the Val Vibrata-Tordino-Vomano industrial district. www.west_east_id.it.
Sammarra, A. 2005a. Districts' boundaries, patterns of formation and evolution, and sector/products of specialization. In WEID Comparative report, www.west_east_id.it.

Sammarra, A. 2005b. Relocation and the international fragmentation of industrial districts value chain: matching local and global perspectives. In Belussi F. and Sammarra, A. (Eds.) *Industrial districts, relocation, and the governance of the global value chain* (Padua: CLEUP) pp. 61-70.
Sammarra, A. and Belussi F. 2006. Evolution and relocation in fashion-led Italian districts: evidence from two case-studies. *Entrepreneurship & Regional Development*. 18: 543–562
Sammarra, A. and Biggiero L. 2001. Identity and identification in industrial districts. *Journal of Management and Governance*. 5(1): 61-82.
Sammarra, A. and Biggiero, L. 2008. Heterogeneity and specificity of inter-firm knowledge flows in innovation networks. *Journal of Management Studies*. forthcoming.
Sanchez, R. and Mahoney, J. 1996. Modularity, flexibility, and knowledge management in product and organization design. *Strategic Management Journal*. 17 (Winter Special Issue): 63–76.
Schmitz, H. (Eds.) 2004. *Local enterprises in the global economy. Issues of governance and upgrading*. Cheltenham (UK): Edward Elgar.
Scott, J. 1991. *Social network analysis: a handbook*. London: Sage.
Signorini, L.F. and Omiccioli, M. (Eds.) 2005. *Economie locali e competizione globale: il localismo industriale italiano di fronte a nuove sfide*. Bologna: Il Mulino.
Simonin, B.L. 1999. Transfer of marketing know how in international strategic alliances: An empirical investigation of the role and antecedents of knowledge ambiguity. *Journal of International Business Studies*. **30**: 463-490.
Sorenson, O., Rivkin, J. and Fleming L. 2006. Complexity, networks and knowledge flow. *Research Policy*. 35: 994-1017.
Spears, R., Lea, M. and Postmes, T. 2001. Social psychological theories of computer-mediated communication: social pain or social gain. In Robbinson, W. P. e Giles, H. (Eds.) *The New Handbook of Language and Social Psychology*. Chichester: Wiley & Sons.
Staber, U. 2001. The structure of networks in industrial districts. *International Journal of Urban and Regional Research*. 25: 537-552.
Storper, M. 1992. The limits to globalization: technology districts and international trade. *Economic Geography*. 68: 60–93.
Storper, M. 1995. The resurgence of regional economies ten years later: the region as a nexus of untraded interdependencies. *European Urban and Regional Studies*. 2: 191-221.
Storper, M. and Venables, A.J. 2004. Buzz: face-to-face contact and the urban economy. *Journal of Economic Geography*. 4(4): 351-370.
Tallman, S., Jenkins, M., Henry, N. and Pinch, S. 2004. Knowledge, clusters, and competitive advantage. *Academy of Management Review*. 29: 258-71.
Teece, D.J., Pisano, G. and Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal*. 18: 509-533.
Tsoukas, H. 1996. The firm as a distributed knowledge system: a constructionist approach. *Strategic Management Journal*. 17: 11-25.
Turvani, M. 2003. Cognitive economies and the "nature of the district. In S. Rizzello (Eds.) *Cognitive developments in economics* (pp. 281-301), London: Routledge.
Walther, J. B. 1992. Interpersonal Effects in Computer-Mediated Interaction: a Relational Perspective. *Communication Research*. 19: 52-90.
Walther, J. B. 1995. Relational Aspects of Computer-Mediated-Communication: Experimental Observations over Time. *Organization Science*. 6(2): 186-203.
Watts, D.J. 2003. *Small worlds: the dynamics of networks between order and randomness*. Princeton: Princeton UP.
Wenger, E. 1998. *Communities of Practice*. New York: Cambridge UP.
Zahra, S.A. and George, G. 2002. Absorptive capacity: a review, reconceptualization, and extension. *Academy of Management Review*. 27: 185-203.
Zyglidopoulos, S.C., DeMartino, R. e McHardy Reid D. 2006. Cluster reputation as a facilitator in the internazionalization of small and medium enterprises. *Corporate Reputation Review*. 9: 79-87.

Zook, M. A. 2004. The knowledge brokers: venture capitalists, tacit knowledge and regional development. *International Journal of Urban and Regional Research*. 28: 621–641.

Appendix 1 – Items of the questionnaire

Internationalization forms are defined according to the following questions:

a	Wholly-owned subsidiaries
b	Joint Equity Ventures
c	Foreign minority holdings
d	Licensing
e	Franchising
f	Management contracts
g	Turnkey projects
h	Contractual Joint Ventures
I	Others

Communication means and recipients are detected through the following question:
"How often does your company use the following communication systems?"

	Media types	Within **main units** of own company	Within **all units** of own company	Shared with suppliers	Shared with distributors	Shared with sup
a	Face-to-face, physical meetings					
b	Letters, Tel, Fax, etc.					
c	Email					
d	Intranet					
e	Other, please name (video-conference, etc,….)					

Values are ranked as follows: 5 = Most of the time; 4= frequently; 3 = Occasionally; 2=very rarely; 1= Never.

The salience of external local technological knowledge sources is investigated through the following question:
"How important are the following as sources of technical knowledge for your company?"

Knowledge type	label
Knowledge embedded in experts hired on the labour market	exloctechknowa
Knowledge derived from interactions with clients and/or suppliers	exloctechknowb
Knowledge derived from cooperation with other companies	exloctechknowc
Knowledge derived from imitation of products	exloctechknowd
Knowledge embedded in technologies, licenses, components, etc.. acquired from outside (technological innovation)	exloctechknowe
Knowledge gained from interactions with public institutions (e.g., universities; public research centres; local government; etc.)	exloctechknowf
Knowledge gained from interactions with semi-public institutions (e.g., chambers of commerce; industry associations, trade unions, etc.)	exloctechknowg
Knowledge provided by consultants and private research centres	exloctechknowh
Knowledge gained from publicly available information (e.g., trade fairs, publications)	exloctechknowi
others	exloctechknowj

For organizational knowledge:
"How important are the following as sources of organisational knowledge for your firm?"

Knowledge type	label

Organisational skills of the newly recruited staff	exlocorgknowa
Organisational skills gained from interactions with clients and/or suppliers	exlocorgknowb
Organisational skills gained from cooperation with other companies	exlocorgknowc
Organisational skills learnt from interactions with public institutions (e.g., universities; public research centres; local government; etc.)	exlocorgknowd
Organisational skills learnt interactions with semi-public institutions (e.g., chambers of commerce; industry associations, trade unions, etc.)	exlocorgknowe
Organisational skills learnt from consultants and private research centres	exlocorgknowf
Organisational skills learnt publicly available information (e.g., trade fairs, publications)	exlocorgknowg
	exlocorgknowh

Values are ranked as follows: 5 = very important; 4= important; 3 = Moderately important; 2= of little importance; 1 = not important at all.

Appendix 2 – Raw results of the principal components analysis

As concerning technological knowledge the following four components do emerge (a Varimax rotation has been used):

Matrice di correlazione

		exloctech knowa	exloctech knowb	exloctech knowc	exloctech knowd	exloctech knowe	exloctech knowf	exloctech knowg	exloctech knowh	exloctech knowh	exloctech knowj
Correlazione	exloctechknowa	1,000	,096	,386	,213	,037	,219	,286	,142	,145	-,235
	exloctechknowb	,096	1,000	,406	,121	,369	,160	,165	,202	,291	-,222
	exloctechknowc	,386	,406	1,000	,220	,285	,370	,408	,281	,336	-,379
	exloctechknowd	,213	,121	,220	1,000	,390	,211	,102	,060	,180	,130
	exloctechknowe	,037	,369	,285	,390	1,000	,403	,296	,236	,357	-,025
	exloctechknowf	,219	,160	,370	,211	,403	1,000	,596	,442	,477	-,012
	exloctechknowg	,286	,165	,408	,102	,296	,596	1,000	,409	,406	-,251
	exloctechknowh	,142	,202	,281	,060	,236	,442	,409	1,000	,359	-,060
	exloctechknowh	,145	,291	,336	,180	,357	,477	,406	,359	1,000	-,214
	exloctechknowj	-,235	-,222	-,379	,130	-,025	-,012	-,251	-,060	-,214	1,000

Total explained variance

Components	Initial eigenvalues			Weights of rotated factors		
1	3,420	34,199	34,199	2,435	24,354	24,354
2	1,364	13,637	47,836	1,618	16,177	40,531
3	1,149	11,487	59,323	1,530	15,301	55,832
4	1,046	10,459	69,782	1,395	13,950	69,782
5	,696	6,965	76,747			
6	,590	5,902	82,648			
7	,530	5,296	87,945			
8	,478	4,782	92,726			
9	,406	4,063	96,789			
10	,321	3,211	100,000			

Rotated components matrix

	Components			
	1	2	3	4
exloctechknowa	,127	-,082	,863	,160
exloctechknowb	,096	,849	,028	,090
exloctechknowc	,310	,487	,572	,086
exloctechknowd	,024	,090	,228	,869
exloctechknowe	,362	,505	-,121	,548
exloctechknowf	,822	,024	,120	,238
exloctechknowg	,757	,073	,325	-,026
exloctechknowh	,743	,083	-,007	-,041
exloctechknowi	,618	,374	,058	,083

exloctechknowj	-,036	-,487	-,517	,482

Extraction method: principal components analysis.
Rotation method: Varimax with Kaiser normalization.
Rotation converged in 11 iterations.

As concerning organizational knowledge, the two emerging components are as follows:

Matrice di correlazione

		exlocorgknowa	exlocorgknowb	exlocorgknowc	exlocorgknowd	exlocorgknowe	exlocorgknowf	exlocorgknowg	exlocorgknowh
Correlazione	exlocorgknowa	1,000	,497	,447	,407	,348	,262	,414	-,180
	exlocorgknowb	,497	1,000	,774	,677	,580	,540	,562	-,176
	exlocorgknowc	,447	,774	1,000	,692	,613	,624	,687	-,136
	exlocorgknowd	,407	,677	,692	1,000	,758	,590	,647	,042
	exlocorgknowe	,348	,580	,613	,758	1,000	,648	,637	,032
	exlocorgknowf	,262	,540	,624	,590	,648	1,000	,640	,212
	exlocorgknowg	,414	,562	,687	,647	,637	,640	1,000	-,009
	exlocorgknowh	-,180	-,176	-,136	,042	,032	,212	-,009	1,000

Total explained variance

	Initial eigenvalues			Weights of rotated factors		
Components	Totale	% di varianza	% cumulata	Totale	% di varianza	% cumulata
1	4,499	56,236	56,236	4,499	56,236	56,236
2	1,246	15,571	71,807	1,246	15,571	71,807
3	,655	8,189	79,996			
4	,445	5,567	85,563			
5	,438	5,475	91,038			
6	,329	4,106	95,144			
7	,196	2,456	97,600			
8	,192	2,400	100,000			

Extraction method: principal components analysis.

Components matrix

	Components	
	1	2
exlocorgknowa	,570	-,421
exlocorgknowb	,833	-,227
exlocorgknowc	,875	-,123
exlocorgknowd	,863	,098
exlocorgknowe	,828	,166
exlocorgknowf	,775	,380
exlocorgknowg	,825	,072
exlocorgknowh	-,042	,903

Extraction method: principal components analysis.

Appendix 3 – Dissimilarity matrixes

Technological knowledge

Distance matrix calculated on the first two components

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0,00	0,99	0,93	0,65	0,94	0,90	0,52	0,90	0,79	0,99	0,81	0,65	0,67	0,65	0,79	0,83	0,40	0,51	0,74	0,72
2	0,99	0,00	0,35	0,37	1,00	0,81	0,88	0,81	0,32	0,00	0,28	0,54	0,47	0,79	0,32	0,50	0,80	0,67	0,29	0,71
3	0,93	0,35	0,00	0,31	0,67	0,47	0,65	0,47	0,15	0,35	0,16	0,31	0,26	0,51	0,15	0,18	0,62	0,47	0,23	0,41

4	0,65	0,37	0,31	0,00	0,74	0,57	0,53	0,57	0,16	0,37	0,16	0,22	0,16	0,47	0,16	0,30	0,43	0,31	0,09	0,42
5	0,94	1,00	0,67	0,74	0,00	0,20	0,42	0,20	0,69	1,00	0,73	0,52	0,58	0,32	0,69	0,50	0,55	0,52	0,75	0,32
6	0,90	0,81	0,47	0,57	0,20	0,00	0,41	0,00	0,50	0,81	0,54	0,37	0,42	0,26	0,50	0,31	0,51	0,42	0,57	0,19
7	0,52	0,88	0,65	0,53	0,42	0,41	0,00	0,41	0,57	0,88	0,61	0,35	0,42	0,16	0,57	0,48	0,16	0,22	0,59	0,27
8	0,90	0,81	0,47	0,57	0,20	0,00	0,41	0,00	0,50	0,81	0,54	0,37	0,42	0,26	0,50	0,31	0,51	0,42	0,57	0,19
9	0,79	0,32	0,15	0,16	0,69	0,50	0,57	0,50	0,00	0,32	0,04	0,22	0,15	0,47	0,00	0,20	0,51	0,37	0,09	0,39
10	0,99	0,00	0,35	0,37	1,00	0,81	0,88	0,81	0,32	0,00	0,28	0,54	0,47	0,79	0,32	0,50	0,80	0,67	0,29	0,71
11	0,81	0,28	0,16	0,16	0,73	0,54	0,61	0,54	0,04	0,28	0,00	0,27	0,19	0,51	0,04	0,24	0,55	0,41	0,08	0,43
12	0,65	0,54	0,31	0,22	0,52	0,37	0,35	0,37	0,22	0,54	0,27	0,00	0,07	0,26	0,22	0,18	0,31	0,16	0,25	0,20
13	0,67	0,47	0,26	0,16	0,58	0,42	0,42	0,42	0,15	0,47	0,19	0,07	0,00	0,33	0,15	0,17	0,36	0,22	0,18	0,26
14	0,65	0,79	0,51	0,47	0,32	0,26	0,16	0,26	0,47	0,79	0,51	0,26	0,33	0,00	0,47	0,34	0,25	0,21	0,51	0,11
15	0,79	0,32	0,15	0,16	0,69	0,50	0,57	0,50	0,00	0,32	0,04	0,22	0,15	0,47	0,00	0,20	0,51	0,37	0,09	0,39
16	0,83	0,50	0,18	0,30	0,50	0,31	0,48	0,31	0,20	0,50	0,24	0,18	0,17	0,34	0,20	0,00	0,47	0,33	0,28	0,23
17	0,40	0,80	0,62	0,43	0,55	0,51	0,16	0,51	0,51	0,80	0,55	0,31	0,36	0,25	0,51	0,47	0,00	0,15	0,50	0,33
18	0,51	0,67	0,47	0,31	0,52	0,42	0,22	0,42	0,37	0,67	0,41	0,16	0,22	0,21	0,37	0,33	0,15	0,00	0,37	0,23
19	0,74	0,29	0,23	0,09	0,75	0,57	0,59	0,57	0,09	0,29	0,08	0,25	0,18	0,51	0,09	0,28	0,50	0,37	0,00	0,44
20	0,72	0,71	0,41	0,42	0,32	0,19	0,27	0,19	0,39	0,71	0,43	0,20	0,26	0,11	0,39	0,23	0,33	0,23	0,44	0,00
21	0,65	0,77	0,49	0,45	0,33	0,25	0,18	0,25	0,45	0,77	0,49	0,24	0,31	0,02	0,45	0,32	0,25	0,19	0,49	0,10
22	0,71	0,33	0,26	0,05	0,73	0,56	0,55	0,56	0,11	0,33	0,11	0,22	0,15	0,48	0,11	0,27	0,46	0,33	0,04	0,42
23	0,63	0,73	0,47	0,41	0,36	0,27	0,19	0,27	0,41	0,73	0,46	0,20	0,27	0,06	0,41	0,29	0,24	0,16	0,45	0,09
24	0,68	0,59	0,32	0,29	0,45	0,30	0,32	0,30	0,27	0,59	0,31	0,08	0,14	0,20	0,27	0,16	0,32	0,18	0,31	0,13
25	0,81	0,29	0,15	0,16	0,72	0,53	0,60	0,53	0,03	0,29	0,01	0,25	0,18	0,50	0,03	0,23	0,54	0,40	0,08	0,42

Distance matrix calculated on the third and fourth components

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0,00	0,21	0,50	0,28	0,49	0,50	0,28	0,50	0,37	0,21	0,18	0,12	0,20	0,13	0,37	0,25	0,22	0,08	0,28	0,09
2	0,21	0,00	0,36	0,31	0,58	0,66	0,38	0,66	0,29	0,00	0,19	0,14	0,25	0,23	0,29	0,29	0,40	0,13	0,31	0,25
3	0,50	0,36	0,00	0,33	0,94	1,00	0,74	1,00	0,17	0,36	0,55	0,39	0,38	0,58	0,17	0,65	0,72	0,46	0,68	0,58
4	0,28	0,31	0,33	0,00	0,77	0,75	0,56	0,75	0,17	0,31	0,42	0,20	0,08	0,40	0,17	0,51	0,48	0,29	0,54	0,37
5	0,49	0,58	0,94	0,77	0,00	0,28	0,22	0,28	0,84	0,58	0,39	0,59	0,69	0,37	0,84	0,29	0,33	0,50	0,27	0,41
6	0,50	0,66	1,00	0,75	0,28	0,00	0,30	0,00	0,87	0,66	0,49	0,61	0,67	0,43	0,87	0,42	0,28	0,54	0,42	0,42
7	0,28	0,38	0,74	0,56	0,22	0,30	0,00	0,30	0,63	0,38	0,20	0,37	0,47	0,16	0,63	0,12	0,15	0,29	0,12	0,19
8	0,50	0,66	1,00	0,75	0,28	0,00	0,30	0,00	0,87	0,66	0,49	0,61	0,67	0,43	0,87	0,42	0,28	0,54	0,42	0,42
9	0,37	0,29	0,17	0,17	0,84	0,87	0,63	0,87	0,00	0,29	0,46	0,26	0,22	0,47	0,00	0,56	0,59	0,34	0,59	0,45
10	0,21	0,00	0,36	0,31	0,58	0,66	0,38	0,66	0,29	0,00	0,19	0,14	0,25	0,23	0,29	0,29	0,40	0,13	0,31	0,25
11	0,18	0,19	0,55	0,42	0,39	0,49	0,20	0,49	0,46	0,19	0,00	0,22	0,34	0,08	0,46	0,10	0,25	0,13	0,13	0,13
12	0,12	0,14	0,39	0,20	0,59	0,61	0,37	0,61	0,26	0,14	0,22	0,00	0,13	0,21	0,26	0,31	0,34	0,09	0,34	0,19
13	0,20	0,25	0,38	0,08	0,69	0,67	0,47	0,67	0,22	0,25	0,34	0,13	0,00	0,32	0,22	0,43	0,40	0,21	0,46	0,28
14	0,13	0,23	0,58	0,40	0,37	0,43	0,16	0,43	0,47	0,23	0,08	0,21	0,32	0,00	0,47	0,11	0,18	0,13	0,15	0,06
15	0,37	0,29	0,17	0,17	0,84	0,87	0,63	0,87	0,00	0,29	0,46	0,26	0,22	0,47	0,00	0,56	0,59	0,34	0,59	0,45
16	0,25	0,29	0,65	0,51	0,29	0,42	0,12	0,42	0,56	0,29	0,10	0,31	0,43	0,11	0,56	0,00	0,22	0,23	0,03	0,17
17	0,22	0,40	0,72	0,48	0,33	0,28	0,15	0,28	0,59	0,40	0,25	0,34	0,40	0,18	0,59	0,22	0,00	0,27	0,24	0,15
18	0,08	0,13	0,46	0,29	0,50	0,54	0,29	0,54	0,34	0,13	0,13	0,09	0,21	0,13	0,34	0,23	0,27	0,00	0,26	0,12
19	0,28	0,31	0,68	0,54	0,27	0,42	0,12	0,42	0,59	0,31	0,13	0,34	0,46	0,15	0,59	0,03	0,24	0,26	0,00	0,20
20	0,09	0,25	0,58	0,37	0,41	0,42	0,19	0,42	0,45	0,25	0,13	0,19	0,28	0,06	0,45	0,17	0,15	0,12	0,20	0,00
21	0,06	0,18	0,50	0,32	0,46	0,50	0,25	0,50	0,39	0,18	0,12	0,13	0,24	0,09	0,39	0,20	0,23	0,05	0,23	0,07
22	0,03	0,18	0,49	0,29	0,49	0,51	0,27	0,51	0,36	0,18	0,15	0,10	0,20	0,12	0,36	0,23	0,24	0,05	0,26	0,09
23	0,04	0,18	0,49	0,30	0,48	0,51	0,26	0,51	0,37	0,18	0,14	0,11	0,22	0,11	0,37	0,22	0,23	0,04	0,25	0,08
24	0,02	0,22	0,52	0,29	0,48	0,48	0,26	0,48	0,39	0,22	0,17	0,13	0,21	0,12	0,39	0,24	0,21	0,09	0,27	0,07
25	0,15	0,08	0,37	0,24	0,58	0,63	0,38	0,63	0,26	0,08	0,20	0,05	0,18	0,21	0,26	0,30	0,36	0,09	0,33	0,21

Organizational knowledge

Distance matrix calculated on the two components

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0,00	0,18	0,50	0,37	1,00	0,97	0,56	0,97	0,43	0,18	0,32	0,43	0,24	0,77	0,43	0,54	0,43	0,74	0,35	0,6
2	0,18	0,00	0,32	0,22	0,94	0,94	0,51	0,94	0,26	0,00	0,27	0,33	0,20	0,65	0,26	0,47	0,42	0,59	0,37	0,5
3	0,50	0,32	0,00	0,17	0,82	0,87	0,48	0,87	0,09	0,32	0,35	0,28	0,36	0,43	0,09	0,41	0,48	0,34	0,50	0,4
4	0,37	0,22	0,17	0,00	0,75	0,78	0,36	0,78	0,09	0,22	0,18	0,15	0,20	0,43	0,09	0,30	0,33	0,38	0,33	0,3
5	1,00	0,94	0,82	0,75	0,00	0,14	0,44	0,14	0,78	0,94	0,68	0,61	0,76	0,42	0,78	0,47	0,58	0,54	0,67	0,4
6	0,97	0,94	0,87	0,78	0,14	0,00	0,43	0,00	0,82	0,94	0,67	0,63	0,75	0,51	0,82	0,48	0,54	0,63	0,63	0,4
7	0,56	0,51	0,48	0,36	0,44	0,43	0,00	0,43	0,42	0,51	0,24	0,21	0,32	0,34	0,42	0,08	0,14	0,40	0,24	0,1
8	0,97	0,94	0,87	0,78	0,14	0,00	0,43	0,00	0,82	0,94	0,67	0,63	0,75	0,51	0,82	0,48	0,54	0,63	0,63	0,4
9	0,43	0,26	0,09	0,09	0,78	0,82	0,42	0,82	0,00	0,26	0,27	0,21	0,28	0,42	0,00	0,35	0,40	0,35	0,41	0,3
10	0,18	0,00	0,32	0,22	0,94	0,94	0,51	0,94	0,26	0,00	0,27	0,33	0,20	0,65	0,26	0,47	0,42	0,59	0,37	0,5
11	0,32	0,27	0,35	0,18	0,68	0,67	0,24	0,67	0,27	0,27	0,00	0,13	0,08	0,46	0,27	0,22	0,16	0,46	0,15	0,2
12	0,43	0,33	0,28	0,15	0,61	0,63	0,21	0,63	0,21	0,33	0,13	0,00	0,20	0,34	0,21	0,15	0,21	0,33	0,25	0,1
13	0,24	0,20	0,36	0,20	0,76	0,75	0,32	0,75	0,28	0,20	0,08	0,20	0,00	0,54	0,28	0,30	0,21	0,52	0,17	0,3
14	0,77	0,65	0,43	0,43	0,42	0,51	0,34	0,51	0,42	0,65	0,46	0,34	0,54	0,00	0,42	0,28	0,46	0,12	0,54	0,2
15	0,43	0,26	0,09	0,09	0,78	0,82	0,42	0,82	0,00	0,26	0,27	0,21	0,28	0,42	0,00	0,35	0,40	0,35	0,41	0,3
16	0,54	0,47	0,41	0,30	0,47	0,48	0,08	0,48	0,35	0,47	0,22	0,15	0,30	0,28	0,35	0,00	0,18	0,32	0,27	0,0
17	0,43	0,42	0,48	0,33	0,58	0,54	0,14	0,54	0,40	0,42	0,16	0,21	0,21	0,46	0,40	0,18	0,00	0,49	0,09	0,2
18	0,74	0,59	0,34	0,38	0,54	0,63	0,40	0,63	0,35	0,59	0,46	0,33	0,52	0,12	0,35	0,32	0,49	0,00	0,56	0,2
19	0,35	0,37	0,50	0,33	0,67	0,63	0,24	0,63	0,41	0,37	0,15	0,25	0,17	0,54	0,41	0,27	0,09	0,56	0,00	0,3
20	0,61	0,51	0,40	0,32	0,43	0,46	0,14	0,46	0,36	0,51	0,28	0,18	0,36	0,21	0,36	0,07	0,25	0,26	0,34	0,0
21	0,60	0,48	0,33	0,28	0,49	0,54	0,22	0,54	0,29	0,48	0,29	0,17	0,36	0,17	0,29	0,13	0,31	0,19	0,38	0,0
22	0,17	0,18	0,41	0,25	0,83	0,81	0,38	0,81	0,33	0,18	0,15	0,27	0,07	0,61	0,33	0,37	0,27	0,59	0,20	0,4
23	0,70	0,59	0,41	0,38	0,41	0,48	0,25	0,48	0,38	0,59	0,38	0,26	0,46	0,09	0,38	0,19	0,37	0,17	0,45	0,1
24	0,56	0,46	0,35	0,26	0,49	0,52	0,16	0,52	0,30	0,46	0,24	0,13	0,32	0,23	0,30	0,07	0,24	0,25	0,32	0,0
25	0,29	0,18	0,25	0,09	0,76	0,77	0,34	0,77	0,17	0,18	0,12	0,15	0,11	0,48	0,17	0,29	0,27	0,44	0,26	0,3

Legenda

1	AMZ Saxony	7	Automotive	13	51-100	19	wid_light_int
2	ValVibrata	8	Film and ICT	14	more than 100	20	mail_intra
3	Verona shoes	9	Footwear	15	hpf	21	mail_inter
4	Montebelluna	10	clothing	16	mpf	22	non_digital
5	Westmidlands	11	1-20	17	lpf	23	intradigital_interf2f
6	Scottish ICT	12	21-50	18	wid_fdi	24	trad_inter_org

[i] Please, note that CMC familiarity does not coincide with the possession of CMC equipments, but instead it refers to the actual use of CMC. I believe that this criterion is better, because some firms can have a number of personal computers, but they do not use them for communication or information systems management.