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SOCIAL, COGNITIVE AND TECHNICAL ASPECTS OF NETWORK TECHNOLOGIES DIFFUSION IN INDUSTRIAL DISTRICTS

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ABSTRACT

The aim of this paper is to investigate the relationship that occurs among network technologies and localised industrial networks of firms such as industrial districts. Industrial districts (IDs) are a typical Italian industrial feature and can be defined as regional hyper-networks, that is networks of inter-organizational networks located in a defined territory. These networks are multidimensional in the sense that district actors (small and medium enterprises, associative structures and local institutions) interact each other at economic, social, cognitive and symbolic level, by creating dense and recursive patterns of interaction. In spite of the apparent fitness among the networked district model and the networking potentiality of new technologies, data collected by Federcomin and TeDIS Center highlight ambiguous trends in the adoption of network technologies by district firms. The paper aims to analyze reasons underlying this evidence by emphasizing challenges and opportunities offered by new technologies to district firms. This paper is the output of my preliminary scouting activity in the field made in order to build a framework for my Ph. D. dissertation on knowledge transfer mechanisms through networked technologies inside industrial district.

1. INTRODUCTION

With the introduction of network technologies and the globalisation of markets, the business model of small and medium enterprises (SMEs) is developing within the ambit of a global competition scenario that involves new opportunities and challenges. Information and communication technologies constitute an efficient means through which it is possible to improve communication flows and increase the creation and sharing of knowledge among firms.

In the Italian industrial scenario, the industrial district constitutes a peculiar model of production deeply rooted on the social context. As a matter of fact, the district is a socio-territorial entity which is characterised by the active presence of both a community of people and a group of firms in a naturally and historically delimited area (Becattini, 1990). Therefore, the territory represents not only a whole of physical factors but mostly a socio-economical and cultural environment, which becomes a necessary infrastructure of communication upon which district relations are based (Micelli and Di Maria, 2000). Some of the main features of the district are the capacity for innovation and the flexible structure of production and work flows. In such a reality, tacit knowledge seems to represent the central resource upon which the competitive advantage of the district itself is based (Belussi, 2000) but the relation between this type of knowledge and the new technologies remains unanalysed. Empirical evidence has shown that district firms are not capable of fully exploiting the advantages and opportunities offered by network technologies that are geared towards supporting their competitive advantages and increasing their resources' value (Micelli and Di Maria, 2000).

Data published by Federcomin and the TeDIS¹ Observatory in the first few months of 2001 evince that district firms have not adopted—at least not more than in a marginal manner—the so called “project technologies” that is the most advanced or complex technologies from the point of view of networking, while they have internalised the *easiest* technologies such as e-mail or the creation of a web site (the so called “package technologies”). Furthermore, the research highlights the lack of a common strategy between district firms in the adoption of new technologies.

This paper intends to illustrate the present situation of the diffusion of network technologies in the Italian industrial districts, highlighting the challenges and opportunities offered by new technologies to district firms in terms of facilities regarding communication and knowledge flows. Moreover, the causes of this difficult union between district firms’ networks and new technologies will be analysed under the Innovation Diffusion Theory (Rogers, 1983) framework.

2. THE CONCEPT OF INDUSTRIAL DISTRICT

It is difficult to propose a model of the Italian district reality given the variety of organisational and relational forms that exist in the diverse districts present in the territory. However it is possible to single out some salient features that have characterised the districts since their phase of development in the seventies.

From a structural point of view, the industrial district can be considered as a network of institutions, associations and small and medium enterprises located in a determined geographical area and normally characterised by a high capability for innovation and self-organisation (Biggiero, 1998). This definition particularly underlines the dimensional aspect of district firms, which are closely interconnected among themselves through vertical and horizontal networks. The district itself as a whole can be considered as a hyper-network, composed of a network of other networks (Biggiero, 1999) that tie the firms between themselves and to the institutions (public bodies, professional associations, trade unions, etc.). Inside the ID, Biggiero (1999) identifies three levels of multidimensional patterns of interaction: at the first level, we find networks of firms composed by SMEs – that are the most part of district firms – and by leading firms – that can be multinationals or bigger sized firms or innovative SMEs. A second level of interaction is individuated in relationships that occur among these firms and associative structures such as consortia, trade associations and real services providers. The third level of interaction involve district firms, associative structures and the local institutions such as municipalities, provincial and regional governmental institutions, schools and universities, banks or other financial service providers. The multidimensionality of those networks resides in the different layers on which relationships occur. Indeed all the actors listed above interact each other at economic, social, cognitive and symbolic level, by creating dense and recursive patterns of interaction.

From a relational point of view, and according to the Marshallian classic model, one can evince many of the distinctive traits of the industrial district as a model of socio-economic organisation (Marshall, 1952; Becattini, 1989,1990; Biggiero, 1998, 1999; Lipparini and Lomi, 1996; Trigilia, 1990). The industrial district is defined as “a socio-territorial entity which is characterised by the active presence of both a community of individuals and a population of firms in a naturally and historically bounded area” (Becattini, 1990, p.39). Particularly, the expression “community of individuals” makes explicit reference to the internal social structure of the district. Such structure is reinforced by a homogeneous system of values diffused within the district, invigorated by daily interaction and transmitted from generation to generation thanks to a “system of institutions and rules” (*ibid.*) (firms, spread families, technical schools, churches, political parties, etc.). The expression “population of firms,” instead, regards the economic aspects of the district’s reality and identifies a spatial concentration of numerous small and medium firms in a geographically delimited area (Paniccia, 1998).

The salient traits of the district structure are mainly caused by the territorial localisation that characterises the district itself: the fact of living in an area which is naturally and historically bounded

¹ Federcomin is the national federation of enterprises operating in telecommunication and information technology sectors.
TeDIS is the Center for Studies on Technologies in Distributed Intelligence Systems of the Venice International University (Italy)

has led to development, and it is, in turn, a product of a common culture, a sharing of codes and values that is reinforced by continuous interaction over time. The expectations of interaction repeated in time and space also favour the creation of mechanisms of identification of the firms with the district (Sammorra, 2000; Sammarra and Biggiero, 2001) which constitute a fundamental antecedent for the dynamics of co-operation, reciprocity and trust that characterise the relations between the firms within the district.

The economic environment of a district as a “population of firms” geographically adjacent also presents peculiar features. First, within the district a radical fragmentation of the value chain takes place. Brusco (1990) underlines that generally, there is a vertical division of work rather than horizontal, which favours the appearance of peculiar dynamics such as a vertical co-operation joined with a horizontal competition although the latter is also characterised by the main common interest, that is, the survival of the district. In this kind of environment, the fact that the division of work between firms prevails over the division of work within the single firm reinforces the reciprocal interdependence of organisations and favours the perception of the local industry’s peculiarities, and particularly, of the human capital, which is requested and developed as if it were common property. This also favours the expectations of long time collaborations between district firms and therefore a reduction of opportunistic behaviours. Second, the fragmentation of the productive system leads to a high degree of specialisation in the single phases of production and to high flexibility and capability of adjustment to the market’s requests (Piore and Sabel, 1984), which has determined the success of the district model in the Italian economy in the latest few decades.

Another important feature of the Italian district model is the manner in which districts create, accumulate and spread knowledge (Becattini and Rullani, 1993; Corno, Reinmoeller and Nonaka, 1999). Most of the knowledge that circulates within the districts have a tacit nature, deeply tied to the experience of individuals that are in the centre of the production dynamics (Micelli, 2000). Therefore one can talk about contextual knowledge (Belussi, 2000; Amin and Cohendet, 1999) meaning the collective result of a slow process of knowledge creation, experimentation, know-how, interpretation and transposition of abstract knowledge. This type of knowledge develops from the continuous interaction in the work place, from repetitively carrying out the same activities over time and from facing the same environmental complexities. Consequently, firms are deeply rooted on the territory and the territory supplies, in this context, a real self communicative infrastructure since it puts together a whole of specific languages and local culture that constitutes the base of the district (Micelli, 2000).

The process of innovation within the districts is therefore strongly influenced by the structure of the district from the economic point of view (flexibility and high specialisation) and mostly from the relational point of view, which makes it a collective phenomenon “that is realised through a social process of diffusion that is centred in the sharing of the same social environment” (Micelli, 2000, p. 162).

3. NETWORK TECHNOLOGIES AND THE DISTRICT MODEL

The diffusion of new technologies, generically grouped under the label of information and communication technologies, has brought about the necessity of a overall revision of business models, not only for big firms, but also for small and medium ones, to be able to handle the market globalisation and thus to face global competition rather than local. Technologies make an impact on both the business processes and the communication flows and they tend to put down geographic boundaries and to eliminate the confines of the same organisations choosing solutions such as integrated value chains between providers and customers or virtual organisations. This heterogeneity of possible solutions involves an infinite variety of technologies, from ERP systems to e-mail, EDI protocols, web sites, intranet and vertical and horizontal portals. The common aim of these technological solutions is to offer support to the development of distributed business models and to the reticulation of organisations both internally and with competitors or partners.

The industrial district is a perfect example of *network without technologies* (Micelli and De Pietro, 1997), a case in which the network, both of economic and social relations exists leaving aside technologies and it is even the source of competitive advantage of local systems of production. The

problem now is to investigate if and how network technologies can integrate or substitute the relational schemes within the industrial districts. Two scenarios have been prefigured in the latest few years (Micelli, 2000): on the one side, technologies could substitute the territory both regarding the system of market transactions and the access to knowledge and its diffusion. Therefore, new models of co-ordination would appear and the district dynamics to better exploit the opportunities offered by new technologies would be redefined. The second scenario, instead, foresees technologies as a support, and eventually as a reinforcement, of the structure of social relations already consolidated in the district and that has determined the success of the district model within the Italian and the international competitive scenarios. Next it will be seen how the tendency of Italian districts is to go towards the realisation of the second alternative, although with many obstacles.

3.1. The diffusion of network technologies in the districts

The surveys 2000 in the TeDIS Observatory have involved 33 industrial districts belonging to the Italian regions that are most characterised by this model of economic development: the North East, Lombardy, Emilia Romagna, Piemonte, Tuscany and Marche. The districts have been selected among the three most significant “made in Italy” fields: fashion, house furnishing and mechanical design and installation. Among the data withdrawn from the survey, the most relevant is the confirmed distrectual firms’ tendency to export: over 40% of the contacted firms produces at least half of the turnover for the foreign markets and less than 10% operates solely for the national market, while all the firms declare to have established collaborative relations with their customers. In such scenario, the data that regard the adoption of computer technologies appear to be a little counter intuitive in the sense that collaborative technologies that favour inter-firm relations are the least diffused. As a matter of fact, the most complex instruments, those that involve high investments and a clear projection, such as ERP, videoconferences, EDI and groupwares have still not been widely adopted, although there are substantial differences if one analyses data in terms of activity sectors. In the mechanical sector, for instance, this kind of “project” technologies are more consistently adopted but this is a logical result considering that the activity is tied to big customers, mostly in the automobile and white domestic appliances sectors.

Instead, technologies that are easy to adopt and use (the so called “package technologies”) such as e-mail and web sites are widely diffused. 93% of the firms uses e-mail frequently, not only in their external relations but also in the internal ones. Also the web site (both in individual and collective forms, that is, as category and consortia associations) is acquiring such diffusion (69.9%) that it has already become a commodity. But the functions offered by the website are not fully exploited by district firms: only 1.3% of the firms makes on-line sales (e-commerce). If web sites are unanimously considered as a new and important tool to interact with the market and the customers, and they are trusted for functions such as the collection of information and relations with the value chain, e-commerce is instead considered not apt for the specificity of the firms and the kind of products they make.

The reluctance to adopt e-commerce is easy to explain if one considers the peculiarities of district firms: small and medium firms that have developed highly specialised competencies and have built their own competitive advantage upon flexibility and their capability of product customisation, establishing close contacts with the customer. Through e-commerce the direct contact with the customer is in a great part lost and thus also part of the added value that the district firm contributes to the product/service it offers.

The Federcomin Report (2001) about digital districts examines 51 consolidated and emerging districts spread all over the country and it makes a slightly different analysis in respect to the one made by the TeDIS Observatory: it focuses on the presence of common initiatives organised by district firms to constitute a real digital self district comparable to the virtual marketplaces. Data from this study are partly different than the TeDIS ones, perhaps due to the inclusion of districts recently created and located in the South of Italy that reflect a tendency to be less familiar with technical innovation if compared to the national average. In any case, Federcomin data confirm a broad e-mail diffusion in

59% of the local systems of production, the presence of web sites shared among firms in 30% of the districts and the existence of *window-portals* both for the firms and the territory.

A particularly significant point in the Federcomin Report is the fact that in only 4% of the districts, the existence of a common strategy towards the digitalisation of the districts is perceived. In the rest of cases, there are isolated phenomena brought forth by single firms that create a diffusion of technologies by spots.

4. THE REASONS FOR THE RESISTANCE TO INNOVATION

Data from the studies presented lead to a series of reflections about the relation between districts and network technologies: on the one side, there is an increasing interest towards new technologies, although, at present, only to facilitate communications. But the real added value of the bond between both realities will be verified only when information and communication technologies will become a real support to the business model of district SMEs. At the moment, however, as indicated by the reluctance towards complex technologies, the road is still long, as can be explained using the interpretive framework supplied by both the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975) and the Innovation Diffusion Theory (IDT) (Rogers, 1983; Knol and Stroeken, 2001) about the formation of attitudes towards the innovation and the role of these attitudes in the innovation process itself. In particular, Karahanna and her colleagues (1999) have focused on the identification of the pre-adoption dynamics that influences the agents decision whether to adopt or not the new technology. As empirical evidence suggests, the adoption of new technologies by district firms is in an early stage, that is, those firms are at the beginning of the innovation decision process (Karahanna *et al.*, 1999) on the convenience of adopting new technologies. Those firms are then in the very sensitive phase of forming their attitudes and beliefs towards the introduction of the innovation in their business activities.

The evidence of Italian IDs confirms Klongan and Coward's (1970) hypothesis that sociological variables may be more important in explaining mental acceptance of innovation, whereas economic variables may be more important in explaining the use of innovation.

Within IDs, indeed, the social, historical and cultural background has a strong impact on the firms' inertia in adopting new technologies, and the economic evaluation of this issue appears not to be so relevant at this stage.

Two main reasons can be identified in order to explain this inertia towards innovation within IDs: first it is evident how district firms show a strong will to keep the relational social and economic structure alive, which has marked the success of the districts through the years, but this position leads to a rigidity from the point of view of the definition of requirements for demand of services and technological products. The district structure seems not to model itself to better exploit new technologies, thus evincing profound discrepancies with the tendencies induced by the so called "new economy." If on the one hand the introduction of new technologies leads to a discontinuity of the business model as an effect of the new available tools, on the other hand, this tendency collides with the firms' strong will to maintain unchanged the business model that has been successful to date.

Under a cognitive point of view, this situation is fully coherent with Gioia's (1986) statement about the rigidity of actors' mental models especially if those model have successfully been applied in order to interpret to the real world for decades.

As Weick (1990) points out actors' attitudes towards new technologies adoption strongly depends on the comparison between actors' mental model about the "right" way to perform their work and the actors' mental model on how information technologies will allow them for performing the work in a new way. If these models are divergent, as they appear to be within IDs, the inertia to change emerges.

Furthermore, the prospective of computerisation reasonably involves investments for projects of radical type, while district SMEs show a predilection for changes, and therefore investments, of incremental type. Also the focus is different. The information systems focus a great deal on transactions and emphasise the technological integration while the crucial point for districts is the maintenance of an interactive and dynamic communication model such as face-to-face with much attention to the contents of communication itself. From these reflections it is clear that the problem lies on a missing encounter between demand and offer. After having underestimated for long the specificity of the Italian productive context, the technology providers have started to propose *ad hoc*

solutions not coming from the downsizing of packets developed for big firms, but studied specifically to meet the requests of a more exigent and concrete demand.

Second, the data collected by Federcomin show that the introduction of new technologies in the light of integration at district level brings into light a problem that has always been present in the Italian districts: the balance between competition and co-operation (Staber, 1998). In 52% of the local systems it is hard to share information with the competence and firms fear, if they introduce shared technologies, to lose their autonomy in the management, which is considered to be necessary to preserve the flexibility that characterises the district productive model. The new technologies are then considered as factors that can upset the regular competitive relations within the district dimension reducing advantages to the firms. The use of common technological platforms and the sharing of information represent a problem not only because these could be advantageous for the competitors but also because the firm would risk losing its own managerial autonomy, transferring it to heterodirect working models (Federcomin Report, 2001) imposed by the technological platform or, in the worst hypothesis, by strong competitors or providers and customers that may impose organisational changes. Therefore, the choice to start common initiatives where the normal co-operative dynamics within the district are not enough depends mainly on the presence of a strong firm in the territory that operates with a district logic² or that strongly and explicitly depends on the commitment of part of the local institutions working as catalysts and promoters of the innovation itself. In IDT's terms, local institutions and leading firms should enhance the social communication of the perceived benefits of new technologies in order to push ahead the innovation diffusion process.

The role of institutions is central also to confront another problem that emerges from the Federcomin study: the difficulty of finding qualified human resources, which is a serious obstacle for the development of innovation. Skill shortage is a relevant problem for the industrial districts but it seems that firms are not disposed to take responsibility in formation; in such context the role of institutions acquires fundamental importance to cover this lack.

4.1. Contextual knowledge and network technologies

The distrust shown by district firms towards the adoption of new technologies also leads us to reflect about problems regarding the possibility of transferring the contextual knowledge to the technological platforms since such knowledge, as we have seen, is the real engine of innovation within the districts. It is evident that knowledge transferred through information and communication technologies is explicit and codified (Nonaka and Takeuchi, 1995; Howells, 1996; Borghoff and Pareschi 1997; McDermott, 1999; Johannessen et al., 2001): it is information that is then “decodified” and interpreted through the cognitive structures of the diverse receivers (Bolisani and Scarso, 1999) to finally flow into their knowledge background. But the whole thing becomes more complicated if the knowledge to be transferred is tacit, like contextual knowledge, deeply tied to the territory in which it is produced and exchanged and to the relational context on which it leans. These type of limits of the technologies are easily evinced if one reasons in terms of manners and means through which this type of knowledge is transmitted (Muzzi and Dandi, 2001). The main knowledge transmission mechanisms within the districts are the informal communications between experts and people who are familiar with such knowledge from working with it, the mobility of workers between different district firms and the spin-off phenomena that generate new firms from the breaking up of bigger firms and the initiative of

² This solution refers to a model of evolution in the districts that locates the engine of development and innovation in the role of the leading firm (Corò and Grandinetti, 1999). This field of research investigates how “endogenous and hermetic” communities (Lazerson and Lorenzoni, 1999, p.362), that are apparently closed to new ideas and information, such as the industrial districts from the classic point of view, can avoid economic breakdown. According to Boari and Lipparini (1999) the enterprises within the district are heterogeneous and not interchangeable in terms of roles and duties (Lipparini, 1995); some firms can build and manage wide and differentiated relation networks with other firms (Lorenzoni and Baden Fuller, 1995) and the district is mainly seen as the product of the dissemination of technologies and knowledge of bigger firms (Lazerson and Lorenzoni, 1999).

former workers of such bigger firms. All these phenomena are based and, in turn reinforced, on the dense relational network within the local system, founded on common trust, culture and identity.

The chances of knowledge transfer offered by network technologies, such as the sharing of on-line best practices, the creation of virtual communities (Micelli, 2000), the creation of databases for the access to on-line curricula, or the various modalities of e-learning seem to be insufficient to grasp the real essence of the knowledge generated within the district. The exchanged know-how working side to side, the trust developed working face-to-face and the reliability generated through informal verbal exchanges are left out (Rullani, 2000).

Therefore, it seems that the actors that operate within districts have a clear perception of the limits imposed by network technologies and their distrust in this context seems to be a justified precaution against a whole of “poor” means of communication in relation to the district network’s richness.

Nevertheless, Johannessen and his colleagues (2001) argue that the only way to fully exploit Information Technologies (IT) potential in transferring and creating knowledge within a community is by making explicit tacit knowledge through trust and relationship building process. This statement, while confirming that only explicit knowledge may be transferred through IT, opens some challenges quite interesting for IDs. Among district firms, the relationships do exist at different levels (see § 2) but, until now entrepreneurs have been mistrustful of the role of network technologies within their social network.

In my view the problem is twofold and should be addressed in two steps. The first problem is the “natural” distrust of district entrepreneurs towards new technologies, and particularly towards their role in supporting, or substituting, the network of social and economic relationships that already exists within each district and that allow for the tacit knowledge transfer. Only after having “educated” Italian district entrepreneurs to deal with network technologies and to fully understand their potential, the second problem could be addressed. This issue emerges from Johannessen’s proposal to explicit tacit knowledge: within IDs, this process is strongly related to the district firms’ willingness to co-operate. Staber (1998) addressed the issue of balancing co-operation and competition within IDs and in a recent study (Staber, 2001) he demonstrates that a co-operative attitude among district firms increase the performance of the co-operative firm. In this perspective, the introduction of network technologies may constitutes an opportunity to develop firms’ co-operative attitude.

Furthermore, in order to attribute to district’s social network the relevance it requires, some appealing solutions could be the implementation of computer supported social networking tools. Those tools, developed mainly in the CSCW research studies, by tracing the personal networks, allow people to be aware of who knows what about a particular problem and help them to find out the faster and easier solution³. In this case, even if the tacit knowledge one holds on a problem might remain tacit, at least the process of acquiring knowledge is made explicit and the co-operation is enhanced.

5. CONCLUSIONS

The analysis of data collected by the TeDIS Observatory and the Federcomin indicates an ambivalent attitude of the Italian district realities towards the adoption of network technologies.

If on the one hand, district SMEs are up to date in the use of simple technologies demonstrating an understanding of the possibilities offered by new technologies as a support to their opening towards a global market, on the other hand they also show an evident distrust towards more complex and “radical” technologies. Even e-commerce has no success in the district context, mostly because of the missing direct interaction with the customer, which is fundamental in the district business model.

Research on the topic shows that the main obstacle for a diffused adoption of network technologies is the perception that such technologies cannot express and reproduce the richness and complexities of the district’s organisational network upon which the competitive advantage of these systems of production leans. This richness can be understood both from the point of view of the relations among district members and that of the means through which their knowledge is transmitted. By the same token, the adoption of shared technologies is perceived as a threat for the autonomy of the single firm.

³ PeCo-Mediator-II (Ogata et Al., 2001) and IKNOW (Contractor et al., 1998) are some examples of those tools.

It also seems that the opportunities offered by these technologies to strengthen the territory and reinforce the district's identity both externally and internally slip the local productive realities. In such a context it is fundamental that the institutions or the bigger and more technologically advanced firms make an effort towards the creation of a "technological culture" that can put together the exigencies and peculiarities of district firms and the opportunities offered by new technologies, reconsidered in an "intelligent" manner by the providers of products and technological services.

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