The «Enterprise of Innovation» in hard times: corporate culture and performance in Italian high-tech companies

The "Enterprise of Innovation" in Hard Times. Corporate Culture and and Performance in Italian High Tech Companies

Journal
European Planning Studies
Volume 25, 2017 - Issue 11: SPECIAL ISSUE ON CULTURE AND INNOVATION IN SMEs AND MICRO FIRMS
Pages 1954-1975 | Received 10 Sep 2016, Accepted 17 Apr 2017, Published online: 10 May 2017

Abstract
The article deals with the strategies that Italian innovative manufacturing companies have deployed in recent years. Italy has, in fact, been hit particularly severely by the international crisis, which has brought with it a sharp decline in employment and a narrowing of the productive base. That said, we know very little about the Italian entrepreneurs' strategies to cope with the economic downturn. To address this topic, the author has used a sample of over 400 Italian companies with European patents in the sectors of mechanical engineering and high technology (EPO-companies), which were investigated by means of a panel-survey: a longitudinal study carried out on the same companies at different times (2010 and 2012). The analysis has two main goals: 1) to describe the socio-economic and territorial characteristics of EPO-companies and their strategies in the years of the crisis; 2) to examine the influence of a "collaborative corporate culture" on company performance. What emerges from the research into EPO-companies is the complementarity of resources useful for innovation and economic performance, between: a) the internal and external relations of the organization; b) the variety of knowledge and cohesion of relationships; c) the short and long networks of collaboration. In conclusion, successful company strategies are those which – thanks to a collaborative company culture – are able to exploit the *embedded complementarity of innovative resources*.

Key words:
Innovative companies; collaborative corporate culture; Company's strategies during the economic crisis; Italy

1. Introduction

One of the central themes in literature on economic innovation is the ability to cooperate in this particular area, especially where small and medium companies are concerned. There are two sides to this issue: one internal, one external. While the first concerns the endowment of human capital and organizational strategies that facilitate collaboration and innovative creativity, the second regards the possibility of access to resources external to the company. These are two sides of the same coin, since getting the best results from the latter depends on both the absorptive capacity of the company and the territorial endowment of resources and local collective goods. If on the one hand external resources increase the *requisite variety* of knowledge, on the other, internal resources are important to potentiate the *capacity of productive use* of such knowledge.

Innovation studies often tend to emphasize that innovation is the result of a combination of various ideas. Picking up on the suggestion of Schumpeter (1912), different authors have defined innovation as a problem-solving process of a combinatorial type: that is, oriented

towards the search for new combinations with known elements as a starting point. With reference to technological change in particular, stress is placed on the importance of the circulation of knowledge to increase the variety of experiences and ideas available to companies. In short, attention is focused on the *socio-cognitive dimension* of innovation. This perspective, however, is a reductive one. The search for new technical solutions, in fact, is only one aspect of the phenomenon we are dealing with – which is broader and more complex.

Firstly, economic innovation is not limited to technological change. Following Keith Pavitt's observation, we can think of it as a process that involves "matching technological opportunities with market needs and organizational practices" (2005, p. 88). Secondly, these combinatorial processes are embedded in social and economic relations, i.e. in learning networks, which are organizationally and territorially structured. Thirdly, the socio-cognitive aspect of innovation is closely linked to the *socio-normative dimension* – such as the internal cohesion of project teams, the social capital available to the company, etc. Both these dimensions are important: the assortment of cognitive resources (variety of knowledge) that facilitate the search for innovative combinations, and the presence of socio-normative resources (cohesion and social capital) that facilitate the exchange of ideas and interactive learning processes inside and outside the company. In other words, innovation actors inside the companies (be they entrepreneurs, researchers, employees, etc.) make use of organizational relationships and personal ties, which convey cognitive resources of variety, as well as normative resources of cohesion and trust.

From this point of view, the study of "corporate culture" – which includes both the socio-cognitive and socio-normative dimensions – is particularly relevant. With these terms, I refer to the system of meanings and shared practices that guide both the internal relations, between management and employees, and external relations with other actors (companies, customers, suppliers, research centres, local governments etc.). Corporate culture consists of two interrelated aspects: 1) the cognitive and normative *dispositions* that guide behaviour; 2) the organizational and relational *practices* that convey these and embed them internally.

The first aspect (*dispositions*) can be compared to what in the social sciences – with reference to individuals – is called "attitude", i.e. a particular dispositional state based on a combination of knowledge, values and beliefs that define the style of the company and direct the decisions and behaviour of the management on specific issues. These dispositions – which are more or less shared and supported throughout the organization – have a structured character, connected both to contextual factors (linked to the productive sector, region and country in which the companies operate) and to factors of a more idiosyncratic kind (related to the specific experience and skills accumulated in the company's history).

The second aspect (*practices*), on the other hand, draws on two strands of the study of innovation and creativity, which emphasize the organizational and interactional aspects underlying the cognitive and normative dimensions. While one strand explores the relationship between organizational design and the ways in which companies learn and innovate (Arundel, Lorenz, Lundvall & Valeyre, 2007), the other is that of the *cultural network analysis* of socio-cognitive spaces. The latter brings together the study of cultural structures – understood as group skills and cognitive styles that are developed through social relations – and the study of groups social structures – understood as networks of belonging and interaction (De Vaan, Vedres & Stark, 2015).

Seen in the light of these contributions, corporate culture throws an analytical bridge between structure and agency, as well as between reproduction and change. On the one hand, in fact, it embodies dispositions of action shaped by the socio-economic context and previous experience, which tend to reproduce the company's routine strategies. On the other hand, however, these same dispositions – subjected to new economic challenges – can steer management behaviour in the direction of innovation. Paraphrasing Giddens, there therefore

exists a constitutive "dualism" in corporate culture connected to the fact that it is not only *structured* but also *structuring*.
This article will address the theme of corporate culture and cooperative attitudes by means of data deriving from empirical research on a sample of Italian manufacturing companies with European patents – companies that have been forced to face up to the acute challenge presented by the economic downturn of recent years. Italy has, in fact, been hit particularly severely by the international crisis, which has brought with it a sharp decline in employment and a narrowing of the productive base. That said, we know very little about the strategies that Italian entrepreneurs, especially the more innovative ones, have deployed in order to cope with the crisis.
To address this topic I have mainly used a sample of over 400 innovative Italian companies, with patents granted between 1995 and 2004 (that is, before the crisis) by the European Patent Office (EPO) in the sectors of mechanical engineering and high technology.[1] These companies were investigated by means of a panel-survey: a longitudinal study carried out on the *same* firms at *different* times (at the beginning of 2010 and at the end of 2012).[2] The analysis carried out in this article has two main goals: 1) to describe the socio-economic and territorial characteristics of EPO-companies and their strategies in the years of the crisis; 2) to examine the influence of a "collaborative corporate culture" on company performance. As a proxy to measure this latter dimension, I will use the attitude of the EPO-companies in terms of building cooperative relationships both internally, through a strategy of *strategic integration* that valorises human capital and organizational flexibility, and externally, through innovative partnerships with other actors.
The article is organized in the following way. In the next two sections (§ 2-3), I will present – concisely and with no claims to exhaustiveness – certain contributions that have stressed the importance of territorial proximity and organizational strategies in order to understand the economic and innovative performance of companies. In the three following sections (§ 4-5-6), I will illustrate the distinctive profile of EPO-companies. Finally, in the last two sections (§ 7-8), I will analyse the performance of the latter and draw some conclusions of a more general nature.

2. Contextual factors: the geography of innovation

Innovation does not happen everywhere. It tends to agglomerate in certain places, rich in resources strictly linked to the socio-institutional context (universities, research centres, advanced services, etc.). The spatial dimension is important for innovation for three main reasons. The first is that the introduction of new products and production processes involves the interaction and exchange between a plurality of actors (companies, governments, research centres); it is configured as a joint process of creation and/or application of new knowledge, which is facilitated by spatial proximity (Asheim & Gertler, 2005).
The second reason relates to the importance of *local collective competition goods* which create external economies, that is to say special benefits for the companies, because they both lower

[1] These productive sectors represent the majority of Italian patents in Europe: the mechanical engineering sector covers 31%, the high-tech sector 24%. Patents are a well-established indicator in the scientific literature (especially in the economic field) that studies innovative output. For a discussion of the analytical potential, as well as the limitations, of this indicator, see Ramella & Trigilia (2010a).
[2] These two surveys form part of a larger investigation into the geography of innovation in high technology in Italy that I carried out with Carlo Trigilia (Ramella & Trigilia 2010a, 2010b). For details, see the Methodological Appendix.

production costs and increase innovative capacity. These externalities can be either tangible or intangible: the former include infrastructure and local services; the latter, both cognitive and normative resources, such as tacit, contextualised knowledge, conventions, norms of reciprocity, and local social capital (Crouch, Le Galès, Trigilia, & Voelzkow, 2001).
The third reason is linked to knowledge spillovers – the, more or less voluntary, circulation of information and knowledge produced in the activity of research and innovation. Knowledge spillovers produce positive externalities which also benefit actors who have not contributed to the production of the knowledge. As a result, the innovative performance of companies depends not only on the resources that they invest in research (within the company itself), but also from those invested by other companies and other actors in the same sector or related sectors, as well as by universities, research centres, etc.. The appropriation of these spillovers is linked, however, to proximity to the source of new knowledge, and this proximity becomes even more relevant the more "tacit knowledge" is also used in the innovation (Polanyi, 1966).
In fact, this territorial expertise, rather than disappearing, actually assumes particular importance against the backdrop of globalisation processes. The more codified knowledge circulates easily through global networks, the more tacit knowledge becomes a strategic asset, generating a competitive advantage that is difficult to imitate (Maskell & Malmberg, 1999). In short, the production and dissemination of – economically significant – new knowledge often take place at a local level, in territorial systems of innovation, through the dynamics of learning through interacting (Lundvall & Johnson, 1994).
Various strands of the literature have contributed to the re-discovery of the "territories of innovation". Some economists have explored either the existence of "geographically bounded" spillovers, or the "localized effects of university research" due to the human capital conveyed by star scientists. Others have worked on systems of innovation at the national and regional level and on the competitive advantages created by agglomeration economies (Ramella, 2016). In general, however, economists have mainly underlined the cognitive aspects of the circulation of information and knowledge and the importance of territorial proximity in facilitating this circulation. In the most recent years, however, economic geographers have elaborated a gradual "relativisation" and "socialisation" of the concepts of distance and proximity and their transformation in relational terms (Rodríguez-Pose, 2011). Recent considerations have attempted to make these categories less static and more processual, transforming them into a continuum of multi-level relations – relations, that is, that take place on different territorial levels. In other words, there is a "relational stretching" of the distance/proximity dyad, with the result that these concepts lose their exclusive anchorage to the dimension of geographical space. In this way, distance is socialised: different types of relationship between the actors render territorial proximity more or less important and proximity thus becomes a multidimensional concept (Boschma, 2005).
Finally sociologists, have helped to understand the social construction of innovation at different territorial and analytical levels. At the macro (global and national) and meso (regional and local) level of analysis, they have underlined the importance of the socio-institutional context and of the "modes of regulation", exploring the links between different varieties of capitalisms and their regime of innovation. At the micro-level, they have analysed the social embeddedness of economic activities, underlining the influence of networks of interactions among innovative actors (Ramella, 2016).

3. Agency and relational factors: entrepreneurial strategies

That said, the emphasis placed on the territorial and systemic aspects of innovation should not over-restrict the space attributed to *agency and relational factors* – in other words, to entrepreneurial strategies. As has been pointed out, a common error in various institutional

and systemic approaches is to read the behaviour of the actors – the companies, for instance – only through the characteristics of the contexts in which they operate (Gertler, 2010, p. 5). But companies have a certain strategic autonomy with regard to the institutional contexts to which they pertain: they are not exclusively *rule-takers* but also *rule-makers* (Crouch, Schröder, & Voelzkow, 2009). They derive a substantial degree of freedom from the reflexive re-elaboration of the repertoire of skills and experience they have inherited from their own past. And this in a way that is partly independent of the industry and the country in which they operate. Susan Berger (2005) described this approach as the "dynamic legacies model".

The study of innovation cannot, therefore, leave the choices made by companies, and their competitive and organisational strategies, out of consideration. With regard to the latter, for example, certain studies link the innovative capacity of companies to the specific organizational designs that they adopt. Research carried out by Lester and Piore (2004) on case studies in the fields of mobile phones, medical appliances and clothing, shows that the most important innovations derive from an organizational and management approach of an "interpretive" type. The authors contrast two different procedural approaches to problem-solving: analytical and interpretive. *Analytical processes* are those that can be applied when the problems to be solved and the possible results are well-known. *Interpretive processes*, however, are more appropriate when neither the decision alternatives nor the possible outcomes are known in advance. Solutions, therefore, must be sought by exploring the frontier of innovation. In the latter case, the activity of discovering new solutions proceeds through *interpretive conversations* between people that pertain to different organizational areas and work teams. Managerial activity, therefore, is aimed at promoting the open exchange of communication and integrating a variety of resources in order to cross predetermined cognitive and organizational boundaries. The results of the study shed light on how the creation of these "interpretive spaces" – open to the contribution of a plurality of subjects – produces the best results.

The three case studies analysed by David Stark (2009) – through ethnographic research on the media and on finance in the United States, and on the machine tool sector in Hungary – also bring out this interpretive aspect in relation to innovation. This is especially true when organizations find themselves operating in competitive environments characterised by scenarios of radical uncertainty. In these contexts the best performance is obtained by *heterarchical organisations*, which are able to take advantage of the uncertainty, nurturing an ongoing capacity for innovation. These organizations tend to systematically and intentionally question organizational routine and foster copresence and dialogue between different evaluative criteria, deriving from different units and skills. *Heterarchy*, therefore, represents a strategy that tends to "organise dissonance", exploiting the intelligence dispersed within an organization and coordinating it, without suppressing the presence of different principles of evaluation and valorisation. The interactive coexistence of dissonant elements, generates "creative frictions" and these foster the innovative recombination of resources.

If, on the one hand, this perspective on business reclaims the analytical independence of "agency factors", it does not, on the other, mean isolating the companies from the context in which they operate. On the contrary, what is really interesting is to see how they are able to exploit the opportunities or compensate for obstacles which are present in the context, developing *interactive learning networks* (relational factors). Both internally, and externally. In fact, in recent years, emphasis has been placed on the development of organizational forms that are not only more flexible but also more open to collaboration with other actors, including businesses, universities, local agencies etc. The rapidity of technological change, the uncertainty of its evolutionary trajectories, growing international competition, and the pluralisation of knowledge sources have made companies more dependent on external resources. Inter-organizational partnerships (alliances between companies, collaboration with universities, etc.) have therefore multiplied, especially in the field of research and innovation.

And this has focused the attention of Innovation Studies on the social and economic networks that support them (Powell & Grodal, 2005).
In conclusion, the different business strategies (agency and relational factors) help to explain the significant heterogeneity of performance observed both in the territories and in the productive sectors (contextual factors). And yet, where the behaviour of the most innovative companies during the international economic crisis is concerned, we know relatively little.

4. The profile of the innovative Italian companies

Italy represents a particularly interesting case in terms of analysing the issues mentioned in the two preceding sections, and for two reasons. The first because it embodies a regionalised model of capitalism with a strong territorial agglomeration of innovation (Trigilia and Burroni 2009; Ramella and Trigilia 2010a, 2010b; Burroni and Trigilia 2011). Secondly, because its production structure has been highly modified by the crisis, and it therefore becomes interesting to understand if and how the adoption of a particular management strategy – collaborative in nature – has helped some firms to cope with this radical challenge.
With regard to the first point, as is well-known, Italy is the second largest manufacturing country in Europe. Perhaps less well-known is the fact that this also applies to medium-high and high technology sectors. Grouping these productive sectors together, it turns out that, in 2012, Italy was first in Europe in terms of number of companies, second in terms of volume of employment and third in terms of turnover and value added (calculations based on Eurostat data). This indicates an extremely respectable productive potential that, however, does not seem able to translate into an equivalent capacity for innovation, as the data regarding patenting clearly highlights. In general, Italian patenting intensity is fairly low, standing at around two-thirds of the European average (70 patents per million inhabitants vs. 109), but it is the country's performance in high-tech sectors that is, in fact, far from satisfactory, where it manages only a quarter of the EU average (2.8 vs 10.5). The gap, in other words, increases precisely in the productive sectors where the deficiencies of the national/regional systems of innovation have a stronger and more negative impact.
As regards the second point, it should be remembered that the blow delivered by the international economic crisis to the Italian manufacturing system was a particularly severe one. There has been not only a significant slowdown in economic growth, but also a drastic reduction in employment and investment.[3] And yet, less negative signals also emerged in the years of crisis, such as an increase in the percentage of companies taking a pro-active approach by investing in innovation.[4] Analysing the profile of innovative companies, especially in high technology areas, may therefore prove interesting in terms of defining the ingredients (external and internal) that explain this improved performance.
To investigate this question, a survey was therefore carried out on Italian companies with European patents in the fields of mechanical engineering and high technology (EPO-companies). 407 companies responded – in whole or in part – to the first questionnaire (see the Methodological Appendix), with a total of 1,478 patents, an average of 3.6 per firm. Their

[3] Giving the per capita GDP of the EU a value of 100, in 2000 Italy had a value of 120. In 2014, this fell to 98, with a reduction of as many as 22 percentage points.
[4] For greater detail regarding the effects of the economic crisis on Italy and the Mediterranean countries, see Donatiello and Ramella (2017).

territorial origin is concentrated in the more developed regions of Italy. 43% are located in the north-west and 50% – especially those involved with mechanical engineering – in the Central and North-east regions: the so-called "Third Italy".

Their biographical and structural profile highlights the solidity of the EPO-companies. Almost 80% have been active for over 20 years. Although there is a clear prevalence of small and medium-sized companies (under 250 employees), about half are medium-large (over 50 employees) and have a good turnover (over 10 million euros) and high labour productivity (with a turnover per employee of around 257,000 euros). In the main, they are companies that cater to national and international markets, providing – particularly in the engineering sector – intermediate and capital goods (machinery and components) that other companies use to produce goods destined for final consumers.

The areas in which they operate are characterized by a high level of competition and radical uncertainty, and human capital is one of the key resources to address these competitive scenarios: 49% of entrepreneurs are university graduates and half of the employees have a high-school diploma or a certificate of higher education. Internal training is also given a great deal of attention. Overall, we are in the presence of solid companies with a good level of production performance. And this is the first distinctive aspect of EPO-companies. To see this clearly, it is only necessary to compare their profiles with the average profile present in the same areas at a national level (Table 1).

Table 1 Profile of EPO companies compared to average national values

	EPO companies			National companies		
	High technology	Mechanical engineering	Total	High technology	Mechanical engineering	Total
Employees						
Up to 9 employees	10.1	8.7	9.1	88.8	75.8	81.3
10-49 employees	31.9	38.1	36.3	8.7	19.8	15.1
50-249 employees	37.7	31.2	33.1	2.0	3.8	3.1
250 employees and more	20.3	22.0	21.5	0.5	0.6	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
Up to 19 employees						
Turnover (thousand euros)	2,116	2,524	2,419	289	567	444
Turnover per employee (thousand euros)	181	268	244	104	130	121
% of turnover on exports	44.0	42.5	42.9	14.3	24.8	21.8
20 employees and more						
Turnover (thousand euros)	352,108	57,538	142,339	34,860	21,273	24,974
Turnover per employee (thousand euros)	378	215	262	254	248	250
% of turnover on exports	53.4	63.8	60.7	36.5	52.6	46.5

Source: EP0-*survey 2010*; Istat *Conti economici delle imprese*, 2010, our elaborations.

Amongst EPO-companies, micro-businesses with fewer than 10 workers are seriously under-represented: just 9%, while in Italy they exceed 80%. Conversely, medium and large companies (over 50 employees) are over-represented: 55% against an Italian average that approaches only 4%. Where size is similar, performance is higher in terms of turnover, labour productivity and export capacity. The gap is particularly significant for smaller companies. Those with fewer than 20 employees have a turnover six times higher than other Italian companies operating in

the same sectors, while labour productivity and export share are nearly double. Such performance levels are extremely important, highlighting high competitive capacity linked – as we shall see – to innovation.

5. Research activity

EPO-companies invest heavily in research and development (R&D). On average in the mechanical engineering sector, a 5% share of the turnover is devoted to this area, while for high technology companies the figure is 7%. These are considerable resources, especially as regards the first of the two sectors. Research work is carried out by specific project teams, present in 79% of EPO-companies (source: EP0-*survey 2010*). The work of the teams is overseen by senior managerial figures who ensure the coordination and integration of the various projects. Team organization follows a precise model, characterised by cohesion and flexibility: coordination by one or more people is accompanied, as regards researchers, by a strong tendency towards self-management in their work. It is a matter, therefore, of small, highly cohesive work groups, within which researchers enjoy a considerable level of autonomy in carrying out their duties.
Informal discussions with colleagues – especially those working for the same company – play a particularly important role. These ongoing dialogues represent the hidden ingredient in what we might call the "dialectic of discovery". This is the subtle weft of conversation (more or less formalized), exchanges of ideas, lively discussions and occasional clashes, which does not exclude playfulness, that leads the group work towards the invention (which may or may not patented).

> These discussions (...) are usually never organized. They take place in the canteen, or after 5.00 pm, or over a pizza, when we're chatting about how a particular machine should be made (mechanical sector).

These conversations accompany the process of discovery both in the generative phase of invention – that is, in the work done before the discovery – and in the later phase of verification and development of the new idea hatched at the crucial moment of *insight*.

> When an idea comes to you, it doesn't immediately come all wrapped up and finished, with the colours and details all in place. Instead, you have this nebulous, confusing stuff that you can't represent or build. So then comes a phase when the nebulous, out-of-focus stuff has to be clarified. And talking to others can be very useful to move this idea on from the nebulous phase to the stage where it becomes clear and defined (mechanical sector).

It is not only the ongoing confrontation with close colleagues that is important, however, but also the cooperation with, and flow of information through, the various teams present in the same organization. And this requires a specific corporate culture and an organizational approach capable of generating positive-sum games and nourish mutual trust, so as to avoid what one interviewee defines as the "closed drawer" trap.

> Office relationships are important. (...) You can't have the "closed drawer" philosophy going around, because that way you'll never get anywhere (mechanical sector).

> You'd try and do something together with the laboratories and then you'd come back and re-discuss everything. (...) In one laboratory there could also be people working on different types of projects, but there was always a discussion going on (pharmaceutical sector).

Alongside these elements, however, the role played by the plurality of skills and knowledge available should not be forgotten. The variety of cognitive resources[5] is, in fact, crucial for the success of inventions and their subsequent development. In 59% of cases, the skills of researchers are defined by interviewees as *akin*: all the team members belong to the same scientific field, but with quite different specializations. In 30% of companies, however, the skills are highly *heterogeneous* and involve the collaboration of researchers from a variety of scientific and technological fields. Finally, in the remaining 11% of cases, there are teams with very *homogenous* skills (source: Inventors-Survey).
The variety of internal skills influences the absorptive capacity of the project teams and, more generally, of the companies themselves (Cohen & Levinthal, 1990). The presence of a plurality of specializations, in fact, increases their ability to absorb information from outside. To acquire the knowledge that is useful to them, companies make extensive use of different sources of information: some comes from the company itself or from other companies within the same group (*internal sources*); other information is derived from relationships with suppliers, customers, competitors, etc. (*external market sources*); and more again arrives from relationships with research institutes, universities, consultants etc. (*external technico-scientific sources*). In general, EPO-companies mainly make use of the first two types of channels. But what most differentiates them is the use of knowledge from the scientific and technological community that is superior not only in high-tech sectors and in the larger companies, but also in those with a greater endowment of researchers and with more diverse skills in project teams. A variety of internal resources (the extent and plurality of skills), therefore, significantly influences innovative capacity. In general, a deficit in variety greatly hinders the production of new and truly creative ideas which require, in addition to synergy within the team, organizational models that allow the circulation of various types of knowledge, derived by the company from both internal and external sources.

> (The most innovative companies are those where) information circulates, both vertically and horizontally. Success is information plus integration, because sometimes it's opposing knowledge and skills that create the solution. (...) Working time has to be broken up, to create discontinuity in the routine; and this generates stress, generates ideas... in fact, I'd say that ideas are produced under stress. (...) And

[5] In other words, the extent and plurality of knowledge and skill available within the company or acquired through external relations.

> that's why we need to have teams with different knowledge and different skills (mechanical sector).

As can be seen, these observations are very much in line with the interpretive approach to problem solving, highlighted by Lester and Piore, and with the heterarchical organizational forms described by David Stark. These results are also confirmed in studies on organizations at the cutting-edge of scientific research (Hollingsworth, R. Hollingsworth, E.J. & Hage 2008).

6. The social and territorial embeddedness of EPO-companies

As previously mentioned, however, organizational flexibility and internal skills alone are not enough to ensure good innovative performance. Since the mid-nineties, innovation studies have shown growing interest in inter-organizational relationships due to the exponential increase in collaborative relations between companies, especially those in the high-tech sectors (Hagedoorn, 2002 , pp. 479-482), and the diffusion of business strategies based on *open innovation* (Chesbrough, 2003).

Collaborative practices of this kind are widespread among Italian EPO-companies. Overall, 70% of EPO-companies have at least one *innovative partnership*: 59% of them have at least one partnership with other companies (mainly small and medium size) and 54% with a research centre or university (source: EP0-*survey 2010*). These are extraordinarily high figures, as is clear from the comparison with national averages. In Italy, in fact, in the same period in which we conducted the research, only 13% of innovative companies had cooperation agreements for innovation with external partners: this was the lowest percentage in Europe, where on average recorded values were 25% (CIS, 2010). While percentages rise in the high technology sector, they still place Italy in the lowest positions in European ranking. The point, to emphasis, therefore, is *the pervasiveness of innovative partnerships, which represent a highly distinctive element of EPO-companies*.

But what kind of collaborations are they? Most of them involve partners located at a certain geographical distance: they are based, in other words, on "long networks" (extra-regional) that make it possible for them to acquire *non-redundant* knowledge and skills – that is, resources and information different to those already in possession of the company and which are not available in the surrounding area. 42% of companies have partnerships with national companies and 34% with foreign companies; 34% with national universities or research centres, and 17% with foreign institutions. This does not mean that short networks – relations with local/regional companies and universities – are not significant: 48% have at least one collaboration of this kind (source: EP0-*survey 2010*). However, long networks should not be seen as in opposition to short networks, since in most cases they coexist and nourish each other. In fact, amongst companies with at least one partnership, those that combine regional/local and extra-regional collaborations represent the majority: 56.3%. Companies with *only* regional/local collaborations amount to 14%, while those who have *only* extra-regional collaborations amount to 29.7%.

Similarly, it would be a mistake to identify these innovative partnerships, which convey a variety of resources, with relationships governed exclusively by the market. Interviewees were asked to rank innovative partnerships with other companies, distinguishing between those with whom they have an occasional kind of relationship based solely on the logic of the market (*market ties*) and those with whom they have established relationships over a period of time and where trust plays a major role (*socio-economic ties*). In two thirds of cases, it is this second

type of relationship that prevails. And this is regardless of the sectors, the size of the companies and the geographical location of the partner. Our research therefore clearly shows the predominant role of - long lasting and trust based - "strong ties" in the structuring of innovative partnerships, both local and non-local. In fact, the importance of tacit knowledge, but also the risks of opportunism related to the use of more codified knowledge, make the fiduciary aspect particularly significant for this type of transaction.

These *interactive learning networks*, which, as we have said, distinguish EPO-companies, should not however be isolated from the internal characteristics of these companies, since they affect performance only through the mediation of precise organizational strategies. This is clearly shown by an index that detects an organizational model based on the companies' *strategic integration*. This index brings together two dimensions: a) the endowment of graduates and the presence of training activities carried out within the company (human capital); b) the autonomy of research teams and researchers combined with the strong commitment of employees to the company's objectives (organizational flexibility and cohesion).[6]

In other words, the index highlights a corporate culture oriented towards collaboration, which on the one hand is based on an entrepreneurial strategy to valorise the company's human capital and absorptive capacity and on the other on a flexible and decentralized organizational model that involves the participation of researchers and employees. They are, then, learning organizations (Arundel, Lorenz, Lundvall & Valeyre, 2007), and this also leads to the activation of external collaborations. In the case of EPO-companies, in fact, high scores on the *strategic integration* index are associated – even taking into account productive sectors and dimensions – to a greater number of external innovative partnerships (Table 2) and – as we will see – to a better level of economic performance.

Table 2 Innovative partnerships. Collaborations with companies, universities and research centres based on the index of strategic integration (% values)

Level of strategic integration	Medium -Low	High
No collaboration	23.9	15.1
From 1 to 5	41.1	31.4
Over 5	35.0	53.5
Total	100.0	100
No. cases	180	172

Source: EP0-*survey 2010*

Note: The "strategic integration index" was derived from analysis both semantic (affinity of content) and statistical (factor analysis) conducted on five variables: (V1) the percentage of graduate employees; (V2) the presence of internal training; (V3) the operational autonomy of the research team; (V4) the autonomy of the team's researchers; (V5) the existence of a strong employee commitment to the company's goals. Factor analysis was conducted with the statistical program SPSS, using the method of main components and oblique rotation (direct oblimin). The analysis led to the extraction of two factors that together explain 50.1% of the variance. The Kaiser-Meyer-Oikin (KMO) test registers a sufficient value, even if not good, equal to 0.53 while the Bartlett sphericity test gave a significant result ($p \leq 0.01$). On the basis of this

[6] For details see the Methodological Appendix, point no. 4.

analysis, two indices were built. The first – organizational flexibility and cohesion – is based on the last three variables (v3 + v4 + v5) and assumes the maximum value when there is simultaneous occurrence of team autonomy, researcher autonomy and employee involvement. The second – *human capital* – is based on the first two variables (v1 + v2) and assumes the maximum value in case of the coexistence of a high endowment of graduates and training activities. The two indices were then aggregated in the strategic integration index (range of variation 0-2), which was used exclusively for typological purposes – i.e. to identify an organizational type characterized by high levels of human capital/organizational flexibility and cohesion (index scores => 1.5). For other details see Appendix.

To this must be added the fact already mentioned in the second section, and that is that the embeddedness of innovation also has a clear territorial matrix. EPO-companies are highly agglomerated in urban areas and most of them are from innovation leading systems in the mechanical engineering and high-tech sectors, which register the vast majority of Italian patenting activities in the two sectors. The identification of the social and economic characteristics of innovation territories was one of the objectives of the survey on Italian companies with European patents. The study of the territorial context has revealed a highly qualified environmental profile not only from an economic-productive point of view, but also in terms of the endowment of local collective goods.[7]

What makes the innovation leading systems in the sectors of mechanical engineering and high-tech stand out? Compared to other local economic systems (control group) – endowed with good entrepreneurial and productive resources in the two sectors but with a far lower patenting capacity – what most differentiates the leading systems is the quality of the local collective goods. In fact, in order to develop a highly innovative local system, in addition to an adequate economic and entrepreneurial base, the support of a strong institutional structure is also necessary; the latter comprises a good endowment of human capital and university centres, a developed infrastructure network, advanced services and a high quality of life. The relevance of "contextual factors" also finds precise confirmation in the evaluations given by our interviewees regarding the quality and importance of collective goods present in their territory (Table 3).

Table 3 Local collective goods present in the territorial area where EPO companies are located (% values)

[7] This part of the study was carried out using ecological variables, a series of indicators and indices, highly disaggregated at territorial level, and deriving from a plurality of sources. For data sources and the ecological results of the analysis, please consult Biagiotti (2010).

% of EPO companies that answered that are:	present in the territory in which they are located	important for the success of their innovations (Score >5 - scale 1/10)
Private services for research and innovation	69.0	53.2
Private services for legal and commercial consultancy	82.7	54.0
Universities and public research centres	86.5	65.2
Specialised financial services for innovative activities	65.6	51.3
Possibility of collaboration with other companies	76.8	66.1
Possibility of collaboration with clients	80.7	79.9
Good endowment of human resources	77.7	80.6
Good communication and logistic infrastructure	75.5	73.2
Good quality of public services	54.5	60.2
Good standard of living	87.1	77.8

Source: EP0-*survey 2010*.

7. Innovative and economic performances

This brings us to the performance of EPO-companies during the years of the economic crisis. The R&D activities carried out in the preceding years have on the whole produced positive economic results. In fact, almost a third of the turnover of EPO-companies is derived from patented products. There is, however, no automatic link between research, patenting, innovation and economic performance. Patent activity is often regarded as a proxy for *innovative output*. In reality, it indicates above all the attitude of companies towards research. First, it shows technological capacity and *inventive output* and, secondly, competitive strategies (not all patents are marketed, since sometimes their main purpose is to block the competition rather than contribute towards innovation). It is a good idea, therefore, to keep it distinct from *company innovation* – the introduction, in other words, of new products and new technological solutions relating to processes, organization and market designed to improve the company's competitiveness and market position.

That being said, alongside research, EPO-companies have also realised many innovations. Over the last three-year period, almost all of them introduced a new product or service to the market (89%); nearly three-quarters of them introduced process (71%) and organizational (74%) innovations; half of them, innovations in marketing (50%) (source: EP0-*survey 2010*). Again, also in this case these are extraordinarily high values when you consider that, between 2008 and 2010, only 31% of *Italian companies* with more than 10 employees managed to achieve some form of product/service or process innovation (European average, 39 %) (CIS, 2010).

Finally, let's look at economic performance. Despite the economic crisis, in the three years studied by the first survey (2007-2009), EPO-companies showed positive results on average: employees increased by 8% and turnovers by 19%. Only in 2009 did the turnover remain static. It is worth noting that, in the same period, Italian industrial companies suffered heavy setbacks: in the first half of 2009, the index of industrial production fell by 23%, with a peak of 36 % in the manufacturing of machinery and mechanical equipment sector; in the second half, the decline was slower but still significant (-14% and -28 % respectively).

The second survey, which refers to the next three-year period (2010-2012), also confirms the good performance of EPO-companies. Only 6% of them ceased activity (compared to a national average of 18%). All the other companies who agreed to respond to the new questionnaire continued to carry out innovative activity, producing good economic results: 41% significantly increased resources devoted to research and development; 45% increased their turnover and

19% remained stable; 45% increased the number of their employees and 49% maintained previous levels (only 6% reduced staff).
EPO-companies, therefore, continued to perform well even in the worst period of the global economic crisis. Amongst the more than 400 companies who responded to the initial survey, however, a marked heterogeneity in performance is visible, especially with regard to the trend in turnover and productivity. Those who suffered most in the crisis were the mechanical engineering companies, the largest and the most exposed to international markets. Conversely, small and medium companies – especially in high-tech areas – show better results.
The factors that explain economic performance and innovative performance, however, are significantly different. The ability to achieve a high output of innovation relates to the techno-scientific configuration of the company: high levels of education amongst employees; the presence of a reasonable number of researchers; good internal collaborative relations; the circulation of non-redundant knowledge gained through external sources; a rich network of innovative partnerships. To these characteristics may then be added the relatively recent origin of the company and a patenting strategy clearly aimed at the productive exploitation of the discoveries made.
Where economic performance is concerned, together with some of the variables mentioned before, other elements also become relevant, mainly connected to organizational and entrepreneurial choices. Company size and competitiveness are both significant: in particular, the performance on extra-regional markets, and the ability to address the demand of public administrations (especially for medium to large companies), large companies (for small companies) and final consumers. Also important is the commercial success of one of the patents obtained.[8]
But what matters most – and this is the point I would like to draw attention to in this article – is the presence of a collaborative corporate culture, both externally and internally. In fact, both in the first phase of the crisis (EP0-*survey 2010*) and in the one that followed (EP0-*survey 2012*), innovative partnerships have significantly improved the occupational performance of the companies (Table 4). And this is especially true for those who have avoided the "trap of localism", often combining short and long networks.

Table 4 Innovative partnerships and occupational performance of companies (% values)

Percentage of companies that increased number of employees during the period:	2007-2009	2010-2012
Innovative partnerships		
None	25.0	37.9
At least one	39.3	51.8
Geographical collocation of partnerships		
Regional & extra-regional	43.0	53.7
Only extra-regional	36.4	55.2
No. cases	225	141

Source: EP0-*survey 2010*; EP0-*survey 2012* .
Note: for details see Appendix.

[8] With reference to these aspects, please again see Ramella e Trigilia (2010a).

The ability to capitalize on external resources, however, is strongly influenced by the organizational model that has been chosen internally. Companies with high *strategic integration* not only have a greater number of innovative partnerships but also better economic performance. An interesting effect of interaction may be observed between these two aspects of corporate culture: in fact, companies that combine a high level of internal integration and external partnerships – that possess, in other words, a corporate culture of collaboration – are those that register the best occupational and economic results (Table 5).

Table 5 The economic-occupational performances of companies according to entrepreneurial and organizational strategies (% values)

Companies with	Increase in number of employees		high economic performance
	2007-2009	2010-2012	2007-2009
No innovative partnership	25.0	37.9	27.3
At least one partnership, with:			
Low strategic integration	35.2	40.4	46.9
High strategic integration	42.7	64.8	54.9
No. cases	225	141	166

Source: EP0-*survey 2010;* EP0-*survey 2012* .
Note: The "economic performance index" was built, in an additive way, from the following variables (the weighting coefficients employed are in brackets): 1) labour productivity (turnover per employee) in 2009 (0.47); 2) variation in labour productivity between 2007 and 2009 (0.40); 3) variation in turnover between 2007 and 2009 (0.48). These variables have been identified from a factorial analysis (principal component analysis, varimax rotation method) that led to the extraction of a factor that explains the 57.4% of variance. The Kaiser-Meyer-Oikin (KMO) test recorded a value of 0.61 and the result of Bartlett's sphericity test was significant ($p \leq 0.001$). The two classes of "economic performance index" (high/low) were obtained by referring to the median of the distribution. For other details see Appendix.

The importance of corporate culture and, in particular, internal organizational strategy is also confirmed by multivariate statistical analysis (logistic regression) carried out on the companies that provided data on employment trends between 2010 and 2012. For reasons of analytical parsimony, a model was tested consisting of few variables, which, however, makes it possible to correctly classify 75% of the EPO-companies (as opposed to 50% in the model with only the intercept). The analysis shows that the chance that companies increased or did not increase employment during the hardest years of the crisis can be predicted by the combination of four variables, only two of which, however, are significant: the occupational trend in the previous period (2007-9), and the strategic integration of the companies (Table 6; for details see the Methodological Appendix, point no. 4).

TABLE 6 Logistic regression that predicts if a company has increased employment in the period 2010-12

Summary of model	Nagelkerke R^2	χ^2	df	Sig.	No. cases included
	.407	33.91	4	.000	93

Variable in equation	B	E.S.	df	Sig.	Exp (B)
Presence of innovation (2007-9)	.311	1.329	1	.815	1.364
Innovative partnerships (2007-9)	-.088	.872	1	.919	0.915
Strategic integration (2007-9)	1.924	.543	1	.000	6.850
Variation in employees (2007-9)	2.238	.579	1	.000	9.371
Constant	-2.755	1.528	1	.071	.064

Data source: EP0-*survey 2010;* EP0-*survey 2012* .
Note: for details see Appendix.

8. Conclusions: the embedded complementarities of innovation

The results of the two surveys on Italian companies with European patents in the mechanical engineering and high-tech sectors provide a clear response to the questions that were asked at the beginning of this article regarding their distinctive characteristics and their behaviour during the international economic crisis. What are the specific features that differentiate EPO-companies from the others? First of all, they are *solid companies* operating in highly competitive and uncertain markets. Even though, in the majority of cases they are small or medium companies, compared to the national average, medium-large companies are over-represented. Second, they are *highly innovative* – research-intensive companies that introduce many innovations to the market. Third, they are *deeply embedded at both a social and territorial level*. The uncertainty of the competitive environments is, in fact, dealt with through the socio-economic embeddedness of their activities.

One of the elements that most distinguishes EPO-companies is their *innovative partnerships*: external collaborations for research and innovation activities. Such partnerships are fairly generalised in these companies, as is the use of external sources of information. Innovation, as we have seen, also has a clear territorial embeddedness. Most EPO-companies hail from the leading innovative systems in mechanical engineering and high technology; that is, they operate in local contexts that are highly qualified in both economic and socio-institutional terms. That said, their innovative partnerships are not confined exclusively to a local level. The companies with the best innovative performance manage to combine the advantages of short networks (local and regional) with those of long networks (extra-regional). But even the latter are socially embedded. The majority of innovative partnerships, in fact, do not respond to purely economic and market logic, but are based on collaborations in which reciprocal trust plays a major role.

Another aspect that emerges from the research is the *importance of the socio-organizational dimension*. An organization that supports its research teams with the appropriate means and allows them full independence, creating cohesive working groups based on flexible coordination methods and a good mix of research integration and researcher autonomy, will significantly enhance inventive/innovative performance. This last, therefore, does not depend exclusively on the characteristics of individual researchers and not even on the simple sum of those in the research team. Rather, it manifests as an emergent property of (often informal) group interactions that are facilitated by an appropriate organizational structure.

The fourth and last element that distinguishes EPO-companies is their *high economic performance*. These are companies with high levels of turnover, productivity and exporting, that have been able to maintain a discreet dynamism even during the most difficult years of the economic crisis. And this is due to the proactive behaviour of the preceding period, especially

in the area of research and innovation. That said, the link between innovation and economic performance is not automatic: even among EPO-companies, revenue demonstrates a high level of heterogeneity. This heterogeneity depends on variable manufacturing, managerial and market expertise, which is not necessarily associated with the technico-scientific skills and innovative capacity present within a company.

In any case, a significant role is played by what we have defined as a "collaborative corporate culture". In particular, positive results in terms of employment and turnover require a strong *strategic integration*: a good endowment of human capital and organizational practices that valorise both work autonomy and company flexibility and cohesion. It is this *internal organizational design* that augments the effectiveness of *external innovative partnerships*. In addition to the importance of the organizational dimension, I also want to emphasise the close relationship that unites the cognitive and fiduciary aspects in innovation processes. The socio-normative component is often neglected in innovation studies, especially those from an economic perspective. However, the generation of new knowledge and its economic valorisation depends on the social capital that the company may have internally, as well as in its external relations. Internal cohesion does not necessarily imply homogeneity of knowledge and judgment criteria, nor absence of conflict. It is, however, the condition that makes it possible to successfully integrate the variety of resources available both inside and outside the company.

That being said, what emerges from the research into EPO-companies is the complementarity of resources useful for innovation and economic performance between: a) the internal and external relations of the organization; b) the variety of knowledge and cohesion of relationships; c) the short and long networks of collaboration. In conclusion, successful company strategies are those which – thanks to a collaborative company culture – are able to exploit the *embedded complementarity of innovative resources*.

What lessons of a more general kind can be drawn from the results of this research? Some, as we have seen, concern the management and organizational strategies useful for promoting improved business performance. Others, instead, concern the public actors and policies useful in the support of long-term development strategy. Research, in fact, confirms the strategic importance of local collective goods and the "systemic" nature of innovation. In the light of these assumptions, therefore, the policies shown to be particularly appropriate are those that aim to strengthen and improve the national/regional system of innovation and the collaboration between the various actors involved therein (companies, research centres, universities, funding agencies etc. In contrast, over the last twenty years, the policy mix adopted by Italy (and the other Mediterranean countries) has been focused on direct support to companies (European Commission 2013b). Moreover, during the crisis, government policies – also taking into account the constraints imposed by the EU – have focused on the reduction of public expenditure rather than on research funding, advanced training and the endowment of public goods for innovation. This 'low road to competitiveness' is thus likely to produce a further weakening of the Italian capacity for innovation. The crisis, instead, could have represented an appropriate moment for a strategic rethinking of development policies, by interpreting it as an opportunity to solve the structural problems of the national system of innovation and to promote more systemic policies for innovation and long-term growth.[9]

[9] Only in the last year has there been some evidence of a rethinking in this direction beginning to emerge; for example, with the "Piano Nazionale Industria 4.0" (National Industry Plan 4.0) launched by the Italian government to encourage – through an integrated approach – the digitization of manufacturing sectors.

References

Arundel, A., Lorenz, E., Lundvall, B.-Å., & Valeyre, A. (2007). How Europe's Economies Learn: A Comparison of Work Organization and Innovation Mode for the EU-15. *Industrial and Corporate Change*. 16 (6), pp. 1175-1210.

Asheim, B.T., & Gertler, M.S. (2005). The Geography of Innovation: Regional Innovation Systems. In J. Fagerberg, D.C. Mowery, & R.R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 291–317). New York: Oxford University Press.

Berger, S. (2005). *How We Compete*. New York: Currency/Doubleday.

Biagiotti, A. (2010), I sistemi locali leader nei brevetti. In F. Ramella, & C. Trigilia (Eds.), *Imprese e territori dell'Alta Tecnologia in Italia* (pp. 75–97). Bologna: Il Mulino.

Boschma, R.A. (2005). Proximity and Innovation: A Critical Assessment. *Regional Studies*, 39 (1), pp. 61–74.

Burroni, L., Trigilia, C. (Eds.) (2011). *Le città dell'innovazione. Dove e perchè cresce l'alta tecnologia in Italia*, Bologna: Il Mulino.

Chesbrough, H.W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston (MA): Harvard Business School Press.

CIS (2010). *Types of co-operation partner for product and process innovation', Community Innovation Survey 2010*, available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database

Cohen, W., & Levinthal, D. (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. *Administration Science Quarterly*, 35 (1), pp. 123–33.

Crouch, C., Le Galès, P., Trigilia, C., & Voelzkow, H. (2001), *Local Production Systems in Europe. Rise or Demise?.* Oxford: Oxford University Press.

Crouch, C., Schröder, M., & Voelzkow, H. (2009). Regional and Sectoral Varieties of Capitalism. *Economy and Society*, 38 (4), pp. 654–78.

De Vaan, M., Stark, D., & Vedres, B. (2014). Game Changer: The Topology of Creativity. *American Journal of Sociology*, 120 (4), pp. 1144-1194.

Donatiello, D., Ramella, F. (2017), The innovation 'paradox' in Southern Europe. *South European Society and Politics*, forthcoming.

Gertler, M.S. (2010). Rules of the Game: The Place of Institutions*. Regional Economic Change*, 44 (1), pp. 1-15.

Hagedoorn, J. (2002). Inter-firm R&D Partnerships: An Overview of Major Trends and Patterns since 1960. *Research Policy*, 31 (4), pp. 477–92.

Hollingsworth, R., Hollingsworth, E.J., & Hage, J. (2008). *Fostering Scientific Excel- lence: Organizations, Institutions, and Major Discoveries in Biomedical Science*. New York: Cambridge University Press.

Lester, R.K., & Piore, M.J. (2004). *Innovation. The Missing Dimension*. Cambridge, MA: Harvard University Press.

Lundvall, B.-Å., & Johnson, B. (1994). The Learning Economy. *Journal of Industry Studies*, 1 (2), pp. 23–42.

Maskell, P., & Malmberg, A. (1999). Localised Learning and Industrial Competitiveness. *Cambridge Journal of Economics*, 23 (2), pp. 167–86.

Pavitt, K. (2005). Innovation Processes. In J. Fagerberg, D.C. Mowery, & R.R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 86–114). New York: Oxford University Press.

Polanyi, M. (1966). *The Tacit Dimension*. New York: Anchor Books.

Powell, W.W., & Grodal, S. (2005). Networks of Innovators. In J. Fagerberg, D.C. Mowery, & R.R.

Nelson (Eds..), *The Oxford Handbook of Innovation* (pp. 56–85). New York: Oxford University Press.

Ramella, F. (2016). *Sociology of Economic Innovation*. London: Routledge.

Ramella, F., & Trigilia, C., (Eds.). (2010a). *Imprese e territori dell'Alta Tecnologia in Italia* [*High-Tech Companies and their Territories in Italy*]. Bologna: Il Mulino.

Ramella, F. and Trigilia, C. (Eds.) (2010b), *Invenzioni, inventori e territori in Italia* [*Inventions and Inventors in Italy*]. Bologna: Il Mulino.

Rodríguez-Pose, A. (2011). Economists as Geographers and Geographers as Something Else: On the Changing Conception of Distance in Geography and Economics. *Journal of Economic Geography*, 11 (2), pp. 347–56.

Schumpeter, J.A. (1912). *Theorie der wirtschaftlichen Entwicklung*. Leipzig: Duncker & Humblot. Eng. trans. (1980). *The Theory of Economic Development*. London: Oxford University Press.

Stark, D. (2009). *The Sense of Dissonance*. Princeton: Princeton University Press.

Trigilia, C., Burroni L. (2009). Italy: rise, decline and restructuring of a regionalized capitalism. *Economy and Society*, 38 (4), pp. 630-653, 2009.

Methodological Appendix

The data discussed in this article form part of a research into the geography of innovation in Italy, in the areas of high and medium-high technology, which was carried out over a period of five years: from the beginning of 2008 to the end of 2012 . The research was divided into three parts: 1) the territorial analysis of patent activity; 2) the study of companies with European patents; 3) an investigation regarding the inventors.

1. Territorial analysis: the EPO patents

During the first phase of research the geography of innovation in Italy was analyzed. We used the number of patent applications filed by Italian enterprises, individuals and public organizations between 1995 and 2004 at the European agency for the protection of intellectual property rights as indicator. The information on the patents was collected through the database of the European Patent Office (EPO - http://ep.espacenet.com).

To identify the high and medium-high technology sectors we used the Eurostat-OECD classification (manufacturing industries classified according to their global technological intensity) that divides manufacturing into four classes according to a descending order of technology intensity.

The geographical localisation of these patents was reconstructed at a particularly precise territorial (sub-regional) level, that of "local labour systems" (LLS). These are the territorial units created by ISTAT, the Central Institute of Italian Statistics, on the basis of "home to work commuting": that is, identifying the areas where there is a high "self-containment" of daily population movement for reasons of work.

2. The survey of EPO companies

2a. In the second phase of the research, the analytical focus shifted from the socio-economic characteristics of territories to the organizational and relational characteristics of companies. The reference in this part of the survey was to high technology and mechanical engineering companies. A panel-survey was used: the same businesses were interviewed in two successive stages. To identify the universe of reference, 5,313 European patents granted to Italian recipients in the mechanical engineering and high technology fields were analyzed. This base was converted into a list of 1,504 active companies, to which a questionnaire was electronically administered (CAWI method: *computer assisted web interviewing*).

2b. The first research stage (EP0-survey 2010) was carried out in early 2010 and 407 companies responded – in whole or in part – to the questionnaire, a response rate of 27%. The second stage (EP0-survey 2012) was replicated in late 2012 using: a) the *same* sample of companies that had responded to the first survey; b) the *same* investigation techniques. 155 companies responded to the second interview, a response rate equal to 40% of the companies that were still active/available. The analysis of the profile of the companies that did not respond to the questionnaire did not show any systematic distortion of the sample compared to the universe of reference. In the first survey, a sample audit was carried out (407 companies) compared to the universe (1,504 companies) based on the geographical localisation and industrial sector of the companies. In the second survey, in addition to the previous two variables, the sample (155 companies) was also compared to the universe (407 companies) according to the size class of the employees. In all cases, the sample/universe deviations were always very limited, comprising between 3% and 8% (the latter percentage refers to the second survey, and the comparison of class size).

3. The inventors

3a. The survey (Inventors-Survey)

The survey was conducted between June and July 2009 and involved 739 inventors. The contact data was extracted from a sample of Italian patents selected from those granted by the European Patent Office (EPO). To select the patents from which to derive the names of the inventors, a mixed sample design (probabilistic and non-probabilistic) was used. 2,825 patents were selected overall, from which a list of 2,681 "useful contacts" was derived for the survey (disregarding those who were untraceable, deceased, etc.). 739 inventors completed the questionnaire (a response rate of 28%). The survey was conducted through electronically administered questionnaires (CAWI method: *computer assisted web interviewing*).

3b. The qualitative interviews
To give the study more detail, a smaller (territorially stratified) sample was also selected of inventors in the fields of mechanical engineering and pharmaceuticals. 30 semi-structured interviews were carried out in the central and northern regions (15 for the pharmaceutical sector, 15 for mechanical engineering) with, in patent terms, the most prolific inventors. 23 interviews were carried out in the South (11 for the pharmaceutical sector and 12 for mechanical engineering) with inventors with more than one patent, resident in one of the following three regions: Campania, Puglia and Sicily.

4. Explanatory notes for the tables in the text

Table 2

Innovative Partnerships. Collaborations with companies, universities and research centres
This category refers to the following questions in the questionnaire:
a. Can you tell us how many companies you have co-operated with on research and innovation activities in the last three years (2007-2009)?
b. And how many universities and research centres have you co-operated with in the last three years?

Index of strategic integration
The "strategic integration index" was derived from analysis both semantic (affinity of content) and statistical (factor analysis) conducted on five variables: (V1) the percentage of graduate employees; (V2) the presence of internal training; (V3) the operational autonomy of the research team; (V4) the autonomy of the team's researchers; (V5) the existence of a strong employee commitment to the company's goals. Factor analysis was conducted with the statistical program SPSS, using the method of main components and oblique rotation (direct oblimin). The analysis led to the extraction of two factors that together explain 50.1% of the variance. The Kaiser-Meyer-Oikin (KMO) test registers a sufficient value, even if not good, equal to 0.53 while the Bartlett sphericity test gave a significant result ($p \leq 0.01$). On the basis of this analysis, two indices were built. The first – organizational flexibility and cohesion – is based on the last three variables (v3 + v4 + v5) and assumes the maximum value when there is simultaneous occurrence of team autonomy, researcher autonomy and employee involvement. The second – *human capital* – is based on the first two variables (v1 + v2) and assumes the maximum value in case of the coexistence of a high endowment of graduates and training activities. The two indices were then aggregated in the strategic integration index (range of variation 0-2), which was used exclusively for typological purposes – i.e. to identify an organizational type characterized by high levels of human capital/organizational flexibility and cohesion (index scores => 1.5).
The variables in the index refer to the following questions in the questionnaire:

1. V1 What percentage of employees have a degree, of the kind indicated? (Degree and post-graduate, high school graduate, vocational school graduate, middle-school graduate)

2. V2 Have any staff training activities been carried out during the last three years (2007-2009)?
1. V3-V4. How would you define the style of working present within these project teams?
    a. V3 The teams have a high level of operational autonomy with regard to the company.
    b. V4 Each team member has a high degree of autonomy in carrying out specific tasks.
2. V5 How would you define the relationship between employees and company management (ownership and management)? Answer B.
    a. There is a clear distinction of roles with respect to the various responsibilities.
    b. There is close cooperation with a strong involvement in all the objectives of the company.
    c. Relationships are difficult because of poor mutual cooperation.

Table 4

Innovative Partnerships.

See the comment above on Table 2

Occupational performance

This category refers to the following items in the questionnaire:

Total number of employees on 31/12/2007; 31/12/2009; 31/12/2010; at the end of 2012

Table 5

The "economic performance index" was built, in an additive way, from the following variables (the weighting coefficients employed are in brackets): 1) labour productivity (turnover per employee) in 2009 (0.47); 2) variation in labour productivity between 2007 and 2009 (0.40); 3) variation in turnover between 2007 and 2009 (0.48). These variables have been identified from a factorial analysis (principal component analysis, varimax rotation method) that led to the extraction of a factor that explains the 57.4% of variance. The Kaiser-Meyer-Oikin (KMO) test recorded a value of 0.61 and the result of Bartlett's sphericity test was significant ($p \leq 0.001$). The two classes of "economic performance index" (high/low) were obtained by referring to the median of the distribution.

In the two surveys, to elicit the turnover, the following question was asked:

What was the turnover in the last three years? (EP0-survey 2010: 2007, 2008, 2009. EP0-survey 2010: 2010, 2011 and 2012).

For the other variables, see the comments to the previous tables.

Table 6

The table shows the results of a binomial logistic regression which I conducted on the 93 companies for which all relevant information is available. As the *dependent variable*, I used the employment trends between 2010 and 2012: the first class includes the companies in which the number of employees remained stable or decreased, the second those in which it increased. I preferred to use this variable, rather than that related to the variation in turnover, as it had fewer missings.

As regards the *independent variables*, I used 4 dichotomous predictors: 1) companies with at least one innovative partnership in the period 2007-9; 2) companies with at least one innovation in the period 2007-9 (see below); 3) companies with high strategic integration in the period 2007-9; 4) companies that have increased employment in the period 2007-9.

Other regressions performed - for control purposes - with variables related to market strategies (% of foreign sales) and intensity of research produced similar results.
Variable 2 refers to companies that gave an affirmative answer to at least one of the following questions in the questionnaire:
In the last three years, has the company introduced:

1. 1. Innovations in Products/Service?
   a. Technologically new (or significantly improved) products?
   b. Technologically new (or significantly improved) services? .
2. 4. Innovations in Processes?
   a. technologically new (or significantly improved) production processes?
   b. Systems of logistics, distribution methods or external supply of technologically new (or significantly improved) products or services?
   c. Other technologically new (or significantly improved) processes concerning the management of purchasing, maintenance and support activities, management of administrative and information systems, accounting activities?
3. Organizational innovations?
   a. New (or significantly improved) management techniques to enhance the use and exchange of information, knowledge and technical skills and internal work?
   b. New forms of work organization, such as the definition of new divisional or business units, the reduction of hierarchical levels, the decentralization of company decision making?
   c. Changes in relationships with other companies or public institutions, such as new production and commercial agreements, partnerships, sub-contracting agreements or outsourcing?
4. Marketing innovations?
   a. Significant changes in the aesthetic characteristics of the products, including those relating to packaging?
   b. New (or significantly improved) marketing techniques and practices or distribution of products or services, such as electronic commerce, franchising, direct sales or distribution licenses?

   For the other variables, see the comments on the previous tables.