Models of Industrial Districts' Evolution and Changes in Technological *Règimes* *

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ABSTRACT

The aim of this paper is to investigate some plausible models of evolution of IDs and clusters, and provide an explanation in light of the peculiar features of technology and technological change. We shall notice how little attention has been paid to the transformation of IDs, and to models geared to explaining their shift from one mode of internal organisation to another. This contrasts with the increasing evidence of cluster reorganisation in response to a changing environment of globalisation of economic and technological activities.

The divide in the empirical evidence and in theoretical approaches appears to be between traditional forms of inter-firm organisation and relationships *versus* more dynamic forms of restructuring with product diversification, upgrading of the technological system, and improvements of more complex relationships with local institutions.

A first and insightful explanation of this difference may be provided by the strand of literature that emphasises the link between industrial organisation and technological change and innovation, and focuses on the concepts of '*technological régime*s'. Within this interpretative framework, we test the following hypothesis:

- The shift in the technological paradigm, that applies to all sectors, requires a substantial industrial reorganisation. Again, firms traditionally operating within IDs need to learn to source their technological knowledge from the most convenient locations outside the ID, and to reorganise their knowledge linkages from a cluster-based approach to a global and broader approach, such as Global Production Network model.
- The prevailing form of the 'Marshallian' ID may not be the most adequate for exploiting the new technological areas and opportunities promising faster and more sustained growth in world markets.

1. Introduction

For several decades in many countries and industries enterprise clustering has offered a competitive alternative to the advantages achieved through a larger production scale, and through the ensuing economies of scale.[1]

The typical uniformity in the growh process of SMEs systems, experienced during the seventies and eighties in Italy's local systems, has come to an end (Carminucci Casucci, 1997). New diversified ('idiosyncratic') patterns of growth have been observed, and the range of options chosen expands when attempting to draw international comparisons. No common and unidirectional development pattern has proved valid anymore, and different avenues have been followed to face the new competitive challenges posed by the globalisation of markets and technology. It appears especially useful to remind the insightful remark of the main scholar of the industrial districts:

> " … particularly in the Italian experience, the industrial district has often proved to be rather a 'stage' in one of the possible different paths of industrialisation" (Becattini 1987).[2]

[1] On this evidence, see the studies in Becattini, Pyke and Sengerberger, and Guerrieri; Iammarino,Pietrobelli, 1998, for a survey.

[2] According to Becattini, Marshall properly distinguishes between different geographical levels of analysis, the industrial district showing a lower degree both in the density of territorial agglomeration and in the weight of services with respect to the urban system, and a mono-sectoral character along with a lesser degree of complexity with respect to the industrial region. The significance of different territorial units clearly depends on the aim of the investigation, although the choice of the district is probably the most appropriate to help understand the "endogenous sources of industrial dynamism" (Becattini 1987: 32).

The aim of this paper is to investigate some plausible models of evolution of industrial districts (ID) and clusters, and provide an explanation in light of the peculiar features of technology and technological change. This task is made even harder by the variety of visions on the notion of ID in the literature, and by the very vast array of experiences of enterprise clusters and agglomerations that have been recorded worldwide. In fact some 'concrete instances of industrial districts are closer to a set of stylised facts than a model (Humphrey, 1995:152), and none of the IDs is strictly equal to another, as also demonstrated by the variety of product specialisations, degree of complexity of organisational and network systems, cultural and social backgrounds. Moreover, the scope and variety of inter-firm organisations is continuously expanding, in relation to the globalisation of technology and the increasing internationalisation of economic activities.

To this aim, we shall first briefly review the literature on the typology of IDs, and in general on the variety of visions on the phenomenon of enterprise clustering, focusing on the explanations of their dynamics and changes in internal organization provided in the literature. We shall notice how little attention has been paid to the transformation of IDs, and to models geared to explaining their shift from one mode of internal organization to another. This contrasts with the increasing evidence of cluster reorganisation in response to a changing environment of globalisation of economic and technological activities.

Among the crucial factors explaining the evolution of the IDs' industrial organisation are the (external) inducements derived from market competition and changes in demand, and from technology and technological change. Especially the latter appears important in the present world. The changes in the technology paradigms and trajectories, that crucially affect the foundations of competitiveness, are increasingly shaped by the internationalisation process,[3] and contribute to determine the prevailing form of company strategy, and especially inter-firm attitudes, and the industrial organisation prevailing within an enterprise cluster. Interestingly, this dimension has often been underplayed in the studies of enterprise clusters and industrial agglomeration.

In order to explain the pattern of success, the similarities and differences, and the evolution of IDs in different parts of the world,[4] we shall explore the emergence of different possible patterns of restructuring.

Importantly, it is the whole enterprise group that achieves this transformation, not necessarily the individual enterprises. Thus, changes in the internal organisation and mode of behaviour of the IDs and of the enterprises therein are expected to occur, such as, for example, a rise in industry concentration, changes in ownership with mergers and acquisitions, the emergence of leaders/followers, and the entry of new firms and new agents, such as service firms, traders or foreign investors. In other words, through such evolution, an ID would be renewing its sources of competitiveness, that was initially based on lower input costs, some (limited) horizontal linkages with a blend of competition and collaboration and mainly external localisation economies.

The structure of the paper is the following. In section 2 some of the main categorizations of IDs proposed in the literature are presented and discussed. It is noted that they seldom focus on the possible evolutionary paths of each model of industrial organisation, and that these categorisations, and their transformation, are not usually put in relation with the prevailing technological *règime* in which enterprises operate. In the third section these two specific features are explicitly addressed to argue that they may play an important role in the search for a dynamic theory of firms' agglomeration and industrial districts. Section four presents some stylised evidence on Italy to support this hypothesis. The final section five concludes and summarises.

[3] See Ernst and Guerrieri, 1998, for evidence on the electronics sector. See Ernst, 1994, 1997, 1998, on the concepts of global production networks and international knowledge linkages.
[4] See Guerrieri *et al.*, 2000, for a detailed analysis of the cases of Italy and Taiwan, and Bagella (ed.), 1996, for cases in Latin America.

2. Categorizations of IDs and the Dynamics of Industrial Organization [5]

The literature on enterprise clusters and industrial districts is sizeable, and was started by the classical contribution of Alfred Marshall (1896) on the importance of external economies for industrial districts. Then, following the increasing complexity and variety of real world inter-firm organisation, several categorisations of industrial districts have been proposed, often grouping widely different realities under the same label

In a study of the Italian evidence of how production is spatially organised, Garofoli (1991) proposed a typology of models of local development that has been rather influential on later work. This classification applies beyond the industrial sector, and is based on structural variables such as the production structure, the enterprises' size, the inter-firm relationships, the background of the entrepreneurs, the features of the local labour market, the sources of innovation, the social structure, the local institutions and economic policies. On the basis of these variables, he defines three systems for regions characterised by the presence of industrial small and medium-sized enterprises (SMEs):

i. Areas of productive specialisation;
ii. Local production systems;
iii. System areas.

The main characteristics of these areas are the following:

i. **Areas of productive specialisation**; in general, in this type of area inter-firm productive relationships are restricted, and this generates a 'horizontal' production system, with firms competing for the same market. They are usually areas of recent creation, the outcome of decisions of productive decentralization, with entrepreneurs that are external to the area, sometimes setting up subsidiaries of enterprises located elsewhere to exploit some favourable local conditions, e.g. cheap labour. Due to the clustering of enterprises belonging to the same sector, a local labour market grows consistently with the characteristics demanded by local firms. The development model of this area tends to be 'extensive' i.e. through a rise of employment, and propelled by outside agents i.e. exogenous industrialisation. Examples of areas of productive specialisation are in Urbania (SP), Santa Maria Nuova (AN), Raiano (AQ).

ii. **Local production systems** tend to be characterised by enterprises belonging to the same sector (horizontal competition) but having stronger and frequent relationships among them, and few production linkages with firms in different sectors. The local production system is structured along entrenched historical traditions of technical and professional culture, and this allows to keep track of the changes in production techniques with minor adjustments. These conditions of productive and socio-cultural homogeneity create vast opportunities for local economic policies. Their development model may also be 'extensive', but led by local agents (i.e. endogenous industrialisation). Cases of local production systems have been detected, among the many, in Montegranaro-Fermo-Civitanova (AP and MC), Castelgoffredo (MN), Solofra (AV), Val Vibrata (TE), Barletta (BA), Civitacastellana (VT), Erba (CO), Norther and Eastern Brianza (CO and MI), Treviso, Cuneo, Alba (CN), Arezzo.

iii. **System areas** are more sophisticated and complex forms of clusters of productive specialisation, based on small and medium-sized enterprises (SMEs). In this case, the local production system is rather complex, with a clear division of labour among these firms , and inter-relations among themselves in the same sector as well as in other sectors. The capital equipment necessary for some productions may also be produced locally. Their development model may be defined 'intensive' i.e. without a rise in employment, and 'endogenous', based on the exploitation of local resources (entrepreneurs, capital and labour). Examples of system areas are Biella (VC), Vigevano (PV), Prato (FI), Carpi (MO), Sassuolo (MO).

[5] This section benefited from Castellano, 1999.

Simplifying this categorisations even further, two categories appear to emerge from these studies. On the one hand, there are areas where enterprises cluster, either for a decision made outside or for a historical tradition, and share the same environment and institutions. On the other hand, there are areas where the local production system is complex, and characterised by intense horizontal and vertical transactions, and by a marked reliance on local factors. Inter-firm and inter-institution synergies are widespread and effective, transactions occur smoothly and generally a lack of hierarchy is observed.

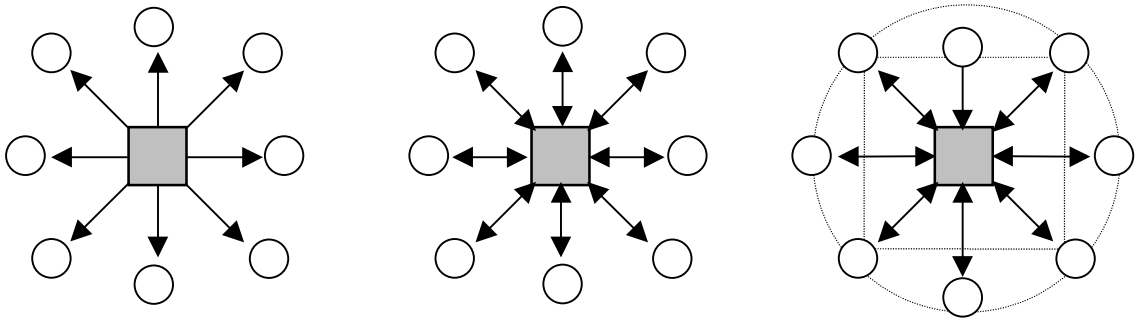
According to Garofoli (1991), neither a necessary transition from one system to another, nor a predefined sequence will be followed. However, in an attempt to draw a dynamic interpretation of his models of local industrial development, they may be taken to represent different phases of the industrialisation process centered on SMEs and local entrepreneurship. Thus, one may read a paradigm of a shift from experiences of recent industrialisation (case 'i' above), to experiences of diffused industrialisation, with SME systems and agglomeration of production, initially growing in an 'extensive' fashion through an increase in employment, and then in an 'intensive' fashion through a rise in the complexity of the local system (Garofoli, 1991). However, these models may also coexist in the same region (location), and the transition from one model to another cannot be taken for granted.

A different and interesting approach explicitly introduces *asymmetries* among the clustered enterprises, and it is centred on the concept of '*leader-firms*' and of the *constellation* surrounding them (Lorenzoni 90, Graph 1 and Table 1). Such 'leader-firm' sets up numerous inter-firm linkages, and is located at the centre of them. It does not need to be a large productive firm. Such linkages may take several configurations:

i. Informal Constellation
ii. Formal Constellation
iii. Planned Constellation
iv. Enterprise Network
v. Enterprise Group

Table 1 describes the key elements of each category of enterprise cluster: the more one moves to the right hand-side of the table, the more the target becomes that of dynamic efficiency and competitiveness, and inter-firm relationships get more complex. The role of the leader-firm also changes from simply designing the project and assembling individual contributions, to that of co-ordination, strategic planning, investment and provision of strategic services.

Graph 1
Enterprise Constellations



Informal Constellation **Formal Constellation** **Planned Constellation**

Source: adapted from Lorenzoni, 1990.

Table 1 Categories of Enterprise Clusters

Key elements	Informal Constellation	Formal Constellation	Planned Constellation	Enterprise Network	Enterprise Group
Target	Static efficiency through cost reduction	Static efficiency, also through quality improvements, and shorter time to deliver	Dynamic efficiency (via adaptation and innovation) and competitiveness	Dynamic efficiency and competitiveness	Competitive efficiency, that is more than simple production efficiency
Leader-firm activities	Project design, assembly, commercialisation	Still leader, but other firms' role acquires importance	Not only the final assembler; also in charge of co-ordination, strategic planning, provision of key services and investments	Provision of strategic services	Provision of strategic services and finance
Role of other firms	Passive	More important: realised that their structure and behaviour affect all the constellation	More active; closer and frequent relationships among themselves; some may play intermediate role between leader and others	Active	Active; they do not simply execute leader's directives; diffuse entrepreneurship favours innovation
Leader-other firms relationships	Leader dominates	Closer interaction;	Co-ordination	Co-ordination	Strategic interaction led by the leader-firm
Rules governing the relationships	Short-term contracts; price is main variable	Long-term trust-based relationships; price loses its central relevance	Long-term contracts, little agents' turnover; routine in the relationships facilitates agreements	Strong identification with the network: common culture and attitudes, clear difference from outside firms; easier to choose outward orientation, and reduce dependency on the local context.	Financial participation (control) of the leader in the group's firms
Factors of Development and Competitiveness	Presence of localisation economies; better socio-economic environment would improve performance		Dynamic external economies play a central role	Strength lays in global-local relationships	Localisation and urbanisation economies affect the organisation's performance

Source: adapted from Lorenzoni, 1990, and Ciciotti, 1993

The author does not foresee any necessary evolution across the various types of clusters. However, a possible transition could occur from the first informal constellation, where inter-firm relationships are minimal, to more structured forms, characterised by forceful and efficacious co-ordination. The final stage may imply the creation of a real network, or an enterprise group in the event the leader-firm held some ownership shares in the other firms within the system. Interestingly, in all cases there is no perfect symmetry among the various agents operating in the cluster, but each agent may play a distinct role, and one (or more of them) leads the cluster in terms of organisation, innovation, and/or finance. The extent of the leadership is more marked the more the system moves towards a 'network' or a 'group'.

Markusen (1996) broadens the picture to include several different forms of industrial organisation within the definition of an industrial district. She argues that the emergence of 'sticky places' in a 'slippery space', characterised by dramatically improved communications, and increasingly mobile production factors and enterprises, may be related to numerous variants of industrial districts. Thus, she opts for an expansive connotation of industrial district, which does not confine it to the most common usage (i.e. the Marshallian – 'Italian' variant – district). Therefore, the definition of ID utilised is the following:

> "…an ID is a sizeable and spatially delimited area of trade-oriented economic activity which has a distinctive economic specialisation, be it resource-related, manufacturing, or services" (Park and Markusen, 1994) [6]

Through an inductive analysis of the more successful metropolitan regions in the US, she develops several typologies of industrial districts, that may be related to the power of larger firms, national (multinational) corporations and the state, to provide

> "… the glue that makes it difficult for smaller firms to leave, encouraging them to stay and expand, and attracting newcomers into the region." (Markusen, 1996: 294)

The conceptualisation proposed focuses on the following essential classificatory principles: firm-size, inter-firm relations, and internal *vs.* external orientations. Table 2 summarises the main characteristics of these four types of IDs.

The concept of **Marshallian Industrial District**, and its **Italian Variant**, was first introduced by Alfred Marshall, who noted that small firms in the same industry realise economies of scale external to the firm through co-location (Marshall, 1896). In the eighties and nineties several scholars resuscitated his insights to explain the superior economic performance of regions such as the Third Italy , Silicon Valley in the US, and others. They emphasised concepts such as the 'industrial atmosphere',[7] the local long-term socio-economic relationships among local firms, involving trust and a blend of competition and collaboration, and the role of local institutions, the latter especially in the Italian version.[8]

The **Hub-and-spoke** ID is the second type of district empirically detected in the US and elsewhere by several studies (Markusen, 1996). It occurs where one or more firms/facilities act as anchors or hubs to the regional economy, with suppliers and related activities spread around them like spokes of a wheel. A single large – often vertically integrated -firm (e.g. Boeing in Seattle and Toyota in Toyota City) or several large firms in one or more sectors (e.g. Ford, Chrysler and GM in Detroit, or the biopharmaceutical industry in New Jersey) may act as hubs, surrounded by smaller and dominated suppliers. The spokes may represent strong ties, as in the previous example, or loose ties, such as the externalities enjoyed as agglomeration economies

[6] Her definition of ID is clearly different from the definition proposed and utilised by the Italian (mainly Florentine) school (Becattini, Bellandi, Dei Ottati, Brusco and others) as she acknowledges several different institutional set-ups as having the essential features of a 'district'. In fact, her typology groups together several different forms of organisation of production where a common geographical localisation plays a central role. As a consequence of this very broad approach the "Italian" version of ID ends up being only one possible form of inter-firm organisation, very close to the original Marshallian idea.

[7] See Pietrobelli, 1998, for an empirical test of the concept of 'industrial atmosphere' in a sample of Italian IDs.

[8] See Guerrieri *et al.* 1998 for a survey.

derived from proximity.[9] The large hub-firms often have substantial links to suppliers, competitors and customers outside the district. This may represent An interesting dynamic feature of this model, insofar as these 'long arms' act as 'sensors' for innovation and creativity in other locations, and thereby enable the transfer of new ideas and technology to the home region. However, such long arms may also inform the hub company of the potential benefits and opportunities elsewhere, and drive the major firm out of the region. Co-operation among competitors within this form of ID is remarkably lacking, and inter-firm relationships occur between the hub firm and their (often long-term) suppliers, but always on the terms set by the former. As a matter of fact, the hub might even be interested in deliberately playing off one supplier against another, as a way of getting more favourable conditions.

In Northern Italy, this sort of agglomeration has developed in Piedmont around the automotive producer FIAT and its intermediate goods and service suppliers, and around Olivetti in Ivrea.

In principle, within this type of ID, an interesting development process may be envisaged. The spark could be represented by the agglomeration of skilled labour and business services around the hub, with the spoke firms setting up alternative and independent links and benefiting from the agglomeration economies generated by the district. In this hypothesis, the presence of a large hub-firm with several activities and multiple linkages with other firms and providers would foster, or *lead* the ID to venturing into new sectors, and diversify away from the traditional specialisation. This may be even more frequent when hubs are active in more than one industry. Therefore, this category of ID may provide an interesting industrial organisation explanation of the evolution of clustering and IDs through deepening product specialisation and upgrading or diversifying into different products and sectors, with reorganisation of production and new inter-firm relationships. It is easy to expect that SMEs by themselves, or organised within the Marshallian ID category would find it hard to follow the latter route and reorganise their activities and linkages as required in times of radical changes in the technological paradigms.

The **Satellite platform** is the third type of ID described by Markusen: it consists of a congregation of branch facilities of externally based multi-plant firms. It is often induced by the policies of national/local governments to stimulate regional development. Key investment decisions are made out of the ID, and tenants of the satellite platform must be able to more or less 'stand alone', i.e. be spatially independent from upstream or downstream operations as well as from the agglomeration of other competitors and suppliers in the same area. There tends to be minimal collaboration among platform firms, often engaged in different activities and industries. Differently from what happens in the hub-and-spoke version, the large, often multinational, corporation is not locally based. Constrains to the development of this type of ID derive from the lack of local sources of finance, technical expertise, business services, 'patient capital', and of the industry-specific trade associations that may provide shared resources and services.

This type of ID appears more adequate to portray the situation in the US than in Italy or other smaller industrialised (-sing) countries. However, its prospects of endogenous development appear remarkably conditioned by externally-made decisions.

[9] An example may be provided by the local skilled labour pool (or cadre of business services) built up by a large firm, that facilitates the start up and growth of SMEs in the shadow of the major firm (Markusen, 1996b).

Table 2 Features of Industrial District Types (*à la* Markusen)

Features	Marshallian ID (ITA, Italian variant)	Hub-and-spoke district	Satellite industrial platform	State-anchored industrial district
Prevailing market structure	Local SMEs	One/several large firms and suppliers	Large firms external to the district	One/several government institutions providing infrastructures
Economies of scale	Low	high	High	High
Local firms' level of activity	High	Low, except for services	Low to moderate	Low or none
Intra-district trade	Highly developed	Between large enterprise and suppliers	Minimal	High between institution and suppliers
Key investments	Local decision	Local decision, but globally dispersed	External decision	In local government or external to the ID
Buyer-producer cooperation (1)	Important (ITA)	Low	Low or none	Low
Regulation of relationships	Long-term contracts	Long-term contracts	Short-term contracts	Short-term contracts
Cooperation with firms outside the ID	Low	High	High with parent company	High with parent-company (institution)
Labour market	Internal to the district Highly flexible	Internal to the district Flexible	External to the district, internal to the large enterprise	Internal (government capital), national from other institutions
Personnel exchanges	High (ITA)	Medium	High , external origin	Medium/high (professional)
Workers' commitment	1 st with ID, 2 nd with enterprises	1 st with large firm, 2 nd with ID, 3 rd with SME	1 st with large firm, 2 nd with ID, 3 rd with SME	1 st with Gov.Institution, 2 nd with ID, 3 rd with SME
Labour immigration	High	High	High for high skills, management / low for low skilled labour	High
Labour (out)migration	Low	Medium	High for high skills, management / low for low skilled labour	Low, unless Gov.Institution leaves
Local cultural identity	Developed	Developed	Virtually absent	Developed
Sources of financing and technical assistance	Internal to the ID	Large firm	External	External (national or local government, military base, State University or research Centre…)
Patient capital *	Exists	Scarce out of the large firm	Non-existent	Non-existent
Local trade associations	Strong presence (ITA)	Virtually absent	Absent	Weak
Role of local government	Important (ITA)	Important	Important	Weak in regulation and industry promotion / Important in infrastructure
Long-term growth outlook	Good outlook	Depending on large firm & industry dynamics	Threatened by relocalisation of activities	Depending on government institution

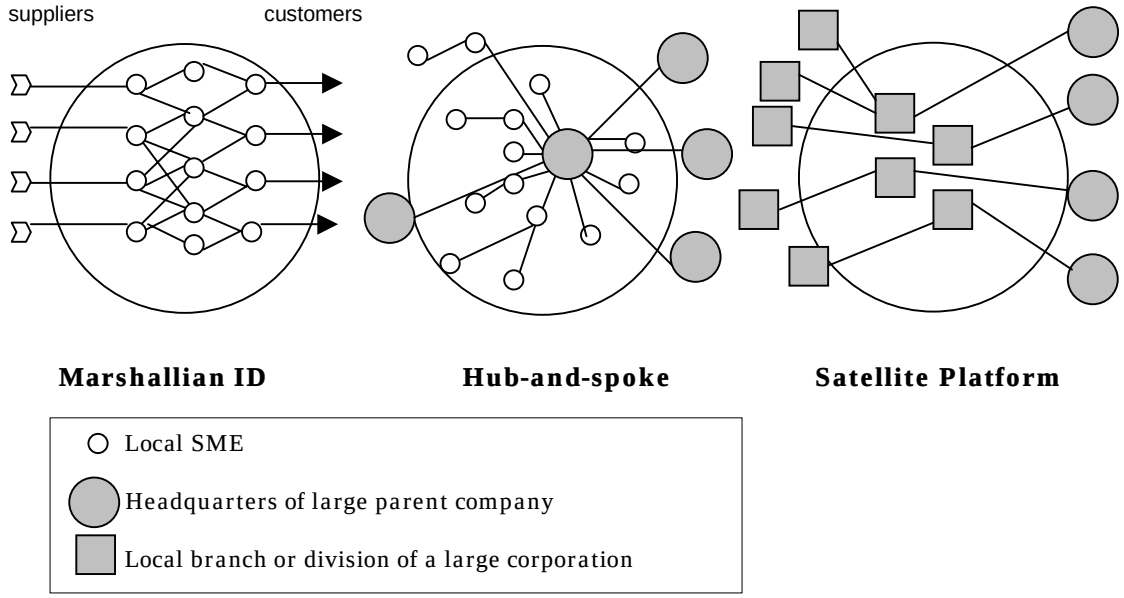
Source: own elaboration from Markusen, 1996 and Castellano, 1999.

* Presence of financial institutions willing to take long-term risks, for the confidence and information they possess.

When industrial activities are 'anchored' to a region by a public or non-profit entity, such as a military base, a defence plant, a university or a concentration of government offices, then a '**State-anchored District'** may emerge. The local business structure is dominated by the presence of such facilities, that follow a logic that is different from private-sector firms' logic. Politics may play a central role in the development of such a form of ID. Indigenous firms will play a smaller role here than in the previous forms of ID. However, some new SMEs may emerge out of specialised technology transfer (e.g. *via* universities) or business services provided by (or spilling over) the anchor institution. Like for the Satellite platform, this type of ID occurs less frequently in Italy than in larger countries such as the US, but may represent a useful way to portray an ID emerging from a government-planned initiative. Thus, the many examples of 'business parks', 'science parks' or the like, being set up in developed and developing countries through a government initiative to finance and promote a local institution such as a training centre, a quality control agency, a technology diffusion centre or a laboratory, testing and R&D facility, may fall within this category.

In this category of ID, the growth of local SMEs, and their diversification into different industries is likely to depend on several specific features of the ID, such as the specificities of the industry prevailing, the technology in use and its transferability from the 'anchor' to local firms, and the existence of local additional competitive factors (e.g. local demand or distribution channels, pools of skilled labour, the presence of 'patient capital').

Graph 2
Typology of Industrial Districts



Source: adapted from Markusen (1996) and Castellano, 1999.

Of course a real-world district may be an amalgam of one or more types. In order to simplify these categories even further by singling out one key characteristic, we may explore whether a form of leadership is present. Thus, IDs may differ depending on whether all forms of leadership are absent, as in the Marshallian type, or whether a leadership is provided by a hub, a parent company located elsewhere, or an anchor financed and promoted by the State.

Over time districts may mutate from one type to another.[10] In search for a dynamic theory of IDs, could we interpret these types as different stages of a possible continuous evolution? This would

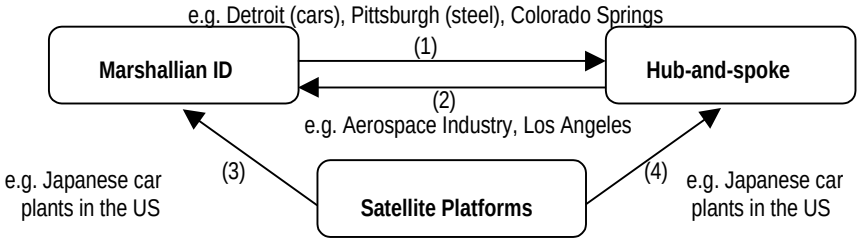
[10] For instance, Silicon Valley hosts an industrial district in electronics (Saxenian,1994), some important hubs (Lockheed, Hewlett Packard, Stanford University), and platforms branches of large corporations (IBM, Oki, Hyunday, Samsung, NTK Ceramics), but it is also the fourth largest recipient of military spending in the US.

be especially interesting insofar as the latter forms of ID may exhibit greater propensities for networking across district lines rather than within or, in other words, greater propensities for diversification into different production lines through more complex networks and inter-firm linkages, rather than for upgrading along the present sectoral specialisation.

Some possible transitions through different types of ID are illustrated in Graph 3. Thus, instances of a transition from a Marshallian ID to a Hub-and-spoke, with the emergence of larger oligopolistic companies (1), are provided by Detroit (automotive industry), and Pittsburgh (steel industry) respectively in the first decades of the XX century and at the end of the XIX century. These regions hosted some kind of Marshallian ID, and later transformed themselves into oligopolies organised like hub-and-spoke (Markusen, 1996:301). In principle, the same process might occur through the recruitment or incubation of a hub within the ID.[11]

Similarly, satellite platforms may transform into a Marshallian ID by strengthening and intensifying backward and forward linkages among SMEs, both suppliers of intermediate goods and competitors for the same final markets (3). In the event larger firms prevailed, or SMEs as a result of increased competition or economies of scale (and of organisation) grew bigger and established leader-follower or hub-and-spoke links, then a hub-and-spoke district might prevail (4). In principle, also a hub-and-spoke might convert into a Marshallian type of district (or an infant variant of it) (2), following the failure or the loss of influence and power of the anchor-firm (institution). However, the latter appears a rather abstract hypothesis, as it requires a true 're-democratisation' of inter-firm relations, and a fragmentation of the power of managing business relationships, previously in the hands of one or few firm, among several different actors. An oligopolistic outcome looks more likely indeed.

Graph 3 'Possible Transitions through types of ID'



How can we summarise the very vast literature on the categorisation of enterprise clusters and IDs that has developed over several decades, and that we have tried to selectively present and discuss here? To the cost of lacking precision, firms may tend to share a geographical agglomeration along three broad modalities:

1. **(Casual) geographical clustering of firms**, with occasional inter-firm linkages, no (little) experience of co-operation, non-existent or little developed local institutions
2. **Marshallian (Italian) ID**, with smoother inter-firm transactions, much better developed practices of co-operation, more developed and effective local institutions, economies of scale at the district level made possible by substantial enterprise specialisation.
3. **Enterprise network with some form of leadership** prevailing, be it a hub-and-spoke, leader-followers, or satellite-platform, with the leader providing the strategic services and impetus for diversification into different products and sectors, with reorganisation of production and new relationships with firms, local institutions, and factor and product markets.

[11] In principle, a State-anchored ID might also turn into a hub-and-spoke if a private company replaced the public firm/institution (e.g. Colorado Springs, Markusen, 1996:308). However, we are considering the case of a State-anchored ID in greater detail here, as this form of ID is ultimately related to a state intervention.

It is important to note that these are not necessarily sequential stages, as IDs may remain persistently different, depending on industry or country characteristics, or historical circumstances and 'lock-ins'. Moreover, among the three modes of clustering, the network is the one that requires, as well as offers the largest opportunities to reach out much further away, breaking the geographical borders without losing its identity and preserving its specificity (uniqueness). As we shall see in the following section, this feature may prove remarkably useful when technological paradigms change, and especially in the new technological paradigm, where we increasingly observe a co-evolution of technology, industrial structures, and the internationalisation of economic activities.

3. The link between ID Evolution and Technological Change

Two new major features of the social and economic systems are emerging and have characterised the last two decades. On the one hand, technology increasingly plays a central role for all economic activities, and the pace of technological change is getting more and more rapid. On the other hand, the scope of all economic and enterprises' activities has become global (Pietrobelli and Samper, 1997).

These two dominant features are intrinsically inter-related and mutually reinforcing. Thus, the rapid pace of technological change materialised by improvements in communication and information technologies (ICTs) is facilitating the international expansion of economic activities, whilst this process of internationalisation is enhancing and further accelerating the pace of technological changes.

It has been shown that technology has become a crucial input for production, with the knowledge intensity of production growing remarkably. Consistently, since the late 1970s, intangible investments including R&D, training, software development, design and engineering, have been growing at three times the rate of tangible investments (OECD, 1992). New technologies such as ICTs, biotechnology, and new materials are creating new products (United Nations, 1995) while at the same time changing the characteristics and performance of many traditional products (UNCTAD, 1995).

The second dominant feature of the prevailing techno-economic model is the widespread internationalisation of all economic and technological activities. International trade and investments now accounts for larger proportions of national income in all countries. With the expansion of international trade and investments, also technology is getting more global. The nature of technology raises the convenience to stretch out the reach of a company's technological activities, source technology abroad and strike R&D and technology partnerships with other companies and institutions (Pietrobelli, 1996). This knowledge needs to be sourced from different origins, as firms become less and less capable of supplying all the technological knowledge required, and all the inter-firm and inter-institution linkages matter more for science & technology (S&T) and R&D. However, differences persist, there is not only one avenue for reorganisation, and technological opportunities widely differ.

The literature has often studied the relationships between the technology in use and the pattern of technological changes. As it is well known, the patterns of innovative activities differ drastically across technological classes and countries, as far as the sources of technological advancement and the organisational structure of learning processes are concerned (Guerrieri and Tylecote, 1997).

An interesting approach to the analysis of the different patterns of innovation is centred on the notion of *technological regimes*. This concept was first introduced by Nelson and Winter (1982), and later developed by others (Malerba and Orsenigo, 1995, 1996). Within this framework, a firm's rate of innovation is influenced by the technological (and industrial) environment facing the firm, that is by:

- *Opportunity conditions*: the firm's likelihood to innovate, given the investment in search;
- *Appropriability conditions*: the possibility of protecting innovations, and the profits thereby derived, from imitation;

- *Degree of cumulativeness*: the extent to which the amount of innovations produced in previous periods raises the probability of innovating in the present period;
- *Knowledge base*: the type of knowledge upon which the firm's activities are based.

In this framework two polar models of innovative activities have been developed following Schumpeter (1934, 1942). On the one hand, the first pattern of innovative activities is characterised by conditions of medium-low opportunity, low appropriability and low cumulativeness so to lead to technological ease of entry in an industry, a relatively large number of innovators, a major role played by new firms in innovative activities, continuously breaking through the current way of production, organisation and distribution. This has been called the Schumpeter Mark I model. On the other hand, the second patterns of innovative activities are related to conditions of high opportunity, appropriability, and cumulativeness which are more likely to lead to a low number of innovators and the dominance of few firms, that are continuously innovating through the accumulation over time of technological and innovative capabilities. They employ their accumulated stock of knowledge, and thereby create barriers to entry to new entrepreneurs and small firms. This model has been called the Schumpeter Mark II model.

Importantly, it has been shown that technological regimes are technology-specific (Malerba, Orsenigo, 1996 b), i.e. that the pattern of innovations in one sector is very similar throughout all countries. However, one can observe also systematic differences in patterns of technological change across countries in all sectors (Guerrieri and Tylecote, 1997).

Does the technological regime within which firms operate have consequences upon enterprise clusters, and especially on their internal organisation, geographical location, and innovative behaviour?

It is reasonable to expect that innovators will emerge from the location where technological opportunity is available and accessible (Baptista and Swann, 1998).[12] When there are conditions of high opportunity, high appropriability and high cumulativeness as in Mark II Model innovators are geographically concentrated. This is also related to the firm's knowledge base, since the more technological knowledge is tacit, complex and systemic, the more constant interaction will be needed, so to expect a greater concentration of innovators, as this type of knowledge can only be learned through daily use, and requires informal personal contacts and exchanges (Nelson and Winter, 1982, Lundvall, 1988). This is what typically happens in a local(ised) ID. This should imply greater industrial and geographical concentration. Conversely, geographical concentration should be less important when the industry's knowledge base is simple and well codified and conditions of low opportunity, low appropriability and low firm cumulativeness prevail. High degree of geographical dispersion of innovators are likely to emerge (Schumpeter Mark I).

The prevailing techno-economic model with the diffusion of the ICTs and the rapid internationalisation of all economic and technological activities would seem leading toward an increasing role and relevance of the Schumpeterian dynamics of the first type. Resources, capital and other inputs can be efficiently sourced in global markets. Furthermore information and technologies become generic, increasingly codifiable and are readily available via globalization. More specifically, firms find it increasingly necessary to create knowledge through linkages with other firms and organisations.
Change in technology and global competition have therefore diminished many of the traditional role of geographical location. The analysis needs to move beyond the boundaries of a region or nation state, and international knowledge linkages acquire increasing importance (Ernst, 1998).

But all that reveals only one side of the coin. In fact location remains fundamental to competition, albeit in different ways in the new techno-economic model dominated by ICTs (Cox, 1997 and Storper and Salais, 1997). The relevant knowledge base involves tacit as well as

[12] Baptista and Swann (1998) study the link between firms clustering and their probability to innovate, and find evidence of a positive relationship for the electronics sector.

increasingly codifiable and codified aspects. The former are related to firms' specialised capabilities, while the latter refer to technological knowledge which is new, widely applicable and generic. So if technology can be licensed or sourced from other locations, components and equipment can be out-sourced, more advanced dimension of competition remain geographically bounded and related to Schumpeter Mark II model. The enduring technological and competitive advantages in a global economy are often still significantly local (Cox, 1997 and Storper and Salais, 1997). In this perspective the spread of global production networks (GPN) may be understood as an organisational innovation that may enable a firm to gain quick access to higher quality and/or lower-cost foreign capabilities that are complementary to its own competencies while maintaining an effective home base for innovation activities (Ernst, 1998:5).

To our present aims, it is important to emphasise that these recent patterns impose drastic reorganisations on all enterprises. Particularly, such changes are sweeping and imply comprehensive industrial restructuring, new skills and intermediate inputs. Unless the requisite new technologies and skills can be rapidly developed, competitive advantage will shift to another enterprise, group of firms or location.

From the above analysis, two working hypotheses may be singled out:

- A shift in the technological paradigm, that applies across sectors, and that requires a substantial industrial reorganisation is being observed world-wide. Again, firms traditionally operating within the ID would need to learn to source their technological knowledge from the most convenient locations outside the ID, and to reorganise their knowledge linkages from a cluster-based approach to a wider and global approach such as the GPN model.
- The prevailing form of the 'Marshallian' ID may not be the most adequate for the new technological areas promising faster and more sustained demand in world markets. In other words the internal organisation of the Italian IDs, and its strength based on local interactions within the cluster, were essential to explain their past performance in traditional sectors. Yet, this kind of organisation may prove less capable of tackling the challenges posed by a new technological regime and an environment that demands the internationalisation of production and commercialisation, and most notably, of knowledge creation.

4. Some stylised evidence from Italy

On the basis of a recent survey carried out on three Italian IDs,[13] Guerrieri and Iammarino (2000) argue that today there is already some evidence to suggest that, into the 2000s, the organisation of economic activities in IDs will be *post-Marshallian*, that is, less locally confined and less vertically disintegrated.

The results of the survey provide some support to the hypothesis of different paths of IDs development dynamics according to the life-cycle phase of the ID. This might affect considerably the capacity to react to global and technological challenges and the consequent restructuring of the ID competitiveness. Overall, the survey seems to confirm the importance of the 'industrial atmosphere' and the strength of the Marshallian model in canonical Italian IDs. Once again, it is confirmed that Marshallian IDs, in the main, derive their competitiveness from the use of flexible and multipurpose technologies (either «traditional» or electronic), craft ability and product adaptability, rather than from the generation of new products.

However, the evidence suggests that so far, the Italian IDs specialised in traditional sectors have exploited the potential offered by the global networks to strengthen ICTs only to a very small extent. In their interpretation, the limited knowledge of new global technological languages, as well as the lack of substantial organisational changes required by the new technologies to be

[13] The following districts were the object of the analysis: Prato, Teramo (mainly S. Egidio Val Vibrata) and Modena (Carpi). The evidence is based on the interviews, carried out by means of a structured questionnaire, to a random sample of 48 textiles and clothing SMEs in the summer-autumn of 1998.

effective, may progressively cut out geographical clusters and, as a result, industrial atmosphere might not be anymore enough to stay ahead in the global economy.

One should point out that innovative activities in Italy seem to fall mostly within the 'widening' model of innovation (Schumpeter Mark I). Italy's technological advantages appear stronger when natality, mortality and discontinuities are high, and they would be associated with processes of 'creative accumulation' by a 'turbulent fringe' of SMEs, and by the activities of a small core of large firms (Malerba, Orsenigo, 1995:187)

A recent study on the cotton textile industry emphasises the relationship between the organisation of firms and industry, and the adoption and diffusion of innovation (Antonelli, Marchionatti, 1998). In the authors' view, modernisation in mature industries is shaped by the co-evolution of technological and organisational changes. In their case study of Italy's cotton textile industry they argue that the presently prevailing organisation of this sector would not be adequate to the widespread diffusion of new information technologies (NIT), a crucial condition for future success.

During the 1970s and 1980s the present structure of highly specialised, geographically clustered, family-owned small firms emerged to cope with the introduction of technological changes such as shuttle-less looms and open-end spinning. In these years, Italy has been modernising its production equipment at very fast rates, the fastest among OECD economies. In turn, given that innovation plays a central role in a sector like cotton textiles, productivity and international competitiveness increased following a cumulative virtuous cycle. This successful trend has been reversed in the late-eighties and early nineties, as firms' responses deepened the same industrial structure (i.e. technical concentration was reduced even further) and progressively slowed the adoption of technological changes. The difficulties have been related to the nature of the innovation prevailing in these years, that has taken the form of NIT.

> "NIT can be considered to be a technological system, which emerges when new technologies, that are individually more effective and productive than their substitutes, provide important scope for further improvements of productivity when associated with new organisational structures, new skills and new intermediate inputs. The successful introduction and adoption of these complementary technological and organisational innovation is part of a process of localised technological change…. Only when the appropriate mix of complementary innovations is available can the full effects in terms of productivity growth be achieved " (Antonelli and Marchionatti, 1998:9-10)

Insofar as it is possible to generalise from cotton textiles to other traditional sectors, this conclusion appears especially relevant to our present aims. Every form of industrial organisation may be suitable to different types of innovations: in other words, the adoption of the innovations required for industrial restructuring and modernisation and the ID diversification, may be constrained by the form of organisation of industry that is prevailing. It follows that the diversification of some Italian IDs now in traditional industries would require a modification of their internal organisation of industry.

What are the possible avenues for such a process to occur? In principle, larger firms, by internalising stages of production and marketing might be better equipped to adopt and make efficient use of innovation; leader firms, or hubs in the above terminology, may be in the position of facilitating this process and bear the prolonged delays between the adoption of NIT and its positive effects in terms of cost reduction and productivity growth.[14] On the contrary, small firms, in order to overcome such drawbacks, need to reach out international markets to source and generate technology, and should strive to set up forms of tighter co-ordination to exploit the possible complementarities, remedy the lack of economies of scale, and bear the cost of large minimum size and complexity of investment to adopt new technologies.[15]

[14] Bagella and Pietrobelli, 1997, explored the hypothesis of the necessary existence of a leader-firm for the internationalisation of an ID.

[15] Organisation changes include modifications such as: closer interaction among internal functions such as production, marketing, finance and strategic decision making; higher levels of vertical integration and product diversification; closer interaction with customers and providers of intermediate goods and services, etc…

In a recent series of studies attempting to monitor the evolution of the Italian IDs (Censis, 1997 and 1998), the following main features have been noticed:[16]

- an expansion of the relationships between the ID firms and international markets and agents, that are not limited to imports and exports, but are increasingly including : decentralization of (parts of) the production, exports of licenses, technology transfers, alliances with foreign firms. This appears to happen mainly with Eastern Europe and the Mediterranean countries;
- a less frequent entry of foreign firms (sometimes multinational corporations) into the ID through acquisitions of local firms.

In other words, the internal organisation of the Italian ID would be shifting from the traditional *circle* (horizontally and vertically integrated organisations geared to production and innovation and located in the same, confined, area) model, to a *star*, that is centred on a strong and clearly defined kernel and spreading out with long rays (Censis, 1997). This would be the consequence of the growing globalisation of markets and of the more competitive framework.

Additional empirical evidence is provided by two recent studies of Bursi et al. (1996 and 1997). They focus on the textile and clothing enterprises in Emilia Romagna, and single out three competitive strategies followed by these firms in the years 1993-97:

- **A high reputation - high quality and market oriented** group, that includes enterprises offering a wide range of products, of a high quality, clearly identified in the market, that sell mainly under their own brand name, with their own offices abroad or large high quality specialised retailers. Firms in this group have a smaller average size with great variance (large and small firms coexist), a high export propensity (40%), and they are also very active in de-localising production (50% of this group has de-localised at least part of its activities).

- **Traditional competitive model:** Sales of these enterprises are falling, and they produce essentially low quality-low price knitwear. They never sell only with their own brand name, sometimes with their customers', and have a high export propensity (60%), mostly to Europe (90%). In the home market they sell essentially to customers with low reputation and large sales' size.

- **Suppliers of large, mainly foreign, purchasing centres.** Their sales have been growing, they are the smallest firms, that offer a small range of products of low-medium quality-price ratio, and are specialised in production services to other firms. Their goods are sold under their customers' brand name, and they appear to have the highest export propensity (85%); 44% of them do not sell anything to the Italian market,

A central result of these studies is to highlight that there is not only one strategy of production, trade and marketing to be competitive. However, only the first and the third strategies have been successful, both implying innovative efforts, though of different kinds. In fact, the first strategy has been typically chosen by enterprises capable of building their quality and reputation, mainly through their own actions. In contrast, firms in the third group have increasingly relied on the organisation and innovation provided by large, often foreign, buyers, giving up part of their independence in exchange for the customers' brand names and transfer of technology. In contrast, the group of enterprises lacking an aggressive innovative strategy of structural reorganisation (second group) is dramatically falling back.

Additional evidence of the increasing hierarchisation of relations among firms within the Italian IDs has been provided recently (IDSE-CNR, 1999), and suggests that the network of inter-firm relationships is quickly taking a more formalised and structured nature. This is especially occurring in IDs specialised in less traditional sectors, such as metalworking, where the network of relationships is assuming a more structured nature, often involving equity linkages, with potential forms of emerging leadership. In contrast, in traditional sectors such as the textiles, clothing and shoes, the informal network of relations of subcontracting, interactions with local

[16] These studies are based on a structured questionnaire to a panel of selected 'privileged observers' of a selection of 40 IDs, that has been repeated every year since 1996 (Censis, 1997 and 1998).

institutions and within producers' associations is not changing, but it still enables SMEs with a little sophisticated internal organisation to be competitive.

Finally, the presence of new leaderships in the IDs, together with the remarkable opening of the leaders to resources and assets external to the original district, appear to positively affect the system's economic performance and competitiveness (Grassi and Pagni, 1998). [17]

5. Conclusions

The broader notion of ID proposed by Markusen (1996) encompasses a wider range of forms of industrial organisation than the Marshallian-Italian concept of ID. It appears more capable of explaining the different technological and industrial specialisations prevailing in the different regions, and their evolution along lines of upgrading the**ir** productive specialisation. Thus, hub-and-spoke variants – with one or more hubs or 'leaders', like large firms or non-profit institutions seem better equipped to upgrade their specialisation pattern to more technologically complex activities, and radically alter and modernise their organisation.

The divide in the empirical evidence and in theoretical approaches appears to be between traditional forms of inter-firm organisation and relationships *versus* more dynamic forms of restructuring with product diversification, progress of the technological system, and improvements of more complex relationships with firms and institutions local as well as external to the district.

Marshallian proper ID, and their Italian version, are expected to be less equipped to cope with structural technological transformation and provide a complex and articulated response. The frequent response, often very effective, has been within the 'deepening product specialisation and upgrading' mould, where individual (isolated) actions of SMEs prove sufficient to resist and articulate a sort of *niche* response. 'Soft' strategies have been centred on product quality improvements, better marketing and distribution, quick reaction to changes in market demand and long-standing reputation..

A first and insightful explanation of these difference may be provided by the strand of literature that emphasises the link between industrial organisation and technological change and innovation. Within this interpretative framework, the hypotheses of the shift in the technological paradigm, that applies to all sectors and requires a substantial industrial reorganisation, .have been highlighted in the paper. It follows that firms traditionally operating within the ID mould, need to learn to source their technological knowledge from the most convenient locations outside the ID, and to reorganise their knowledge linkages from a cluster-based approach to a global, GPN's approach.

In this perspective we have argued that the prevailing form of the 'Marshallian' ID may not be the most adequate for exploiting the new technological opportunities promising faster and more sustained demand in world markets. These hypotheses, in spite of the heterogeneity of experiences, appear to be supported by the stylised evidence presented, and cast doubts on the capability of the Italian IDs to respond to these challenges and design and implement an appropriate strategy.

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[17] Examples of a dynamic form of reorganisation exist in Italy, but are few and isolated, such as the networks developing around INVICTA (Belussi and Arcangeli, 1998, Camagni, 1997)

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