

NETWORK TECHNOLOGIES AND LOCAL NETWORKS: EVIDENCE FROM A THREE YEAR SURVEY IN NORTH EAST ITALY

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1. INDUSTRIAL DISTRICTS AND ELECTRONIC NETWORKS: A POSSIBLE CONVERGENCE?

Industrial districts represent the specific Italian model for economic development, which distinguishes Italy from other countries and organisational forms such as large firms (Piore and Sabel, 1984; Pyke et al., 1990; Porter, 1998). Industrial districts SMEs competitiveness, based on a high level of specialisation, flexibility, and informal management of business relations, led to the well known success of Italian products throughout the world. The economic success of these economic systems has resulted from the broad influence of the territory with its social and cultural features on the economic dynamics as well as on competitive advantages, even outside Italy (Porter, 1998).

Despite SMEs' positive results in international markets, globalization trends as well as the recent rise of network technologies such as Internet push even those local networks to transform their business models, but it is still not completely clear what the implications of ICT will be.

Up to now, in fact, researchers have dedicated their attention to the relationship between technologies and organisations mainly from the perspective of large firms (i.e.; Porter and Millar, 1985; Fulk and Steinfeld, 1990; Sproull and Kiesler, 1991; Bradley et al., 1993; Venkatraman, 1994); either technological products and services have been focused on large companies, in particular to satisfy big firms' needs in terms of co-ordination and process efficiency.

In recent times, thanks to the evolution of network technologies and the decrease in transaction costs due to ICT, technology providers have developed innovative solutions for SMEs as regards communication and the management of business processes outside the district. From this perspective, SMEs could refer to a completely different way of doing their business, where the advantages of the local embeddedness such as informal exchanges could be overcome by the benefits of electronic marketplaces (Malone et al., 1987, 1989; Malone and Rockart, 1991; Rayport and Sviokla, 1994; Bakos, 1991; Benjamin and Wigand, 1995; Malone and Laubacher, 1997).

Despite the interest for the transaction cost theory, Italian scientific literature has adopted a completely different perspective. The focus on the impact of ICT on local SMEs networks more broadly concerns how innovation and knowledge management processes are developing after the introduction of electronic networks.

However, in order to understand the real impact of network technologies on the district model, we have to look at the different kinds of technologies that refer generically to the domain of ICT in more

detail. More specifically, it is possible to identify a variety of technology applications aimed at sustaining specific information or communication processes, which may have different implications for SME strategies and district evolution.

We argue that the great variety of ICT solutions, applications and platforms available on the market, can be classified into three main categories, according to the level of codification of the business processes supported by them (Micelli, 2000):

- 1) *enterprise computing solutions*, that support codified information management and processes, where the most innovative and revolutionary systems are ERP (Enterprise Resource Planning) ;
- 2) *computer-supported co-operative work (CSCW) solutions*, aimed at facilitating the co-ordination and collaboration of people within and among organisations (i.e. groupware);
- 3) *Web-based applications*, such as multimedia tools or other applications that support interactive rich communication processes on the Web, based on Internet universal and open protocols.

Information technologies such as ERP systems improve firm efficiency through high quality data management related to structured and codified processes. In addition, firms can gain effectiveness in managing distributed work through electronic solutions (groupware), which are able to sustain co-operation and co-ordination at a distance. Communication technologies such as the Internet and the Web are a powerful tool to provide firms with rich interactive *on line* environment, where content publishing as well as interaction are supported by multimedia solutions.

The classification shows that expectations regarding the *new economy* relate particularly to a reduction in transaction costs based on more efficient information processes carried out through Internet and significant advantages resulting from the electronic management of exchanges (electronic commerce) (Kaplan and Sawhney, 2000). However, as regards organisations where business relationships and manufacturing processes are based on rich interaction and collaboration among local players, such as industrial districts, it should not be taken for granted that SMEs' interests in using electronic networks should only be limited to sustaining transaction processes through on line platforms. Rather, as each kind of technological solution is targeted to specific business processes and activities, we should study SMEs' alternative uses of technology more closely to produce a more comprehensive framework of the effects of ICT on industrial districts.

Although information and communication technologies (ICT) have been considered innovative tools able to redesign sources of firms' competitiveness, nevertheless the paths of ICT adoption within district SMEs are still difficult to predict. In order to analyse the diffusion model and the impact of electronic networks in redefining the district model and how SMEs are exploiting opportunities arising from ICT potentials we will present the results of a survey carried out for three years in the most important 12 industrial districts of North East Italy aimed at analysing trends of diffusion of ICT within networks of SMEs; the results of these surveys are particularly interesting because they cover the most important years involved in the rise and fall of the new economy paradigm.

2. ICT ADOPTION WITHIN INDUSTRIAL DISTRICTS: THE CASE OF NORTH EAST ITALY

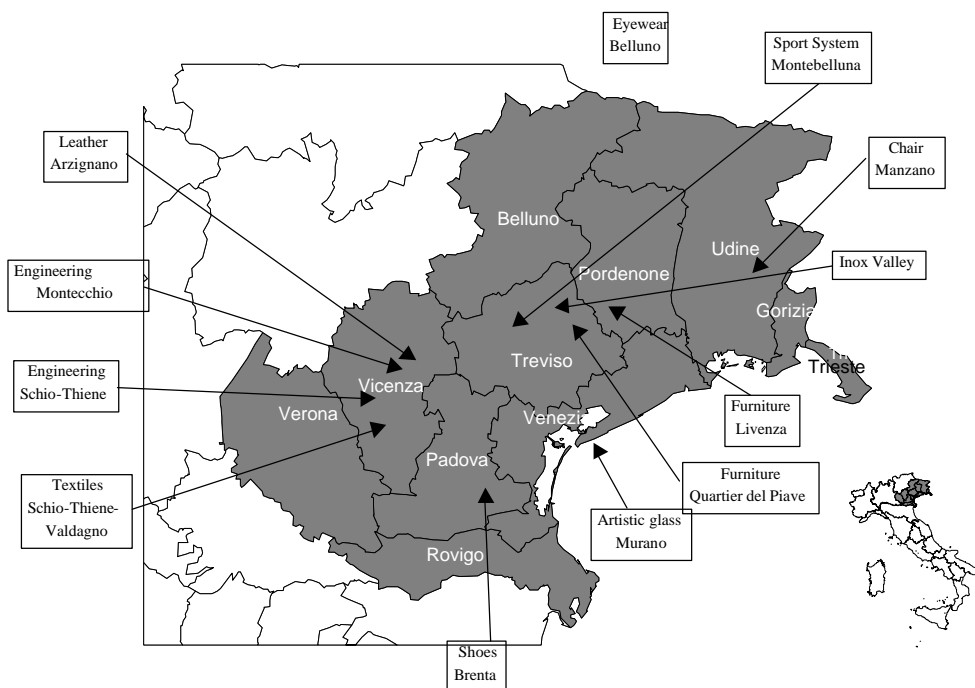
In order to provide a complete picture of the relationships between the business and organisational model of industrial districts, its evolution and ICT, in 1999 the TeDIS Center¹ launched an annual survey aimed at studying the coherence between economic and technological variables of the district path of development in order to understand the diffusion of ICT solutions among SMEs and to outline alternatives for policy concerning technological innovation in local systems (Micelli and Di Maria, 2000).

¹ TeDIS is the Center for Studies on Technologies in Distributed Intelligence Systems of the Venice International University (<http://www.viu.unive.it/tedis>).

The survey since the beginning has had a special focus on the North East Italy, an area where the industrial district model has been particularly successful; in fact, even if the most traditional country of industrial districts is Tuscany, with the Prato textile district, in North East the business model based on local production systems is at the base of the success of some productions, like eyewear, high quality shoes, chairs, sportswear, textiles, that gave a large - and commonly recognised - contribution to the diffusion of the made in Italy throughout the world. Over the time the survey has covered the whole Italy, involving 33 industrial districts in 2000.

Empirical evidence discussed in the paper refer to the three surveys carried out from 1999 to the end of 2001² in 12 industrial districts of North East Italy belonging to the three main macro-industries of the Italian economy: home furnishings (furniture, glass, ceramics), engineering, fashion (textiles, eyewear, shoes, and sportswear) (fig. 1).

Figure 1. The map of the 12 industrial districts



Data refer to 207 firms, that are the companies that participated to all the three surveys: in the 1999, the survey was conducted on all the companies that had a turnover of over 10 billion Lire in 1996 (5,164.57 Euro); the following editions of the survey maintained the same database, without additions, in order to measure real trends, attributable to a change in the firms behaviour, not in the firm number or composition.

The sample was composed of typical medium-sized, industrial district firms, with an average turnover of 37,7 billions lire in 2000 (the last survey was conducted in 2001, before Euro) and 95,1 employees on average. The majority of firms had a turnover of under 50 billion Lire (81,9%) and about 69,5% of the firms employed less than 100 employees. 42,0% of firms belongs to an industrial group, the organisational solution that many SMEs adopted to grow without losing advantages of small size such as flexibility and informality in internal and external relations.

² If not specified, the general discussion of data is referred to evidence of 2001; in these cases the comparison with the previous researches is not significant.

48,8% of firms belong to the home-furnishing industry, 30,0% to the fashion one and 21,3% to the engineering sector. They mostly produced finished products for the market (62,8%) and finished products for other manufacturers (21,7%), while only a small percentage of the firms was involved in the production of semi-manufactured products and components (11,6%) or work on behalf of other firms (3,9%). SMEs' customers are mainly wholesalers and retailers (60,2%) or manufacturing firms (35,9%), while few district firms sell directly to final customers (3,9%); customer relations with manufacturing firms, are collaborative in the majority of the cases.

As far as it concern the organisation of production, firms participating in our survey systematically outsourced manufacturing activities (about 91,8% of the firms). The supply chain is still rooted in the local system: for 58,8% of the firms interviewed the district area is regarded as the main location of strategic subcontractors. The strong embeddedness of supply relationships in the district system is counterbalanced by the remarkable successes obtained in the international markets. 43,6% of the firms made half of their turnover abroad, while only 4,5% sold only to the Italian market. In order to reach national and international markets, they rely on a wide network of sales agents (87,4%), commercial infrastructures and partnerships. Particular attention is placed on types of distribution that allow for a better and more direct control over information and knowledge related to the final markets.

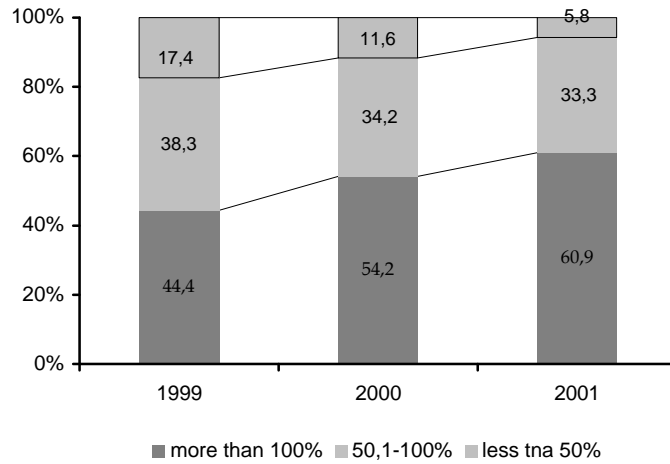
To sum up, evidence from the survey confirms that SMEs located in industrial districts apply an innovative business model based on extensive outsourcing, where the *network-based model of governance* refers to the *local territory*. If we focus on sales, we can say that industrial districts are internationalised. However, when we analyse the geographic location of manufacturing partners districts appear to be still rooted locally. Hence, despite trends towards globalisation, that are always more evident, the *local system* is still a source of competitive advantage for SMEs and a strategic resource as a supplier of specialised knowledge and competencies.

3.1 Network technologies beyond the new economy

In the previous section we outlined three categories of technological solutions, according to the level of codification of the business processes supported: enterprise computing solutions, computer-supported co-operative work solutions and Web-based applications. According to our survey, we can anticipate that within Italian industrial districts SMEs are specifically oriented towards Web-based applications and other related easy-to-use solutions that support interactive communication, while they do not generally invest in more complex technologies for internal process management, which were originally targeted for large companies. In addition, while at the end of '90s district firms were scarcely affected by network technologies, such firms are now showing a *growing interest* in tools that can innovate the traditional co-ordination and communication model, which was based on physical proximity. Data collected in three years, across the "new economy phenomenon", on one side confirm the basic model of ICT diffusion just outlined; on the other show a continuous enrichment of information and communication tools available to the firm. That means that SMEs are investing beyond the conjunctural optimism of the new economy boom.

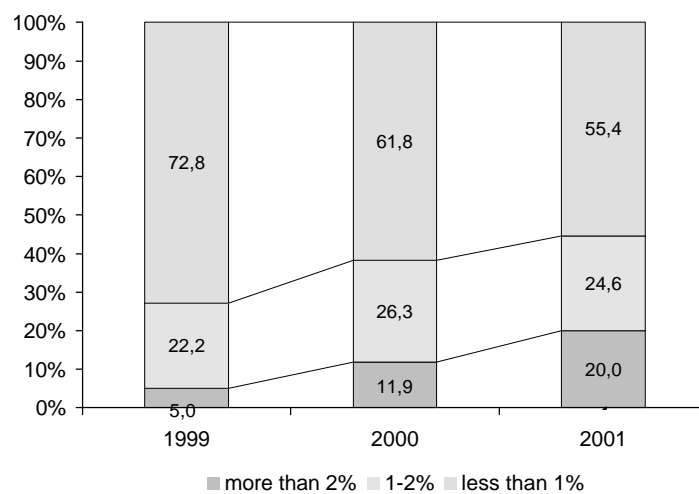
A first indicator used to evaluate SMEs technological innovation refers to the technological infrastructure from an internal standpoint; the results of the survey highlighted a clear increase in the diffusion of technology for office automation, measured with the ratio PCs/employees; in the three years the percentage of firms with a ratio of more than 100% (that means that each employee has at least one PC and personal computers are also used outside administration) grew from 44,4% of 1999 to 60,9% of 2001 (Fig. 2).

Fig. 2 – Diffusion of office automation (%PCs/employees)



Another indicator that confirms a greater attention towards ICT is the budget dedicated to the EDP function. As shown in figure 3, we registered an increase of the number of firms that invest more than 2% of the turnover in information systems: from 5,0% of 1999 to 20% in 2001 (23,7% in the engineering industry).

Fig. 3 – Budget of the EDP manager (% on total turnover)



Entering the more specific analysis of network technologies, table 1 shows percentages of adoption in the three years. The most interesting aspects of these data are differences in trends of diffusion of different technologies; particularly these points will be discussed:

- a. in all districts and sectors there was evidence of a remarkable *split* in the paths of ICT diffusion between complex and simple technological solutions (i.e. ERP, groupware, EDI vs. e-mail, web site, corporate banking, Isdn);
- b. within complex technologies, we observe a continuous increase of ERP adoption, a different trend with respect of other technologies of the same category;
- c. the e-mail is diffused in almost all the companies, followed by the web site;
- d. the e-commerce is quite absent.

Tab. 1 – Adoption of technological solutions in North East Italy

<i>Network technologies</i>	1999	2000	2001
E-mail	82,1	96,6	98,6
ISDN	68,6	87,9	88,9
Web site	67,6	83,6	84,1
Corporate Banking	76,8	83,1	84,1
Erp	8,2	19,8	28,5
ADSL	-	-	15,5
Groupware	10,6	15,0	15,0
Edi	9,2	9,7	13,0
Videocoferencing	8,2	7,2	9,7
E-commerce	0,5	0,0	4,3

2.2 A new era for ERP?

Table 1 clearly shows differences in the paths of diffusion of complex and simple technological solutions. On the one hand, a group of technologies had reached a level of diffusion of over 80% (e-mail, websites, corporate banking), while on the other hand, other technologies had been adopted on a very low scale (groupware, Erp, Edi, videoconferencing), especially when compared with big corporations.

SMEs prefer to invest in what we called *commodity technologies*: simple, cheap, easy-to-use without too much training, flexible and sold in standard packages. E-mail and websites are the best known and most used technologies among firms. Such technologies are *consistent* with district characteristics, where informal communication and easy interaction are an important basis for firm processes and for their competitive advantage. However, small businesses still show little interest in the more innovative but complex solutions that require clear strategies and projects, as in the case of ERP, groupware or EDI, while e-commerce is almost ignored.

Nevertheless, the data about the adoption of ERP systems seems particularly interesting; compared with other tools like groupware and EDI, they receive a different attention from SMEs, even more evident among engineering companies: with respect to the total sample, the percentage of adoption grew from 8,2% to 28,5% in three years (from 10,6% to 15,0% for groupware applications and from 9,2% to 13,0% for EDI), with a peak of 45,5% in the engineering sector.

This evidence is notable for at least two reasons: on one hand there was a wide scepticism on the capacity of those kind of technological solution to respond to characteristics and specificity of SMEs; on the other hand, the decision of a an increasing number of firms to invest in an ERP system, beside e-mail and web site, proves that small businesses are evolving their approach to network technologies.

ERP solutions are aimed at increasing efficiency in the management of codified data. They allow for a better quality of information and more transparency within the organisation and the value chain. Moreover ERP are “verticalised”, specified for different sectors of production on the basis of best practices of each industry; in that way they include an important source of knowledge related to the organisation and management of business processes. These solutions, traditionally developed for the management of internal processes (cost management, production, finance), have been recently extended to include modules aimed at integrating the supply chain on one side and the customer on the other.

ERP have been targeted for big companies in order to provide them with higher flexibility and efficiency in the management of internal processes in coherence with their BPR strategies. Instead, the implementation of such systems in small businesses gave birth to a lot of problems in terms of organisation rigidity and project length. Moreover, implementation costs were extremely high.

These characteristics were the reason of some unsuccessful experiences; but they also produced a critical approach towards these applications, considered too far from specificity of Italian SMEs.

In recent years software providers have modified their technology and products in order to satisfy SMEs, paying attention to specific requirements of small enterprise in terms of business processes, relational behaviour, resources. Data collected from Tedis Center seem to show that the investment has been successful, at least in North East.

However a different offer wouldn't probably be enough without a new approach of SMEs towards the importance of information management. An investment in an ERP system doesn't come from a generic opportunity to gain a competitive advantage; it comes from a specific need of re-organisation of the basic business processes to afford real competitive challenges: globalisation, quality, time to market, differentiation. In order to reduce costs but offer greater variety and better service to the customer, the capacity to manage information on a proper way, more formalised, become a strategic resource; this is even more important in relation to increasing internationalisation processes that determine the need to co-ordinate a wider system of distributed information.

3.3 The e-mail as co-ordination tool

Although meetings and telephone conversations are still important communication channels for SMEs, the data collected show that electronic mail is becoming a common communication tool for district firms, supporting business communication both at a distance and locally. Almost all the firms interviewed (98,6%) have an e-mail address. Moreover, email has been adopted widely within each organisation, as 60,3% of the firms have separate e-mail addresses for all the firm's departments (against 23,6% in the 1999) (see Figure 4).

E-mail diffusion within and among firms is coupled with a growing use of this application to support communications in the value chain. (Figg. 5 and 6) About 53,4% of the firms use e-mail to communicate with strategic suppliers with high or medium frequency (17,% in 1999). If we consider interaction with the sales network, the figure increases to 74,3% of firms (34,0% in 1999). The engineering industry has the highest percentages in both cases: close to 80% of the firms use e-mail to interact with the supply chain and more than 90% for communications with the sales network.

Though the prevailing communication model of industrial district SMEs is still traditional, (telephone, fax and face-to-face meetings etc.), network technologies are achieving a more interesting, less marginal role.

Fig. 4 – E-mail diffusion within the organisational structure

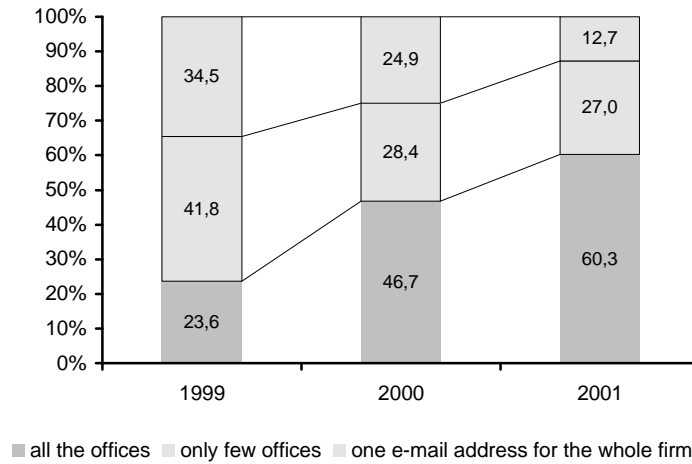
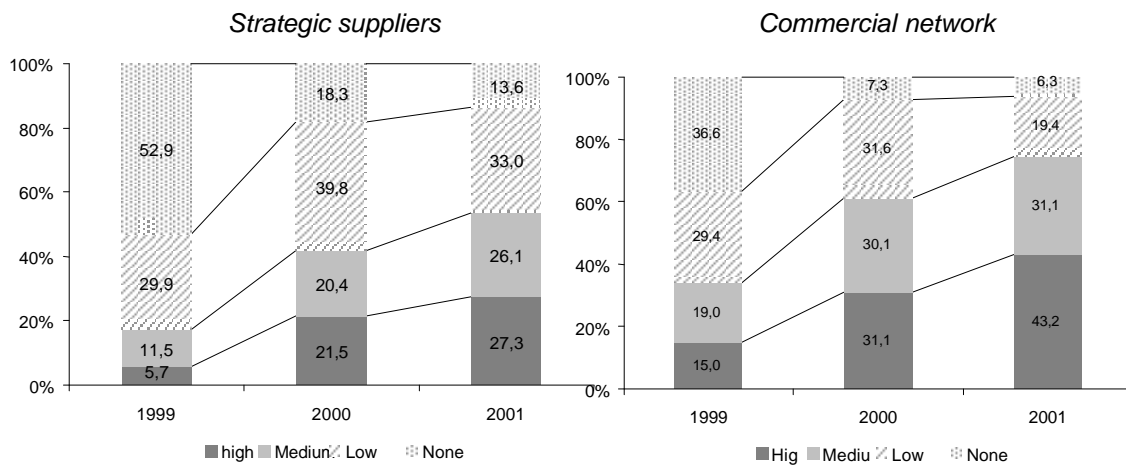


Fig. 5 and 6 – Use of the e-mail with strategic suppliers and commercial network



3.4 The web site: from e-commerce to interactive marketing

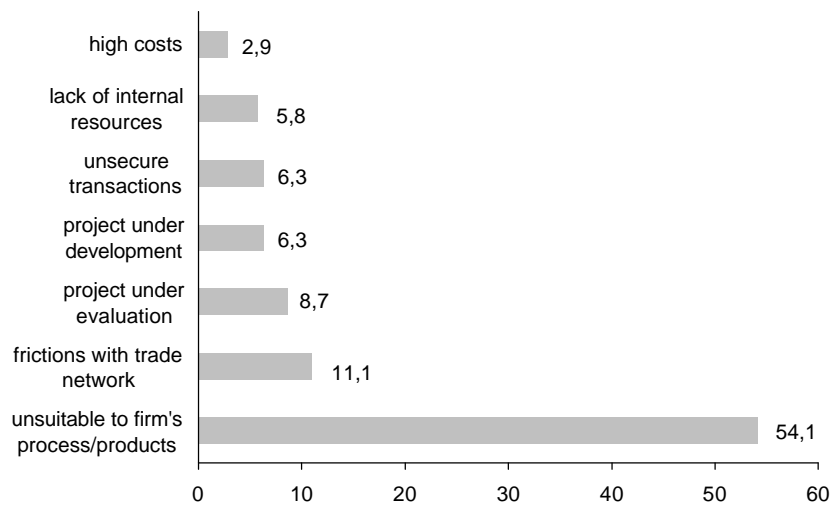
Another communication tool widely diffused among SMEs is the web site. About 84% of district SMEs have their own websites, but it is not a sales tool. Despite the fact that e-commerce is claimed to have a primary impact on business, evidence from the survey showed that this was not yet the case as regards industrial districts. Table 1 shows that only 4,3% of the firms interviewed sold their products through the Web; moreover even the projects under evaluation are decreased, from the 17,5% of 1999 and 18,8% of 2000 to 8,7% in 2001.

District SMEs have always revealed a weakness in their ability to control final markets, due to long distribution channels that make it difficult to collect information and to react to changing demand rapidly. Scholars have stressed the potential of electronic transaction management, where small and large companies could exploit websites and electronic markets to carry out exchanges speedily, efficiently and independently from their location (Malone et al., 1987, 1989; Bakos, 1997). The

limited diffusion of e-commerce among those firms highlights the low interest in the promised advantages of lower transaction costs related to an electronic management of exchanges.

A comprehensive explanation also arises from our data. SMEs do not refuse on-line transactions due to a lack of internal resources or security problems, which have been considered the main difficulties for e-commerce diffusion. Rather, they refuse to invest in e-commerce because they do not consider it to be suitable to the firm's product/process characteristics, which are specific and cannot be offered or managed on-line (Fig. 7).

Fig. 7 – Reasons for low investment in e-commerce



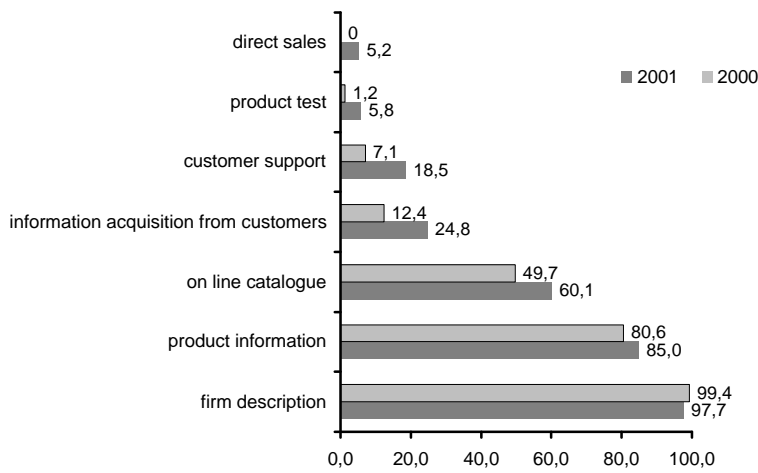
Those results are consistent with the sources of competitive advantage of the district firms, which are used to obtaining their products and managing manufacturing processes on the basis of an interactive and collaborative relationship with their customers. SME's ability to manage complex products and manufacturing processes by exploiting the network of collaborative relationships inside the districts is one of the most important sources of competitive advantage of industrial districts. It allows SMEs to maintain an important role in the international market in spite of the greater efficiency of big corporations. Therefore, SMEs will not consider an investment in e-commerce solutions seriously until they are also able to support collaboration, in addition to the transaction of standard goods.

Such evidence does not exclude that SME's will adopt a positive path as regards technology. Rather, it highlights the fact that district firms are involved in a learning process in respect to applications available on the market. However, the use of websites gives rise to some interesting and promising trends.

Small firms consider websites as being an interactive, communicative tool, which is able to sustain a valuable information exchange with customers. Websites are not just used to advertise the firm and its products, but also to manage information acquisition as well as to get feedback from the market (Figure 8)³.

³ Data about the use of the web site were collected only in 2000 and 2001.

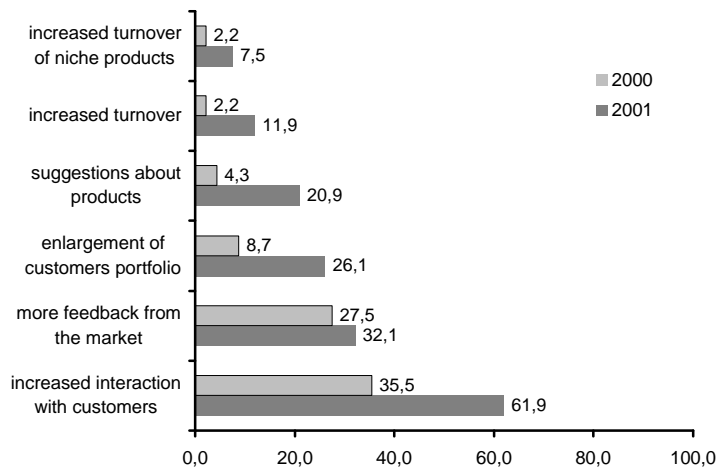
Fig. 8 – Functions of the web site



By exploiting customisable electronic solutions (such as on-line forms or more evolved tools such as reserved areas), SMEs have found new attractive ways to enhance their contacts with other firms inside as well as outside their established relationship networks. The adoption of such solutions is aimed at improving information management and allowing external partners access to their internal processes. The main advantages obtained from the website are a higher level of interaction with customers (35,5% in 2000 and 61,9% of the firms with websites in 2001), together with more feedback from the market (27,5% in 2000 and 32,1% in 2001). SMEs are also able to enlarge their customer portfolio (8,7% in 2000 and 26,1% in 2001), while an increase in the firm's turnover is a secondary outcome (Fig. 9).

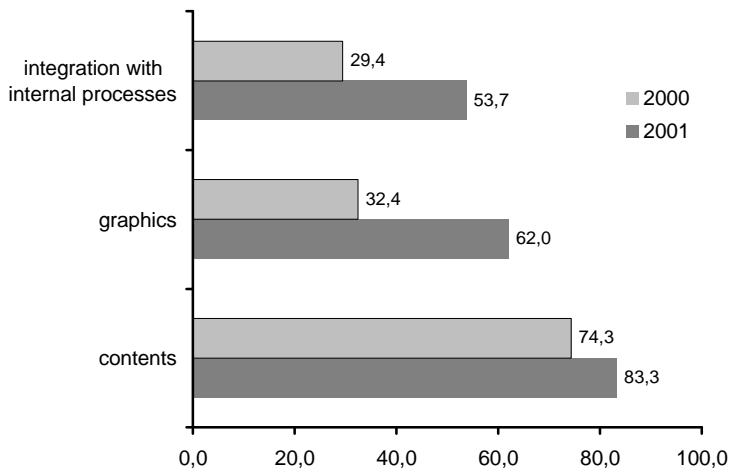
Those trends stress how important websites are to SMEs as a strategic marketing tool and this trend is certain to continue in the near future. Through high-quality content offered on the Web, district firms will be able to improve their presence on-line and hence to improve customer relationships. Websites offer a better understanding of the market, thanks to direct interaction with customers. If we analyse district firm websites, many of them are well produced and include reserved on-line areas aimed at facilitating electronic interaction and communication dialogues especially with sales firms and agents.

Fig. 9 – Advantages produced by the web site



Some interesting data, arise from future investments. In fact, besides the positive results just outlined, only 62,4% of the firms affirm their will to invest more resources on the web site and on the internet infrastructure, against 78,4% of 2000. Investments will be specifically dedicated to content enrichment and graphics, but we registered a great increase in needs of integration of the web with internal processes (from 29,4% to 53,7% in 2001) (fig. 10).

Fig. 10 - Future investments on Internet



This evidence could have two interpretations. After a couple of years of enthusiasms about Internet opportunities, that induced many firms to create a presence on the web, now it's time of more realism, but it's also time of consolidation of results, overall by those firms that obtained some strategic objectives and don't perceive the need of further enrichments of the web. On the other side, some companies perceive the necessity to better co-ordinate tools and information sources of the firm and need an increasing connection between internal processes and external relations.

To sum up, after the rise and fall of the new economy we observe a greater strategic awareness of SMEs. Concluded a pioneeristic phase in search of the gold promised by the web, where companies were open to experiment a new tool cheap and easy, today decisions are more well-considered and two paths seems to emerge: some companies are reinforcing pilot solutions with enrichment and integration with the whole organisational structure; on the contrary other companies are abandoning such experiments or are giving them a marginal position when the web doesn't seem strategic for the competitive advantage.

3. CONCLUSION: NETWORK TECHNOLOGIES AS SUPPORT FOR ORGANISATIONAL AND STRATEGIC INNOVATION

The main results of our survey show that the paths chosen by SMEs in the adoption of information and communication technologies are different from those foreseen by scholars, and which characterised large companies.

The communication technology infrastructure of SMEs is still *not adequate* to handle the complexity of business relations developed by local systems. Except for e-mail, available technology is not able to completely support the richness of exchanges established by the firm with its web of partners inside the local area or abroad. At first glance if we take it for granted that it is advantageous for firms to manage transactions electronically, this diffusion model could be interpreted as a weakness for industrial districts. In fact, with respect to the district models, it has been stressed that the rise of electronic networks and initiatives related to electronic marketplaces should create considerable opportunities for SMEs to reduce their transaction costs and to achieve new competitiveness.

However, a more in-depth analysis reveals that this apparent weakness could be the result of a strategy directed at *selecting* technologies that are *most appropriate* to the specific business and relational model of SMEs, and in this way enhance the source of competitiveness that is specific to Italian local systems. Thanks to the district model, SMEs are usually able to build and renew their competitive advantages in a continuous innovation process involving manufacturing processes that require collaboration and knowledge sharing among players. From this perspective, the most suitable technologies are those that allow relations and communications within the value chain to be reinforced from a knowledge management perspective. The goal of SMEs is not to structure relations, but to innovate interaction with the market through flexible communication tools such as e-mail and websites.

The ICT adoption strategies of industrial districts point out that firms could rely on electronic networks not to achieve benefits in terms of low transaction costs, but to support their competitive models in those cases where technological solutions are coherent with interaction and communication processes. In a broad perspective, district firms find difficulties to explain the impact of ICT on organizational performances from the point of view of transaction costs. Instead, the district model highlights the role of electronic networks in supporting dialogue and interaction among firms, where the advantages for firms primarily refer to opportunities in sustaining manufacturing processes and innovation on the basis of business networks as distributed knowledge systems.

However, ICT adoption trends in three years demonstrate that SMEs are learning how to use technologies traditionally excluded like ERPs and how to integrate different technology families in a proper and specific way aimed at sustaining new organisational needs and strategies in order to face the challenges of the international scenario.

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