

Systems, Innovation and Technology



Technology & Innovation

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ABSTRACT

This paper analyzes the System, Technology and Innovation model as a trend towards new types or relations within National Innovation Systems. Based on the review of the evolution of the national innovations systems and the analysis of the meaning of cooperation in the technological field, we expose that a System, Technology and Innovation system model fulfill the ultimate objective of satisfying the technological requirements of companies, so that they may face up to the demand of present and future markets with greater chances of success.

INTRODUCTION

On the twenty-first century, it is a well-known fact that the acquisition and development of technologies constitutes a fundamental part of the generation of resources for the improvement of business competitiveness, and that technological dynamism does not appear in the economy if we do not have the infrastructures and capacities necessary for supporting the innovative activity of companies and allowing the spread of new technologies.

The evolution of the traditional Science and Technology System towards a National Innovation System integrated into socioeconomic life has highlighted the growing need to encourage and develop the interactions among those participating in the innovation process. In this respect, current policies relating to innovation and the transfer and spreading of technology are placing increasing importance on cooperation mechanisms as a means of enabling effective interaction to take place among science, technology, production and the market.

On the basis of the review of the national innovation systems and the analysis of the meaning of cooperation in the technological field, we study the cooperative model as a trend towards new types of relations within the national innovation systems. This progress allows greater interaction among the participating agents, especially in the case of the member nations of the European Union, whose project of integration in the technological sphere superimposes different levels of action linked to the principle of subsidiary.

As a conclusion, we propose the modelling of a Cooperative Innovation System, taking into account the principles for its functioning and the different areas of interaction, which would fulfil the ultimate objective of satisfying the technological requirements of companies so that they may face up to the demand of present and future markets with greater chances of success (Martin, 2005).

THE EVOLUTION OF INNOVATION SYSTEMS TECHNOLOGY

The importance of linking the scientific and technological activity of universities and research centres more closely with industry is considered to be a key element for the economic and technological growth of countries. The technology policy constitutes the axis around which the scientific, technological and innovation activities are structured, activities which help to bring about technological advances as an indispensable public asset for growth.

In an initial stage, the technology policy was manifested in what were known as science and technology systems, whose main objective consisted in developing policies geared towards creating, mainly, research infrastructures. In this model, the interactions among the universities, the government and the business world were characterized by the existence of a reduced flow of ideas from the universities and research centres to the companies, the State acting as an intermediary in the allocation of

resources -originating from the payment of taxes on the part of the companies- in order to finance the research activity. The evolution towards a model in which there is greater interaction among the universities and public research centres, the companies and the government is regarded as a necessity for satisfying the requirements of services, research and development, as well as continuous training, over a period of years in which the speed of innovation has meant that it takes very little time for a new product to reach the market after it has been designed in a research laboratory, and in which the new technologies -in the sphere of acquisition and processing of information, in telecommunications and materials- have opened up possibilities for rapid technological progress in the most diverse fields of knowledge. The concept of National Innovation System (NIS) has been introduced into the literature in order to designate the existence of certain organizational and operating mechanisms which enable interaction among science, technology, production and the market (Hagedoorn et al. 2000). The National Innovation System -or science-technology-industry system- is an institutional organization scheme which encompasses different capacities (information, knowledge, financial resources, etc.) from different origins (public laboratories, university research centres, engineering firms, information centres, users, etc.) which make the innovation processes possible within an economy.

Therefore, we can define the national innovation systems as being those which bring together all the economic and social agents that intervene in any of the phases of the innovation process. Specifically speaking: the companies, the public R&D system (which includes the universities and public research centres), the government services which carry out policies relating to technology and the promotion of innovation, the innovation support infrastructures and other agents or related subsystems (the education system, the capital markets, etc.).

REVIEW OF LITERATURE

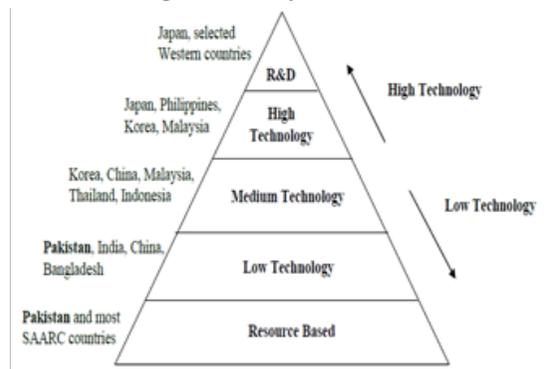
As regards the way in which the companies carry out the innovation processes, the significant increase -starting from the mid-1980s- in the number of strategic alliances based on collaboration for the development of innovations highlights the fact that technological innovation is the result of a process which is carried out within a network (Hagedoorn, 1993). The network comprises not only the companies which collaborate, but also clients, supplier, sources of technological knowledge (Universities, Public Research Centres), administrators, etc., whereby a large number of interactions are generated among the various participants. In this context, the definition of National Innovation System implicitly entails the acknowledgement of the multiplicity of factors and agents that intervene in the technological innovation process and, therefore, in the technical change. Freeman (1987), for example, by associating the substantial technological changes with the national innovation systems, defines the latter as "the network of institutions in the public and private sectors, whose activities and interactions initiate, import, modify and spread new technologies". These institutions range from the institutional and political apparatus of the State to the private individual, who will be the end consumer of the new

products or services offered on the market. Along similar lines, Hauschildt (1994) also stresses the fundamental role played by interactions in the multiplication and acceleration of the technological results.

NEED OF THE STUDY

- a) The role of science, technology and innovation in the processes of industrial growth and development.
- b) Exploring the inclusion of innovation and knowledge in sub-national, regional, global and local innovation networks
- c) Research on the interaction among governments, industries, businesses, universities and communities in the use and application of science, technology and innovation policies; particularly comparative works that have implications for all developing economies.
- d) Critiques of science, technology and innovation policies and their applications in India

World Technological Status Pyramid



In order for India to move towards the apex of this pyramid towards R&D and innovation, it is necessary for it to develop its indigenous technological capabilities (ITC)

It is important to realize that this entire exercise of developing innovation and R&D capabilities to bring about a shift towards a national innovation system would not be possible until a supportive technology climate is in place. Technology climate refers to the national setting within which technology based activities are carried out (UNESCAP, 1989).

Moreover, differences in technology climates can cause similar transformation facilities or production units within two different countries to produce different results. Thus, a transformation facility is likely to produce better results in a supportive technology climate than in a less supportive one. Furthermore, it should also be noted that a supportive technology climate is also necessary in order to make the most effective use of ITC.

Without a supportive technology climate in place, it would neither be possible for Pakistan to develop its ITC capabilities as per its ITC pyramid, nor for it to bring about a paradigm shift towards high-tech and R&D areas. The development of a supportive technology climate is thus very much necessary in order to facilitate movement up to the apex in India ITC and world technological status pyramids. Moreover, a supportive technology climate is imperative for the development of skills from low levels of sophistication in skills (operating capabilities) towards high levels of sophistication (design and R&D capabilities).

Hence, none of these interventions to move Pakistan from imitation to innovation will be effective without a supportive technology climate in place to facilitate this entire process. Policy directions are thus required in this regard, in order to create a fostering and supportive technology climate.

CONCLUSION

We have already mentioned that the National Innovation Systems involve different organizational schemes and different policies which, furthermore, involve the creation of effective mechanisms of interaction among agents.

We have also highlighted how the interactions based on cooperation are very suitable in the field of technology, given that as well as representing an efficient solution, from the economic point of view; they lead to saving in transaction costs.

Furthermore, given that cooperation involves establishing a contractual relation between agents in order to jointly perform a certain business function, in order for cooperation to be established there must be an incentive and this will exist provided that the agents, upon cooperating, obtain greater profits than they would achieve individually. The synergic effects arise, therefore, when the total profit of operating together is greater than the sum of the profit of each one of the participants considered individually.

Therefore, the interactions based on cooperation within the National Innovation Systems might be the most suitable, given that they permit synergic effects, both in the performance of horizontal actions (exchange of information, linking among agents, etc.) and in the integration of vertical actions in the different levels of analysis mentioned above:

At an individual level: since technological knowledge is tacit knowledge (learning by using, learning by doing... learning by learning) and given the difficulty involved in spreading it, it is essential to create work teams based on cooperation as a means for learning and spreading technological knowledge.

At a company level: either by promoting cooperation among companies with the aim of generating economies of scale, or by seeking complementarily through a closer relationship between universities and public research centres by means of cooperation.

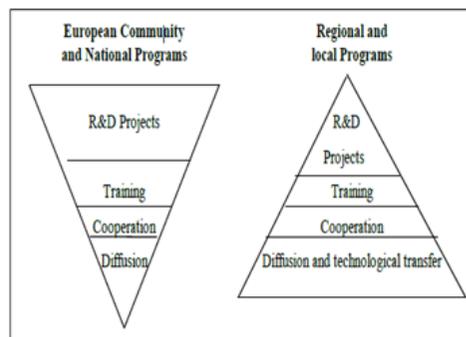
At a regional, national or supranational level: given that individuals and companies operate in geographical spheres of different sizes in which actions which correspond to the different spheres mentioned may be coordinated through cooperation.

This proposal virtually becomes a necessity in the case of the European Union. On the one hand, at a Community level, the search for effective coordination among the different governments of the member nations with regard to R & D has led to the establishment of plural-annual Framework Programmes, in which the actions of each government in this sphere must be carried out in a coordinated manner in keeping with the objectives proposed in the Programme.

On the other, the principle of subsidiary underlies all the Community's actions. This term refers to the need to assume responsibilities in a decentralized manner through the various levels of government, as a mechanism for reinforcing the efficiency of the actions.

In short, the aim is to ensure that the effective coordination

Figure 1. Technology Policy: field of application



among the different governments is guided by efficiency criteria, and as we have seen, cooperation involves an efficient solution from the economic point of view. Together with this, the dual and complementary nature of national and/or supranational actions with respect to regional ac-

tions is highlighted, and therefore efficiency, in this sense, from our point of view, comprises two aspects:

Cooperation among regional and local organizations based on complementarity, given that the programmes they carry out -taking advantage of their proximity to the company- will focus on the areas where the economies of accumulation of knowledge are more important (the spreading of technologies and the promotion of cooperation among the economic and social agents of their environment).

Cooperation in national and/or supranational actions based on the search for economies of scale, given that most of their resources will be devoted to the financing actions which, due to their extent require high investments (research projects, technological development and demonstrations), as well as to the training activities which help to create teams of research and innovation excellence in the European and national spheres.

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