The relationship between needs and instruments of innovation policy in different regions: the Matrix INT (Instruments and Needs of Technology)

Riccardo Cappellin
Department of Economics
University of Rome "Tor Vergata"
cappellin@economia.uniroma2.it

Paper presented at the

43rd Congress of the European Regional Science Association

27 Aug 2003 - 31 Aug 2003

University of Jyväskylä, Jyväskylä, Finland

Introduction

Innovation – both technological and organizational – is a fundamental ingredient of economic growth, both directly and indirectly – via exports and trade and it has a crucial role in enhancing the positive potentials of the process of international integration.

However, the perspective of the "knowledge society" raises the risk of exclusion, which may reduce the benefits of international integration and lead to further divergence and segmentation between economically strong regions and countries and less developed countries and regions.

This study focuses on the case of small and medium size firms (SMEs) and on the medium and low technology industrial sectors, which may represent the crucial specialization in the industrialization process of less developed countries. Innovation affects the capabilities of small and medium size firms to survive and to growth in the actual process of liberalization and openness to the international markets. In particular, innovation in small and medium size firms should be broadly defined as extending beyond research and development activities and also beyond the adoption of new technologies, in order to include more incremental developments, such as the adaptation of product and services to meet the changing needs of customers and markets and the adoption of new organizational methods both internally and in the relations with other firms in a sectoral or regional framework.

The methodology, which is described in this study, aims to evaluate the gap between the characteristics of the demand and the supply of technology transfer (TT) services to small and medium size firms in a wide international framework, comprising both developed countries and less developed countries (*).

The study focuses on a "demand led" and strategic approach. It underlies that the problems and opportunities of development of the small and medium size firms in the various individual countries are different and that determines a different structure of the demand of technology transfer services.

Moreover, this study aims to identify the role and characteristics of the TT intermediaries in the wider framework of the strategies and instruments of innovation policies. In fact, the instruments of innovation policy are not only those, which operate directly on the individual firms, but also those, which can operate on the "selection environment", within which the firms are embedded.

1. The problems and needs of firms in the innovation process

The design of the innovation policy and the identification and creation of specific policy instruments requires that the policy case study to be considered (i.e. individual firm, sector, cluster, national or regional economy) is analysed according to three dimensions:

(*) This study is based on a report, coordinated by Riccardo Cappellin and jointly elaborated by the "OSELR-Observatory on Local and Regional Economies" of the University of Rome "Tor Vergata", with the participation of Daniele Archibugi, Maurizio Decastri and Luigi Orsenigo, and a research group of "IPI – Istituto per la Promozione Industriale", Rome, coordinated by Andrea Bianchi and with the participation of Paolo Gugliemetti, Silvia Grandi, Pier Francesco Cerritelli and Beatrice Marani. The report aimed at elaborating a methodology to be adopted in a joint project of the "International Network for SME's (INSME)", promoted by the "OECD Ministerial Conference on SME" (Bologna, June 2000) and participated by 48 different countries.

- the typology of industries/technologies,
- the typology of firms and
- the typology of regions.

as that allows to identify some of the major problems and needs in the field of innovation policy.

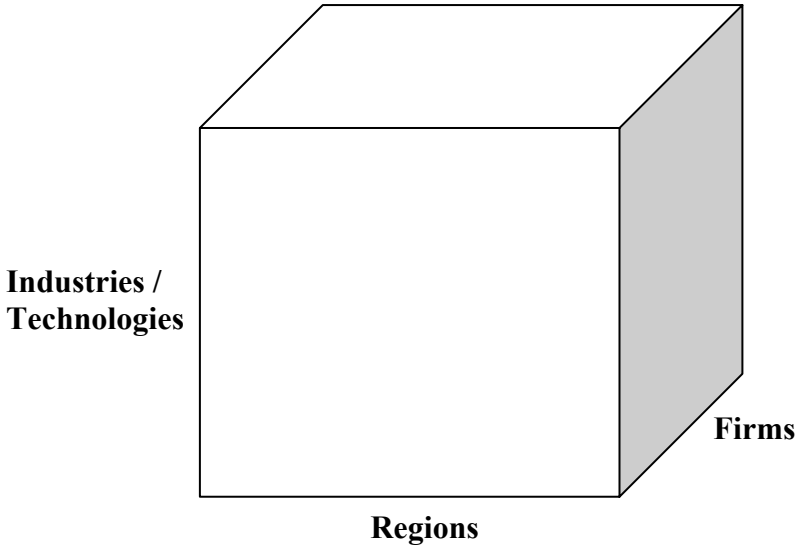


Figure 1: The combination of three dimensions in the design of innovation policies

First of all, the evolution of the technological bases in the various fields of production affects the need of modern policy instruments in innovation policies. That underlines the importance to analyze the process of technology convergence and the increasing interdisciplinary integration of modern technologies and also the parallel process of increasing specialization and diversification of the various industries.

According to Archibugi and Orsenigo (2002), industries can be grouped in five large categories, which build upon Pavitt's taxonomy of innovating firms (Pavitt, 1984; Marsili, 2001). Individual firms are included in each category according to the sources of innovations (Pavitt, 1984; Winter, 1987; von Hippel, 1988; Breschi, Malerba and Orsenigo, 2000, Archibugi et al. 1999, OECD 1992) and the technological trajectory they follow, rather than according to the characteristics of the prevailing product, as in the usual statistical classifications.

The *science-based* regime characterises innovative activities, where the universal nature of scientific knowledge technologies generate a continuous stream of new products. They are characterized by high technological entry barriers, whichoriginate in the high specificity of knowledge applications across production processes, and in high cumulativeness of innovation. Innovative activities are principally devoted to product innovation and benefit from the direct contribution of scientific advances in academic research.

The *fundamental-processes* regime characterize activities, where technological entry barriers are high and are especially related to scale advantages in innovation, and strong persistence of innovation. Innovation is mainly process innovation and, although affiliated firms and users represent the main external source of knowledge, it benefits from the quite important and direct contribution of scientific advances in academic research.

Typology of industries/technologies

1. Science Based
2. Fundamental Processes
3. Complex knowledge system
4. Product-engineering
5. Traditional industries

Needs by typology of industries/technologies

1. Density of SMEs and needs of entrepreneurial assistance
2. Speed of technological change
3. Needs of in-house R&D
4. Need of strong scientific research
5. Need of strong applied knowledge
6. Need for IPR regulation
7. Need for support in scanning the technological environment
8. Lack of awareness of technological needs
9. Need of higher education
10. Need of firm specific innovation support
11. Need of generic technological infrastructures

Typology of firms

1. Schumpeterian firm
2. Marshallian firm
3. Smithian firm
4. Marginal firm

Needs by typology of firms

1. Need of a strong, independent technological base
2. Need of technological diversification and variety of sources
3. Need of developing tacit and appropriable knowledge
4. Need of developing codified knowledge and access to it
5. Appropriability and protection from imitation
6. Proactive vs. reactive technological strategies
7. Organizational complexity and formalization
8. Entrepreneurship vs. management
9. Need of innovative finance
10. Development of strong links with suppliers
11. Development of strong links with clients
12. Needs by small firms
13. Growth of firm
14. R&D intensity and persistence of innovative activities
15. Access to skilled labour and intangible assets vs. equipment

Typology of regions

1. High-tech clusters
2. Metropolitan regions in developed countries
3. Diversified and dynamic industrial regions
4. Specialized industrial clusters
5. Intermediate regions
6. Old industrial and reconversion regions
7. Transition economies
8. Economic lagging regions
9. Metropolitan areas in economic lagging regions/countries
10. Border regions
11. Internal small rural areas
12. Large peripheral areas

Needs by typology of regions

1. External openness, accessibility, exports and external investments,
2. Territorial quality, territorial planning and infrastructure
3. Institutional thickness, decentralization and multilevel governance
4. Local identity and consensus on a common development strategy
5. SMEs birth rate and entrepreneurship capabilities
6. Sectoral diversification and spin-offs of new firms
7. Access to credit and diversification of financial intermediaries
8. Horizontal/vertical integration, subcontracting networks and firms specialization
9. Interactive learning processes, diversity, creativity and knowledge networks
10. Skilled human capital, receptivity and labor mobility between firms
11. Productivity growth, adoption of innovation and R&D investment
12. Employment growth and low unemployment rate

Table 1 : Typology of industries/firms/regions and problems or needs in the innovation process

The *complex (knowledge) system* regime presents a knowledge base that combines mechanical, electrical/electronic and transportation technologies. The distinctive feature of this regime is in the high degree of differentiation of technological competencies developed by firms, especially in upstream production technologies, and of external sources of knowledge, including an important, although indirect, contribution of academic research.

The *product-engineering* regime includes the bulk of capital goods firms. This regime is distinguished by the high diversity of technological trajectories explored by firms. Innovation is in products and benefits from external contributions of knowledge, mainly from users.

The *traditional industries* regime includes a variety of production activities, which mainly benefits from upstream sources of capital-embodied knowledge, as the knowledge base is characterized by the acquisition of technological expertise from specialised suppliers. However these activities are also characterized by strong innovative capabilities in product design and vertical and horizontal differentiation, often have a direct contact and knowledge of large national and international markets and are quick to introduce product incremental innovations and customization.

Table 1 schematically reports the most important needs of SMEs in terms of technology transfer, when these are analysed according to the perspective of the typology of industries/technologies or the typology of firms or the typology of regions.

1) The distribution of SMEs is not uniform across the various categories (see Archibugi, Evangelista and Nascia, 1999), thus not all the five categories are in need of entrepreneurial assistance to the same extent.

2) Not all categories are equally affected by technological change of the same speed. Where this is most important the search for potential innovations become the major competitive strategy. On the other hand, small firms have a greater difficulty to have an innovation routine.

3) When internal R&D is a fundamental component of firms' strategy, the most effective policies would be to make resources, infrastructures and funding available. However, only a small percentage of SMEs have the financial and organisational capabilities to have their own R&D labs.

4) Some industries should have access to strong scientific public research and rely much more on interconnections with universities than others. Often, the existing small firms in science based sectors are more in demand of interaction with public scientific research than large firms are.

5) Some industries are in need of strong applied knowledge, in many countries supplied by public and private institutes devoted to standards, measurement and regulation. Applied knowledge is likely to benefit most product-engineering firms.

6) Another very relevant factor is associated to the rules for the protection of industrial property rights. The relative importance of IPR depends, obviously, from the position of a firm in the innovative chain. Producers are more interested in strong IPRs than users.

7) The obstacles to innovate faced by firms indicate that there is the need to scan the technological environment through agents outside the firm. Firms in the product-engineering and traditional industries groups should be helped to keep the eyes open on "what's going on".

8) While some firms might be aware of the need of acquiring information on technological developments, others might be even unaware of this need. This latter firms may need more the support of technology transfer agents.

9) The need of qualified personnel also changes across industries. Some group of firms might be happy with generic education at the secondary level. Others might need advanced degrees.

10) In some cases the needs can be considered firm-specific, such as in the case of product-engineering and traditional industries firms.

11) In other cases the needs of firms are collective and can be addressed by innovation policy at the industry or district levels.

Second, the process of technological innovation is related to the development of learning process and to the accumulation of knowledge within the individual firms. That leads to address the issue of the organizational structures and dynamics within the firms, in order to design policies aiming to enhance the internal production of know-how, the competencies of the human resources and the creative and entrepreneurship capabilities. According to Orsenigo and Decastri (2002), small and medium sized firms can be classified in four major types:

- *"Schumpeterian" fi*rms, i.e companies which are born on the basis of an innovation and try subsequently to develop it.
- *"Marshallian" firms*, i.e. SMEs that are active in a specific geographical area (clusters, districts, productive and innovation systems, etc.). They are typically extremely specialised in some stage of the value chain and/or in a product niche. They entertain close – often socially shaped – linkages with the other firms in the area and they learn largely via informal processes, acquisition of capital goods, exposition and solution of immediate, specific problems, interactions with other companies. Their technological strength derives essentially from the processes of knowledge sharing and by the dense knowledge flows that take place in the geographical area where they are located. In many cases, such knowledge flows are largely informal.
- *"Smithian" firms*, i.e. firms based on processes of division of labour and specialised in the supply of intermediate products and components to other (often larger) companies, often on the basis of organised sub-contracting relations and hierarchies. Their participation to the network of sub-contracting relations is a fundamental source of technical knowledge and skills.
- *"Marginal" firms*, characterised by low technological skills and little efforts explicitly devoted to learning.

The main problems that these types of firms face in their innovation and learning activities and therefore the scope for potential policy action may be indicated as in the table 1.

1) The first need is the availability of a strong and independent knowledge base, that is to say the control of technical knowledge that provides them with distinctive capabilities for innovation and product development.

2) The knowledge base of firms may show varying degrees of diversification and it can come from a variety of sources. In some cases, the know-how of any one company is relatively well-defined and self-contained. In other cases, the knowledge underlying the firms' products is instead highly differentiated and fast changing. Under these conditions firms must develop access to a large variety of sources of external knowledge (Cefis and Orsenigo 2001).

3) In their innovative activities, firms need to develop tacit knowledge, as tacit knowledge is essential in the learning activities and it provides an important barrier to imitation (Nonaka and Konno 1998).

4) Learning and innovation require also the access to and the development of codified knowledge. Codification makes the transmission and replication of new knowledge easier within the firm and it allows easier access to external knowledge, insofar as a common "language" is used.

5) Firms may face problems in defending their innovations from imitation. That need is linked to a variety of means which include first mover advantages, rapid exploitation of learning curves, the control of complementary assets and obviously intellectual property rights.

6) Certain firms must develop internal creativity and adopt proactive strategies, trying to pre-empt competitors and always staying on the frontier of technological developments (Guilford 1959, Steiner 1965, Koelster 1975, Galbraith 1982, Nadler and Tushman 1986, Tushman and O'Reilly 1997, Geroski et al. 1997). Other types of firms can survive and perhaps prosper by using. reactive technological strategies, that make them ready to adopt new technologies, without necessarily creating them.

7) A complex and diversified knowledge base requires higher degrees of formalization of the organizational structure for coordinating and integrating the various fragments of knowledge. However, organizational complexity may be managed by certain types of firms without necessarily designing and codifying detailed structures.

8) Innovative firms always have to attain a difficult balance between the preservation of an entrepreneurial attitude and the adoption of more « managerial » styles of running the company (Duncan 1976, Decastri 1984, Tushman and O'Reilly, 1997, Galbraith 1982, Perrin, 2000).

9) For some firms the availability of venture capital is crucial in order to raise substantial external funding to sustain R&D and growth. In other cases, more traditional forms of financing, e.g. banks, may be more appropriate, as long run relationships with the firm owner allows to be partly de-coupled from the vagaries of the stock market.

10) Strong links with suppliers are always important, but for certain typologies of firms they constitute one of the main source of knowledge and competitiveness.

11) Similarly, linkages with clients are always crucial. But firms whose activities consists mainly in tailoring products to specific customers, clients are an essential source of know-how and innovation.

12) Different types of innovative activities may require a different "optimal" size for firms. In some cases, economies of scale and scope in R&D dictate at least a minimum size. In other cases, even very small companies can successfully learn and innovate.

13) Some firms must grow, possibly rapidly, to attain the minimum required scale and to be able to be present in large markets. For other companies, growth as such is less important, if they can successfully operate in specific niches.

14) High R&D intensity and continuous innovation is fundamental for firms active in high tech industries. In other instances, learning and innovation does not necessarily require formal R&D.

15) Firms differ in their need of skilled labour. Certain companies derive their value and competitiveness essentially from their intangible assets, e.g. skilled labour and know-how. Other companies, instead, are characterized by higher capital intensity.

Third, the innovative potential of firms depends not only from internal capabilities, but also from their relations with other firms and their embeddedness in a positive local environment. Thus, innovation and development policies should have different characteristics according to the type of regions considered. Regions may be classified according to different perspectives, such as: their development and technology level (i.e. *developed regions, intermediate regions and economic lagging regions*), the level of urbanization and the structure of their urban system (i.e. *metropolitan regions, intermediate regions and rural regions*), the diversification of their sectoral composition (i.e. *high tech clusters, diversified industrial regions, specialized industrial districts, rural areas*), the dynamism of their industrial sectors and the bounds to a past structure (i.e. *dynamic industrial regions, old industrial and reconversion regions, transition economies*), the geographical position (i.e. *metropolitan regions, border regions, internal small rural areas, large peripheral areas*).

In particular, according to the approach of territorial networks (Cappellin 1998 and 2003a), it is possible to identify a limited set of factors (cfr. table 1) which have a key role in the process of innovation and of economic development within the various regions. Clearly, these factors assumes a different importance and priority in regional policies according the specific characteristics of each region.

1) Regional development is driven by the growth of exports and the attraction of external investments. In particular, the external openness is a key factor in the enhancement of innovation. The need for international openness is particularly high in the case transition economies, economic lagging regions, internal small rural areas and in large peripheral areas (Cappellin 2002).

2) A positive factor in regional economic development and innovation is the quality and balance of the regional territory and the endowment of physical infrastructure, based on a sound territorial planning. In particular, regions with higher congestion levels may assign a greater priority to this need.

3) The institutional thickness or the process of institutional building and decentralization of powers to specific local or sectoral institutions and organizations is a positive factor in regional economic development and innovation. The "social capital" is inadequate especially in transition economies, in economic lagging regions and in metropolitan areas in economic lagging regions/countries.

4) The existence of a strong local identity and the consensus on a common development strategy is a factor leading to regional development and facilitating the adoption of innovation and especially of radical innovation. Some regions, seem to particularly need these policies since they are often characterized by political conflicts between the local actors, divided to the belief in different values and strategies. Other regions may further strength this factor, which has played a positive role in the development process.

5) The importance of small and mediums size firms and the level and quality of entrepreneurship capabilities has been historically favourable for the fast development of some regions. On the contrary, the need to promote the creation of SMEs is particularly important in the case of all the less dynamic regions.

6) Regional development and innovation is tightly related to the process of diversification of the sectoral structure, the development of new sectors and the spin-offs of new firms. This need is clearly important in those regions, with a very specialized sectoral structure, such as specialized industrial clusters, old industrial and reconversion regions, transition economies (Cappellin 1998).

7) Regional development and innovation requires the access to credit and a well diversified mix of financial intermediaries. This problem assumes an high importance for those regions where small new firms are most important and for those where the development of a modern credit and service sector may be particularly inadequate.

8) The diffusion of subcontracting, the vertical and horizontal integration represent an organizational innovation and are a factor leading to employment creation, a greater specialization of firms in particular fields of production and a greater international competitiveness. That may be important in those regions where subcontracting networks are rather rare (Piore and Sabel 1984, Becattini 1991, Brusco and Paba 1997, Porter 1998).

9) The development of interactive learning processes, which may involve many regional actors, is a factor promoting innovation and regional economic development. That may be especially important for those regions ("learning regions") which identify knowledge or intellectual capital as their key competitive factor (Lundval 1988, Braczyk et al. 1998, Steiner 1998, Maillat and Kebir 1999, Cappellin 2000 and 2003)

10) The quality of human capital and levels of education is a key factor in promoting innovation and economic development. However, these factor still represent a bottleneck and should have an higher priority in the case of specialized industrial clusters, intermediate regions and of old industrial and reconversion regions (Cappellin and Orsenigo 2000).

11) The adoption of new products and modern process technologies requires higher investments in R&D. That is especially important for the regions which are leading in the technology frontier.On the other hand, productivity increases and innovation may be linked less to R&D investments and more to investment in human capital, to the attraction of external firms and to the development of interactive learning process within innovation networks between the firms.

12) The creation of job opportunities and a low level of unemployment is a factor facilitating innovation, as this latter is much more difficult in the situation of a structural decline. Policies aiming to increase the employment level is of high priority in the case in those regions characterized by high unemployment levels.

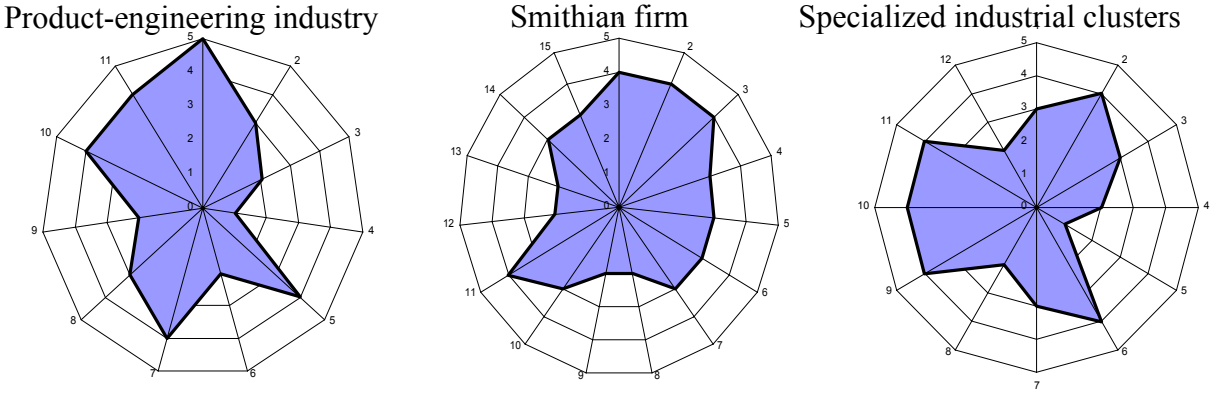


Figure 2 – The profile of the individual industries/technologies, firm types and region types

These various needs identified according to the three dimensions indicated above may be quantified according to a tentative scale from 1 (not important) to 5 (very important). That leads to identify, that each of the industry/technology, firm type and region type indicated above has a different profile, which may be represented as in the radial graphs of figure 2.

2. The policy-making approaches and the instruments of innovation policies

The analysis of the role and characteristics of the individual intermediaries in technology transfer polices can be set in the wider framework of the various instruments of innovation policy. Moeover, the design and implementation of this policy requires to tackle the problem of the architecture of the institutional framework and to solve the issues in the relationships between the centre and the periphery, the public and the private sector, the firms, the workers and the various external stakeholders, the world of production and that of financial intermediaries, the public technology transfer centres and the private consulting companies and least but not last the integration of an economic and technological perspective with a social and institutional perspective.

In this perspective, the debate in Europe on industrial and innovation policies allows to identify various alternative approaches in public policy making:

- the centralist model of sectoral planning ("government"),
- the free market model and
- the public-private partnership model of "multi-level governance".

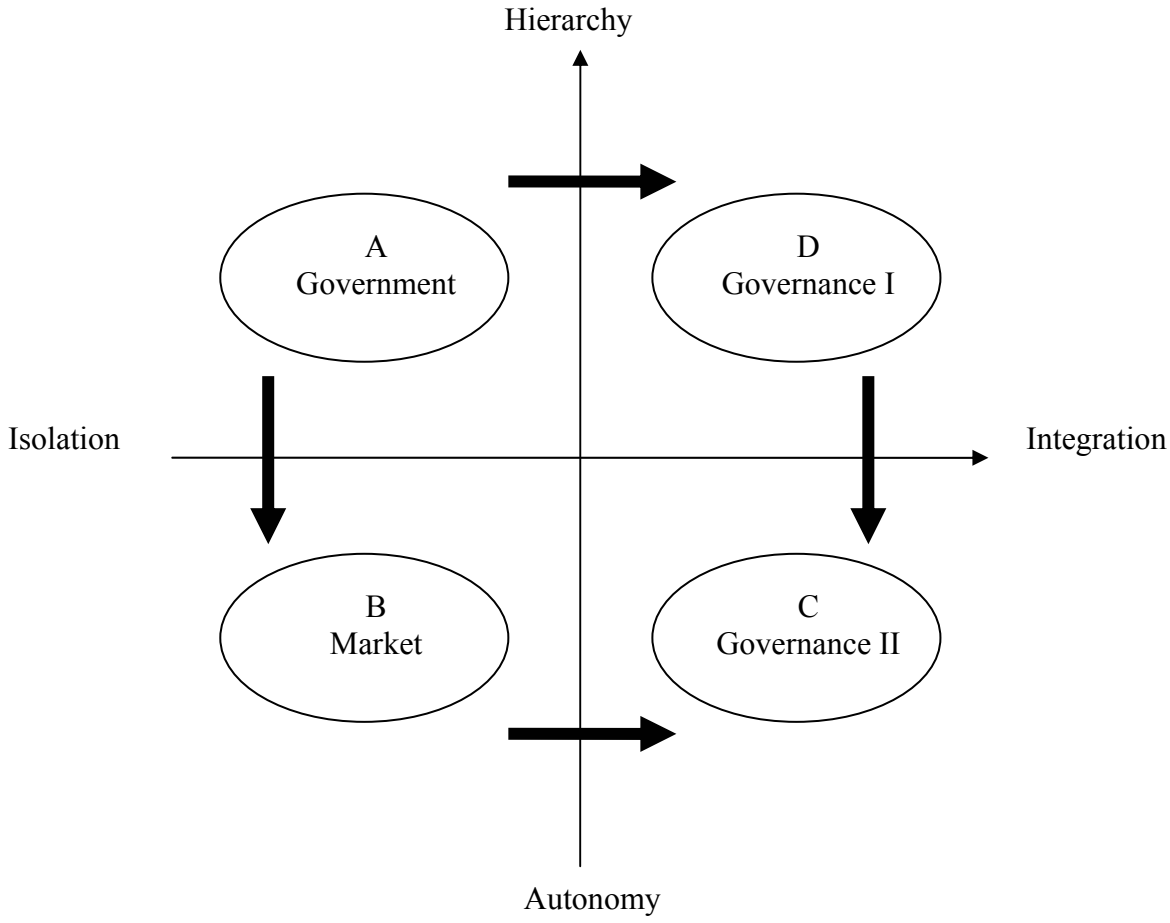


Figure 3: Four decision-making models

Both the recent evolution of technologies and the process of increasing international integration of national economies seem to underline the usefulness of the model of "multilevel governance". In fact, most of programs designed and implemented at the European level have focused on stimulating the process of institutional building and aimed at the creation of "national or regional systems of innovation", by promoting the creation of inter-firm networks in innovation. Especially in the economic lagging regions, the evolution from a traditional hierarchical model ("government" model) has been promoted by the various European programs, where public-private partnerships has assumed a crucial role.

The "governance" model allows a flexible combination of bottom-up initiatives and top-down coordination and financing. Thus it is possible to distinguish within it two different types, which may be indicated as "governance model 1: public-private strategic partnership" and "governance model 2: local networking and cooperation". The first type is characterised by a crucial role assigned to national public authorities in promoting and "steering" the innovation networks made by different firms and actors. On the other hand, the latter type is characterized by a stronger autonomy of the different economic and social "stakeholders". It may represent the case of a "complex adaptive system" characterized by an high capability of self-organization and where the role of the national authorities is mainly that to provide incentives to local and international networking (Holland 2002).

These four models of policy-making may be described according to their respective position within two major dimensions (figure 3) : "hierarchy vs. autonomy" and "isolation vs. integration", where the first dimension measures the power of the central authorities and the second dimension measures the sharing of common values, the sense of belonging and the level of explicit economic interdependence. In fact, the process technological change seems to indicate both a need to increase the autonomy of the various firms and actors and the need to a greater integration of these latter, due to their increasing interdependence and the increasing complexity of the innovation processes.

Thus, for facilitating an international comparison, the different instruments in innovation policies may be grouped according to the above indicated four policy-making approaches, as indicated in table 2.

The first class of instruments ("government" model) considers the case, when the national government intervenes directly in order to promote "national champions" or to protect "strategic industries". A crucial role in this case is played by national ministries and agencies created by the national government, although these latter may be regionally decentralised. Thus, also the cases of large science parks and research institutions and of technology transfer centres totally publicly financed may considered in this class. These types of innovation policies instruments seem to be the most diffused at the international level and they can still play an important role in many both less developed and also developed regions and countries.

A second and opposite class of instruments ("market" model) considers the case, when the crucial role to promote innovation is left to market forces. Certainly general measures in industrial policy, such as privatization, liberalization and market competition regulation, as also specific regulations of intellectual property rights, may have an indirect but powerful impact on innovation performance of regional and national economies. According to this approach, a crucial role may be played by private TT intermediaries, such as professional services, technology brokers, venture capitalists and specialized new research start-ups. However, even according to this approach the public authorities play a crucial role, especially in facilitating the circulation of information and in enhancing an higher level of formal education of the labor force.

The third class ("governance" model 2) encompasses those policy instruments, which are based on the concept of public-private partnership, when the leader role is played by public authorities. This is certainly the case of national planning contracts with large private or public firms, of territorial pacts for employment bringing together many local actors. A tight integration between public and private institutions is also aimed by specific instruments, such as university-industry liaison offices, TT cofinanced by private industries, technology parks focusing on specific sectors and clusters. Moreover, the concept of co-operation is the key element in programs aiming to create networks at the national and international level between the various actors and intermediaries active in a regional or national innovation system.

A) "Government" model 1. Public owned industries 2. Subsidies to strategic private industries 3. National agencies of sectoral industrial plans 4. Public funding of R&D 5. Regional offices of national agencies or departments 6. Public demand and fiscal incentives 7. Large public R&D institutions 8. Science Parks 9. TT service centres (fully public financed)	**C) "Governance" model 1: public-private strategic partnership** 1. Strategic planning contracts with large firms 2. Territorial pacts with local actors 3. Regional technological parks and centres 4. TT centres and programmes (partially nationally publicly financed) 5. University – industry liaison offices 6. Professional continuous education centres 7. National programs for R&D and innovation networks 8. National networks of TT service centres 9. National financial trusts for financing innovative firms 10. International networks of TT centres
B) "Market" model 1. Privatisation of public industries 2. Market deregulation 3. Liberalization and MNE attraction 4. IPR regulation and national patent offices 5. Private professional services 6. Private technology brokers 7. Private venture capital 8. Private research companies 9. Technological education centres 10. Public information and benchmarking centres	**D) "Governance" model 2: local networking and cooperation** 1. Cooperative research projects between SMEs (CRAFT) 2. Autonomous - non governmental research institutions or foundations 3. Business Innovation Centres (BIC) and Innovation Relay Centres (IRC) 4. TT centres of industry associations and chambers of commerce 5. Local incubators of innovative firms 6. Regional/local development agencies 7. Local stakeholders coordination tables 8. RIS - regional innovation system 9. Territorial knowledge management (TKM) 10. Regional innovative start-up funds

Table 2: Policy-making approaches and instruments of innovation policies

Finally, the fourth class ("governance" model 1) encompasses those policy instruments, which may be and often are supported by public resources, but have been clearly created by a bottom-up initiative of private actors, groups and citizens. A crucial role in this case is played by the co-operation between firms and especially between SMEs, by the incubators of new firms and by independent foundations or research institutions. Local actors ("stakeholders") may grouped together around an industry association or chamber of commerce. Business Innovation Centres and Regional Development Agencies may be very helpful instruments in promoting local co-operation.

In this approach, may also be classified some innovative instruments, such as "Regional Development Strategies", which have been widely experienced in European countries, and the adoption of modern "knowledge management" methods within territorial networks, in order to facilitate the relationship between local firms, and finally the creation of start-up funds (seed capital and venture capital) by regional organizations, aiming to finance SMEs in innovative productions.

Table 3 - Problems and needs of innovation policies

	Needs by industries/technologies	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**T**				
A	Large public R&D institutions	0	2	2	2	2	2	2	1	2	1	2	18				
B	Private venture capital	2	2	2	2	1	2	1	1	1	2	1	17				
C	TT centres and programmes	2	2	1	1	2	1	2	2	1	2	2	18				
D	RIS - regional innovation system	1	2	2	2	2	1	2	2	2	2	2	20				
	Needs by firm type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**T**
A	Large public R&D institutions	2	2	1	2	2	2	1	0	0	1	1	0	1	2	2	19
B	Private venture capital	2	2	2	0	2	2	2	2	2	1	2	1	1	2	2	25
C	TT centres and programmes	1	2	2	1	2	2	1	2	1	2	1	2	2	2	1	24
D	RIS - regional innovation system	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	28
	Needs by region type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**T**			
A	Large public R&D institutions	2	1	1	2	0	1	1	0	3	1	3	1	16			
B	Private venture capital	3	0	1	1	2	2	3	0	1	0	2	0	15			
C	TT centres and programmes	2	2	2	2	3	3	1	3	2	2	2	1	25			
D	RIS - regional innovation system	2	1	2	3	1	2	1	1	3	1	2	1	20			

Note: the number of the columns correspond to the number of the same need in table 1.

The various instruments in innovation policies have a different capability to respond to the various problems and needs, which have been indicated in the table 1. The policy maker should try to identify those policy instruments which may be more effective and improve their internal organization by comparing the policy instruments locally available with international benchmarks.
Table 3 indicates the relative importance of four specific policy instruments, when the various policy needs have been considered in a industry/technology perspective, in firm typology perspective and in region type perspective. A score has been assigned to each couple instrument-need. That allows to underline that specific instruments, which may be classified within the four specific policy models: government, market, governance 1 and governance 2, may be more effective than other or may be better qualified to respond to specific needs.

3. The model of Matrix INT

The choice of the most appropriate policy instruments in innovation policy should take into account the various needs which characterize the different firms, the respective sector and regional environment. That choice may be facilitated by the model: "*Matrix INT - Instruments and Needs of Technology"*, which is characterized by a wide flexibility and may consider different types of regions, industries and firms, to be combined in multiple solutions. The approach adopted in the Matrix INT model may be illustrated as in figure 4.

In particular, the model starts with the identification of the types of industries/technologies, of firms and of regional characteristics, which characterize the case study to be analysed. That, leads to identify a set of scores which may describe the intensity of the problems/needs of that case study in the process of innovation. These problems/needs may refer to the industry/technology specialization, the prevailing firm characteristics and the characteristics of the region of localization

and they may correspond to those indicated in table 1 (i.e. 38 scores). The value attributed to a score may increase with the intensity of the problem/need within a given predefined range (for example 1-5). These scores may be indicated in the vector **B** of equation 1).

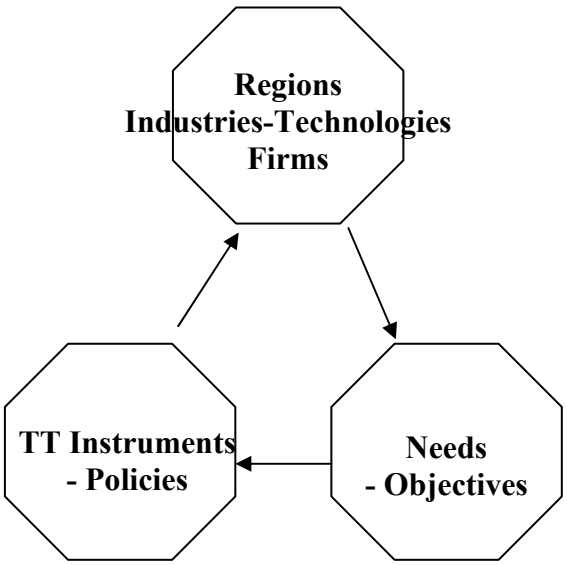
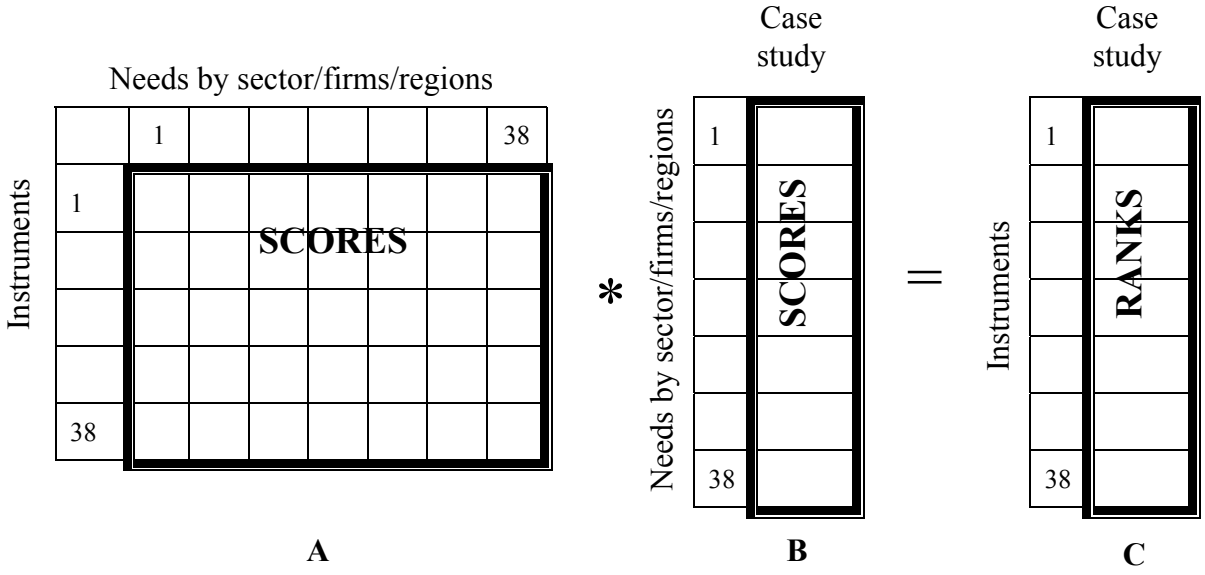


Figure 4: The approach of the Matrix INT

The various policy instruments in innovation policies, which have been indicated in table 2 may have a different potential or effectiveness in tackling the above indicated problems/needs. That may be described with a set of scores, which have a greater value the more effective is the instrument considered on the specific problem/need and have a nil value in the case that no relationship may be identified between a couple of instrument and problem/need.. Also these scores may have value selected with a given predefined range (for example 0-3). These scores may be indicated in the matrix **A** of equation 1.

(1)



The final result of the matrix multiplication gives a vector **C**, which indicates the rank the various policy instrument according to their overall effectiveness in the case study to be considered.

The approach adopted in the model of Matrix INT may also be described as in figure 5. In fact, the identification of the industry/technology characteristics, the firm types and the local environment

characteristics of a selected case studied (i.e. firm, cluster, sector, region) leads to the identification of the problems/needs in the innovation process of that case study. Then, on the base of those problems/needs it is possible to rank the various policy instruments according to their respective effectiveness.

In order to simplify or guide the assignment of a scores to the various problems/needs and to the various policy instruments in innovation policy, it may be useful to identify specific benchmarks on the base of international experience. The study for the INSME network has considered the characteristics of the various problems/needs in the different types of industries/technologies, firms and regions, which have been indicated in table 1.

That has led to define a set of scores, which take into account the relative importance of these problems/need in an international comparative perspective. Moreover, on the base of a previous large survey on more than 100 technology transfer intermediaries in various countries, it has been possible to assign a score to the various innovation policy instruments according to their capability to tackle to the specific problem/need to be considered.

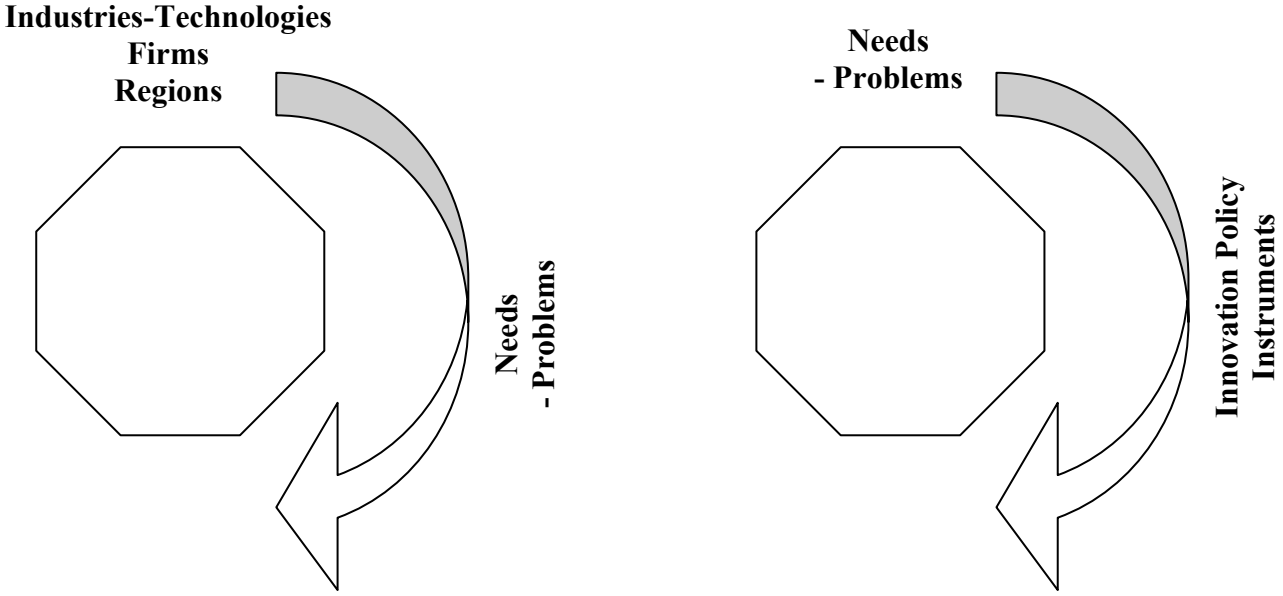


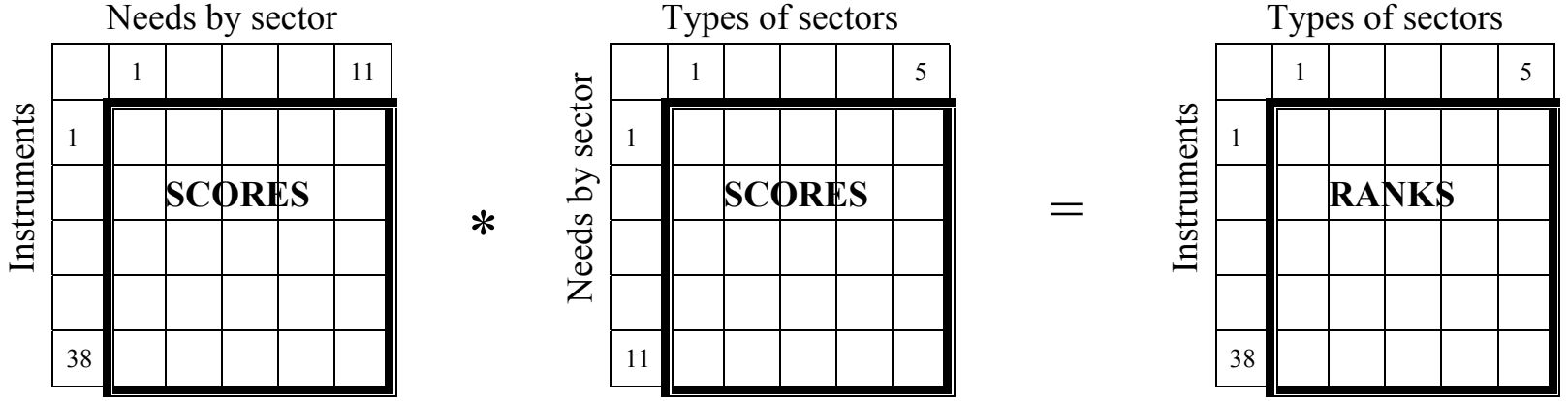
Figure 5 : From the country characteristics to the innovation policy instruments

Clearly, the scores assigned in the INSME feasibility study represent the result of the consensus reached within a group of experts with different background and competencies and these scores may be adapted in specific case studies, in order to take into account the characteristics of the specific needs and the relative efficiency of the various intermediaries to be considered. Similarly, the selection of the value of the scores may represent an useful exercise in other policy studies, as it the policy-makers are obliged to make explicit their respective opinions in order to reach a coherent overall result.

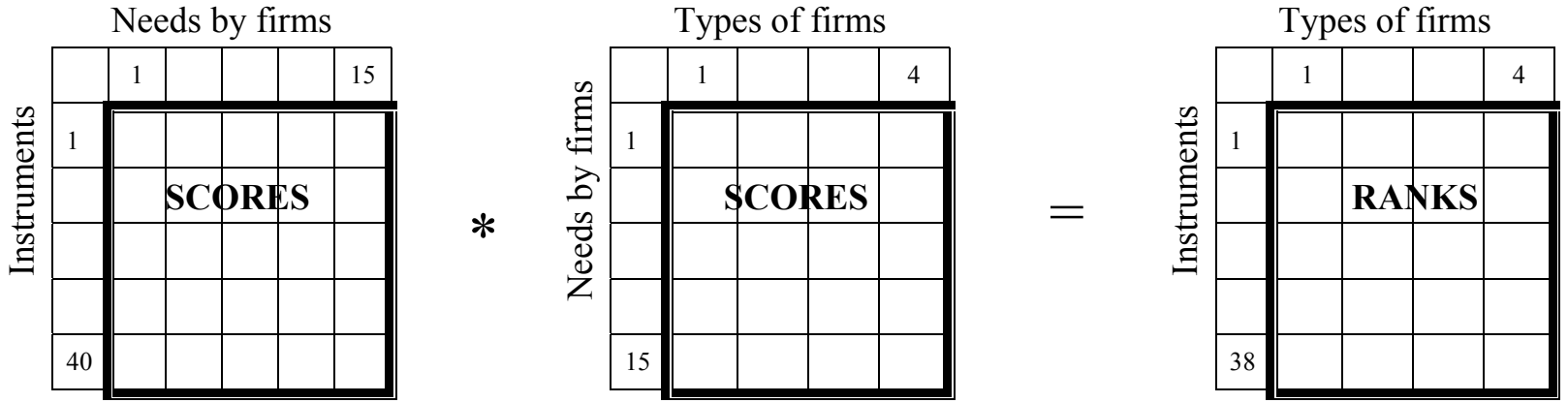
That leads to define the matrices indicated in equations 2.1), 2.2), 2.3). The "Matrix INT" model allows to estimate the relative effectiveness of the various policy instruments by computing a set of scores through the following matrix multiplication:

3) **A** (Instruments*Needs) * **B** (Needs* Industries/Technologies-Firms-Regions)
=
C (Instruments*Industries/Technologies-Firms-Regions)

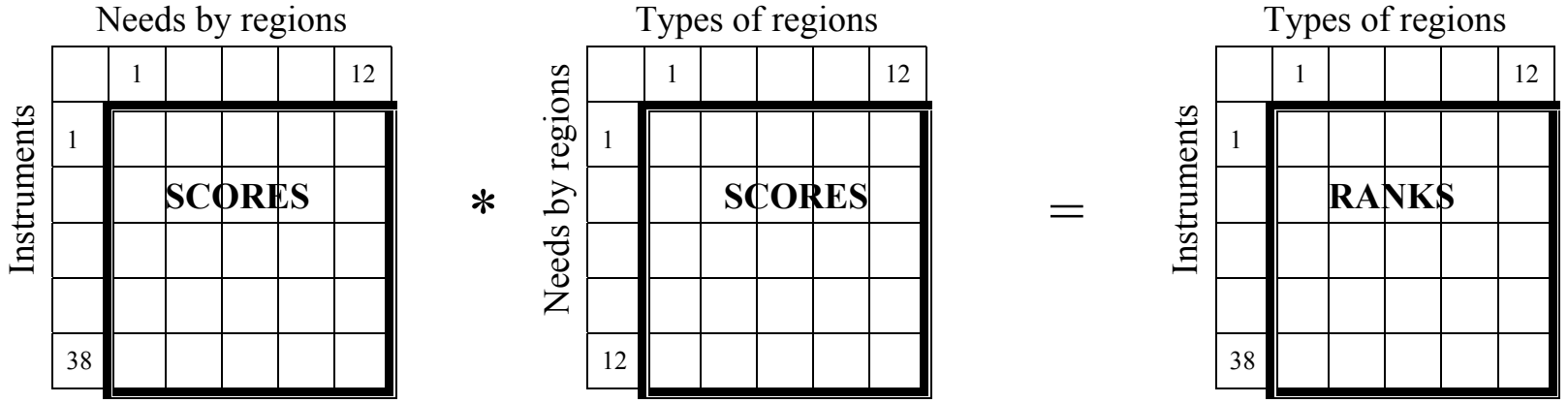
(2.1)


Needs by sector
Instruments
1
11
1
38
SCORES
*
Types of sectors
Needs by sector
1
5
1
11
SCORES
=
Types of sectors
Instruments
1
5
1
38
RANKS

(2.2)


Needs by firms
Instruments
1
15
1
40
SCORES
*
Types of firms
Needs by firms
1
4
1
15
SCORES
=
Types of firms
Instruments
1
4
1
38
RANKS

(2.3)


Needs by regions
Instruments
1
12
1
38
SCORES
*
Types of regions
Needs by regions
1
12
1
12
SCORES
=
Types of regions
Instruments
1
12
1
38
RANKS

In a more formal way the procedure to compute the scores of the Matrix INT may be illustrated with the following analytical expressions. Given the following indexes:

i: index of the need to be considered in an industry/technology and firm and regional dimension (i: 1, …11, 12,….26,27,….38),
p: index of the policy instrument to be considered in a specific industry/technology or firm or regional dimension (j: 1,…38),
t: index of the various industry/technology to be considered (t: 1,…5),
f: index of the various firm types to be considered (f: 1,…4),
r: index of the various region type to be considered (r: 1,…12),
we may define:
n_{it}, n_{if}, n_{ir}: scores of the need (i), respectively in the dimension of industry/technology (t) or of firm (f) or of region (r),
x_{ip}: score of the policy instrument (p) in response to the need (i).

As indicated above, in the actual calibration of the model, the scores (n) have been defined with a value between 1 (low importance) and 5 (very important), with the constraint that the summation of the scores of all the needs will be the same for each industry/technology or firm type or region considered type. That assures the comparability of the results, between the industry/technology or firm type or region t considered type, and obliges to identify a well defined priority between the various needs for a given industry/technology or firm or region type..

Similarly, the scores (x) have been defined with a value between 0 and 3, where the value 0 indicates that a given policy instrument does not have any specific effect on a specific need, while the score assumes the value 3, when the instrument is particularly appropriate to respond to a specific need.

Finally, the weights (W), to be assigned to a specific policy instrument (p) according to the three dimensions considered: industry/technologies, firms and regions (t, f and r), can be computed:

4.1) $W_{tp} = \Sigma_i n_{it} x_{ip}$
4.2) $W_{fp} = \Sigma_i n_{if} x_{ip}$
4.3) $W_{rp} = \Sigma_i n_{ir} x_{ip}$

as the multiplication of the scores attributed to the individual needs by the specific scores attributed in the effectiveness of the specific policy instrument to be considered with respect to these same needs.

The overall weight (W_p) of a specific policy instrument (p) can be computed through the following simple expression:

5) $W_p = a W_{tp} + b W_{fp} + c W_{rp}$

where the parameters (a, b and c) can be used in order to standardize the various scores or to assign a different importance to the industry/technology, firm and regional perspectives.

Thus, rather than to define “ex novo” the value of the scores, as indicated in equation 1) it is possible to adopt the scores defined in the INSME study. In particular, the specific policy case study to be considered (i.e. firm, cluster, sector, region) may be characterized with respect to the specific industry/technology (t), firm type (f) and region type (r) indicated in table 1. As each specific policy instrument has a specific score in these three dimensions, the ranks indicated in the equations 4.1)

4.2), 4.3) for that specific policy instrument may be summated in order to compute an overall score and this latter can then be compared with the scores of other policy instruments.

That leads to identify a set of "appropriate" innovation policy instruments, which take into account the analysis and the evaluations based on an international comparison of various countries and of the opinion of an interdisciplinary group of experts. Clearly these scores may be adapted in specific case studies, in order to take into account the characteristics of the specific needs and the relative efficiency of the various intermediaries to be considered.

The model of Matrix INT underlines, first of all, the wide variety of the instruments, which can be used in innovation policies. Second, the matrix of "Instruments and Needs of Technology" allows to measure in a rigorous and quantitative way the complementarity and the trade-offs of the policy instruments, when aiming to respond to various and interdependent needs. The model clearly indicates the interaction between the various needs in the innovation process and the various policy instruments, as the same need may be satisfied through various instruments and the same instrument may be adapted in order to respond to various needs.

Third, the model may helps the policy maker to make explicit the priorities (the parameters: n_{it}, n_{if}, n_{ir}) of the various needs to be considered, as also the expectation on the effectiveness of the various instruments (the parameters x_{ip}). In fact, a specific policy instrument can be demonstrated to be superior to other policy instruments, only when these parameters assume a specific level. That obliges the policy makers to analyse the combination of industry, firms and regional typology characterizing the policy case study to be considered and may lead him to change the instruments to be adopted, according to their overall impact on a rather wide set of problems/needs which have been considered.

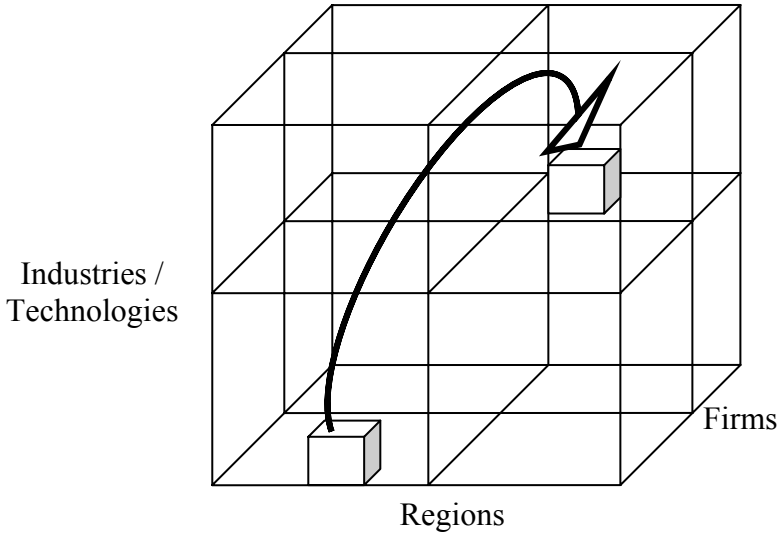


Figure 6: The shift to a new profile within the regions-technologies-firms space

Fourth, the model may be used, in order to compare the different needs of policy instruments in two cases, which may be characterized by a different combination of industry/technology, firm type and regional type, as it is indicated in figure 6.

According to the scores adopted in the INSME study, the instruments which seem particularly most important in the case of the less technologically advanced industries, such as the "product-engineering industry" and the "traditional industry", are:

- TT service centres (fully public financed),
- Regional technological parks and centres,

- TT centres and programmes (partially nationally publicly financed),
- Public information and benchmarking centres,
- Professional continuous education centres,
- Local incubators of innovative firms.

The policy instruments, which are mostly needed by the less technologically advanced firms, such as the "Marshallian" firms and the "marginal" firms, are:

- liberalization and MNE attraction,
- private professional services,
- TT centres and programmes (partially nationally publicly financed),
- professional continuous education centres,
- cooperative research projects between SMEs (CRAFT),
- Business Innovation Centres (BIC) and Innovation Relay Centres (IRC),
- TT centres of industry associations,
- chambers of commerce and RIS-Regional Innovation Strategies.

Finally, the less technologically advanced regions, such as: the "old industrial and reconversion regions" and the "economic lagging regions", indicate an higher need, with respect to the more technologically advanced regions, of the following policy instruments:

- regional offices of national agencies or departments,
- strategic planning contracts with large firms,
- territorial pacts with local actors,
- Business Innovation Centres (BIC) and Innovation Relay Centres (IRC),
- TT centres of industry associations and chambers of commerce,
- regional/local development agencies,
- local stakeholders coordination tables,
- regional innovative start-up funds.

As indicated in equation 5), it is also possible to compute an overall score, once a specific sector, firm type and region type has been defined. In particular, it is possible to compute the need of innovation policy instruments in two extreme cases, characterized by a very different technology level (table 4), such as:

- case study 1: Science based industries + Schumpeterian firms + High tech clusters
- case study 2: Traditional industries + Marginal firms + Economic lagging regions

The case study 1 is more technologically advanced and it underlines the demand of those innovation policy instruments, which mainly contribute to the creation of "codified knowledge" and support R&D investments, such as:

- IPR regulation and national patent offices,
- large public R&D institutions,
- subsidies to strategic private industries,
- technological education centres,
- autonomous - non governmental research institutions or foundations,
- public funding of R&D,
- national programs for R&D and innovation networks,
- public owned industries,
- university – industry liaison offices,
- public demand and fiscal incentives,
- science parks.

Table 4 - Matrix INT : comparison of two extreme cases

Policy-making model	Instruments of innovation policy	**Case 1:** Science based - Schumpeterian firms - High tech clusters	**Case 2**: Traditional industries - Marginal firms - Economic lagging regions	Difference of total scores
B	4. IPR regulation and national patent offices	281,81	202,4	79,41
A	7. Large public R&D institutions	335,01	265,74	69,28
A	2. Subsidies to strategic private industries	308,58	245,51	63,06
B	9. Technological education centres	343,32	284,01	59,31
D	2. Autonomous - non governmental research institutions or foundations	312,19	261,83	50,37
A	4. Public funding of R&D	284,87	240,01	44,86
C	7. National programs for R&D and innovation networks	340,86	299,45	41,41
A	1. Public owned industries	234,59	193,47	41,12
C	5. University – industry liaison offices	349,55	310,98	38,57
A	6. Public demand and fiscal incentives	237,32	200,08	37,25
A	8. Science Parks	386,44	352,74	33,7
A	3. National agencies of sectoral industrial plans	206,32	177,49	28,83
C	9. National financial trusts for financing innovative firms	296,44	270,64	25,8
D	9. Territorial knowledge management (TKM)	363,61	338,82	24,8
B	8. Private research companies	345,63	324,98	20,65
B	7. Private venture capital	321,96	306,71	15,26
C	8. National networks of TT service centres	317,16	308,31	8,84
D	5. Local incubators of innovative firms	339,23	330,67	8,56
B	6. Private technology brokers	350,34	344,46	5,88
C	10. International networks of TT centres	264,1	259,71	4,4
C	3. Regional technological parks and centres	384,01	381,95	2,06
D	1. Cooperative research projects between SMEs (CRAFT)	352,37	350,91	1,46
C	1. Strategic planning contracts with large firms	269,71	270,59	-0,88
B	3. Liberalization and MNE attraction	312,32	317,7	-5,38
D	8. RIS - regional innovation system	371,92	378,81	-6,9
D	10. Regional innovative start-up funds	318,78	332,77	-13,99
C	6. Professional continuous education centres	353,5	373,33	-19,83
A	9. TT service centres (fully public financed)	317,32	343,84	-26,52
B	2. Market deregulation	207,44	237,9	-30,46
B	1. Privatization of public industries	194,38	231,23	-36,85
B	5. Private professional services	245,97	292,36	-46,38
C	4. TT centres and programmes (partially nationally publicly financed)	341,96	390,68	-48,72
D	3. Business Innovation Centres (BIC) & Innovation Relay Centres (IRC)	310,23	359,87	-49,64
A	5. Regional offices of national agencies or departments	265,64	316,26	-50,62
B	10. Public information and benchmarking centres	278,67	334,67	-55,99
D	7. Local stakeholders coordination tables	225,24	293,15	-67,91
D	6. Regional/local development agencies	237,39	316,13	-78,74
D	4. TT centres of industry associations and chambers of commerce	253,16	335,33	-82,17
C	2. Territorial pacts with local actors	240,66	324,55	-83,89
	Total	11700,00	11700,00	0

In contrast, the case study 2 is less technologically advanced and it indicates an higher demand of those policy instruments, which mainly enhance the development of "tacit knowledge" and of interactive learning processes between the various SMEs and local stakeholders, such as:

- territorial pacts with local actors,
- TT centres of industry associations and chambers of commerce,
- regional/local development agencies,
- local stakeholders coordination tables,
- public information and benchmarking centres,
- regional offices of national agencies or departments,
- Business Innovation Centres (BIC) and Innovation Relay Centres (IRC),
- TT centres and programmes (partially nationally publicly financed),
- private professional services.

For example, table 4 indicates that the four specific policy instruments considered in table 3 have a different relevance in the two policy case studies. The most technologically advanced industries, firms and regions may emphasize the role of large public R&D institutions and private venture capital. On the contrary the less technologically advanced industries, firms and regions may emphasize the role of TT centres and programmes and of RIS-regional innovation systems. Moreover, the empirical results in the INSME study highlight that an appropriate combination of the "government" and the "market" approach may be more appropriate for the more advanced case study 1, while the "governance 1" and the "governance 2" approaches seem more appropriate for the less advanced case study 2.

5. Conclusions

The study has allowed to design a model: "Matrix INT - Instruments and Needs of Technology" , which is characterized by a wide flexibility and may consider different types of regions, industries and firms. It represents a new method of evaluation, which is similar to multicriteria analysis, usually adopted in the choice of investment projects or in environment evaluation.

That approach may be synthetically summarised with the need to articulate the policy making process in the following phases:

a) the identification of the different dimensions of industries, firms and regions to be considered in a specific case study,
b) the identification of the priority needs related to the specific obstacles to innovation according to these three perspectives,
c) the selection of a complex set of complementary instruments most effective with respect to the identified needs.

The model indicates the complementarity and the trade-offs between different instruments in innovation policy, having a different priority in various industries, firms and regions. It implies that the different problems and opportunities of development of the small and medium size firms in the various individual countries determine a different structure of the demand of technology transfer services. Each problem may be tackled by different types of instruments and intermediaries, which may be characterized by various degrees of effectiveness.

Thus, the two major characteristics of the model "Matrix INT" are:

- the adoption of a "demand led" rather than a "supply push" approach. That has led to focus the analysis on the characteristics and needs of innovation by the various regions, sectors and firms, rather than on the survey of the potentials and problems of existing TT intermediaries.

- the identification of an intermediate step in the relationship between the analysis of the characteristics of the specific countries and the design of the innovation policy instruments. Tha has led to focus on the relationships between the specific needs ("demand") by the various industries/technologies, firms and regions and the relative effectiveness of the types of innovation policy instruments ("supply").

The choice of the TT intermediaries and of the innovation policy instruments is often made on hre base of the subjective preferences of the policy maker or on the base of the actual interests of the already existing TT intermediaries in the region or country considered. That seems a less optimal approach than that indicated by the Matrix INT, which allows to choose the most appropriate policy instruments by considering three complementary dimensions (types of industry/technology, firm and region), a large set of problems/needs related to these dimensions and finally a diversified set of complementary policy instruments.

Moreover, the "Matrix INT" indicates a methodological framework suitable in an international comparative perspective. It may be useful in empirical studies and in operative projects to be carried out jointly within international research and policy networks, aimed to elaborate comparative analysis and to identify specific benchmarks.

It must be underlined that the model of "Matrix INT" does not propose a recipe, but a methodology, that has to be handled with care and adapted to specific circumstances and problems. It does not indicate a unique best solution for many heterogeneous cases, but rather it may help the policy makers to disentangle the various dimensions and the various variables and parameters, which have to be considered and estimated.

This methodological framework may help in the evaluation of the gap between the characteristics of the demand and the supply of technology transfer services to small and medium size firms in a wide international selection of countries. It may also be used for the definition and the implementation of specific "pilot projects" to be elaborated in the framework of schemes of international co-operation. For example the model of "Matrix INT" could be adopted as:
a) a methodology for collecting statistical information on innovation factors,
b) a methodology for defining a coherent set of priorities in policy-making,
c) a methodology for the "ex ante" evaluation of the most appropriate policy instruments in innovation policies,
e) a methodology for a comparative analysis of the success or failures of given innovation policy instruments in various countries.
d) a methodology for a comparative analysis of innovation problems and needs in various countries,

Thus, the model of "Matrix INT" provides a methodology in the analysis of the TT needs and instruments and it could facilitate the international diffusion of modern approaches in innovation policy and improve the understanding on how to adapt international experience and theoretical models the specific countries.

6. References

Archibugi, D., Evangelista, R. and Nascia, L., 1999. "Il ruolo delle piccole e medie imprese nel sistema innovativo italiano" in Antonelli, C., *Nuovi paradigmi dell'innovazione e specificità italiana*, Fondazione Agnelli, Torino.

Archibugi, D. and Orsenigo, L. (2002), The problems and needs of innovation in a typology of industries / technologies, in Cappellin, R. (ed.), *A methodological approach for the identification of*

SME innovation policy instruments. INSME – Feasibility study, IPI – Istituto per la Promozione Industriale, Roma.

Becattini, G. (1991), The Marshallian industrial district as a socio-economic notion, in Pycke, F., Becattini, G. and Sengenberger, E. (eds.), *Industrial Districts and Inter-firm Co-operation in Italy*, Geneva, International Institute for Labor Studies: 37-51

Braczyk, H. J., Cooke, P., Heidenreich, M. (1998) (eds.), *Regional innovation systems. The role of governances in a globalized world*, London, UCL Press.

Breschi, S, Malerba, F. and Orsenigo, L. 2000. "Technological Regimes and Schumpeterian patterns of innovation", Economic Journal, 110: 388-410.

Brusco, S. and Paba, S. (1997), Per una storia dei distretti produttivi italiani dal secondo dopoguerra agli anni novanta, in Barca, F. (ed.), *Storia del capitalismo italiano dal dopoguerra a oggi*, Roma, Donzelli Editore: 263-333.

Cappellin, R. (1998), The transformation of local production systems: interregional networking and territorial competitiveness, in Steiner, M. (ed.), *From agglomeration economies to innovative clusters*, London, Pion Editor, European Research in Regional Science: 57-80.

Cappellin, R. (2000) Learning economy, tecnologie dell'informazione e sistemi produttivi regionali, *Economia e Diritto del Terziario,* n. 3: 853-898.

Cappellin, R. (2002), Regional industrial policy and the new economy, in G. Atalik and M. M. Fischer (eds.) *Regional Development Reconsidered*, Berlin, Springer Verlag.

Cappellin, R. (2002b), (ed.), *A methodological approach for the identification of SME innovation policy instruments*. INSME – Feasibility study, IPI – Istituto per la Promozione Industriale, Roma.

Cappellin, R. (2003a) Territorial knowledge management: toward a metrics of the cognitive dimension of agglomeration economies, *International Journal of Technology Management*, Special Issue on: Evaluating Innovation Policies, December 2002.

Cappellin, R. (2003b), Networks and technological change in regional clusters, paper presented at Kiel Institute of World Economics and Institute for Regional Research, Kiel University, International Workshop on: "*Innovation Clusters and Interregional Competition*", 12. - 13. November 2001.

Cappellin, R. and Orsenigo, L. (2000), The territorial dimension of modern industry and the scope of regional industrial and labour market policies, in Klemmer, P. and Wink, R. (eds.), *Preventing unemployment in Europe. A new framework for labour market policy*, Cheltenham, UK, Northampton, US, Elgar: 166-187.

Cefis E. and L. Orsenigo (2001), The Persistence of Innovative Activities. A Cross-Countries and Cross-Sectors Comparative Analysis. *Research Policy*

Decastri, M. 1984, *Organizzazione e cultura dell'innovazione in impresa. La funzione ricerca e sviluppo*, Giuffrè Editore, Milano.

Duncan, R.B. 1976, The Ambidextrous Organization: Designing Dual Structures for Innovation, in Kilmann, R.H., Pondy, L.R. and Dlevin, D.P. "*The management of Organizational Design*", Elsevier – North-Holland, New York.

Freeman, C. 1982. *The Economics of Industrial Innovation*, Frances Pinter, London.

Galbraith, J.R. 1982, "Designing the innovating organization", *Organizational Dynamics*, winter 1982.

Geroski, P.A., Van Reenen, J. and Walters, C.F. (1997), "How Persistently Do Firms Innovate?", *Research Policy*, 26(1), pp. 33-48.

Guilford, J.P. 1959, "Three faces of intellect", *American Psychologist*, n. 14.

Holland, J.H (2002), Complex adaptive systems and spontaneous emergence, in Quadrio Curzio, A. and Fortis, M. (eds.), *Complexity and industrial clusters: dynamics and models in theory and practice*, Heidelberg, Phisica-Verlag: 25-34.

Lundvall, B.-A., 1988. "Innovation as an interactive process: from user-producer interaction to the national system of innovation", in Dosi, G. et al. (eds.), *Technical Change and Economic Theory*, Frances Pinter, London.

Maillat, D. and Kebir. L. (1999), "Learning region" et systemes territoriaux de production, *Revue d'Economie Regionale et Urbaine*, n. 3: 430-448.

Mansell, R. and Wehn U. (1998) (eds.), *Knowledge Societies: information technology for sustainable development*. Oxford: Oxford University Press.

Marsili O. 2001, *The Anatomy and Evolution of Industries: Technological Change and Industrial Dynamics*, Edward Elgar, Cheltenham

Nadler, D.A. and Tushman, M.L. 1986, *Strategic Organization Design*, Scott, Foresman, Homewood.

Nelson, R. ed. 1993. *National Innovation Systems*. Oxford University Press, Oxford.

Nonaka, I. and Konno, N. (1998), The concept of "Ba": building a foundation for knowledge creation, *California Management Review*, 40, 3: 40-54.

OECD 1992. *Oslo Manual. Proposed Guidelines for Collecting and Interpreting Technological Innovation Data*, OECD, Paris.

Orsenigo, L. and Decastri, M. (2002), The problems and needs of innovation in a typology of firms, in Cappellin, R. (ed.), *A methodological approach for the identification of SME innovation policy instruments*. INSME – Feasibility study, IPI – Istituto per la Promozione Industriale, Roma.

Pavitt, K. 1984. "Sectoral patterns of technical change", *Research Policy*, 13: 343-73.

Perrin, B. 2000, *A Venture Capitalist Approach to Evaluation, or How to Evacuate Innovation*, Presentation to the European Evaluation Society Conference, Lausanne, 13 October 2000.

Piore, M.J. and Sabel, C.F. (1984), *The second industrial divide*, New York, Basic Books.

Porter, M. E. (1998), Clusters and the new economics of competitiveness, *Harvard Business Review*, December: 77-90.

Steiner, G.A. 1965, *The creative organization*, The University of Chicago Press, Chicago.

Steiner, M. (1998), The discret charm of clusters: an introduction, in Steiner, M. (ed.), *From agglomeration economies to innovative clusters*, London, Pion, European Research in Regional Science.

Tushman, M.L. and O'Reilly, C.A III 1997, *Winning Through Innovation: A Practical Guide to Leading Organizational Change and Renewal*, Harvard Business School Press, Boston.