

Innovation and innovation systems: relevance for the area of health

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Abstract

In the final decades of the 20th century, renewed attention began to be paid to processes of generating, diffusing and using knowledge. Various analytical and normative approaches have been developed to try and understand and guide these processes. The aim of this article is to present and discuss the concept of innovation systems, and its advantages and challenges, and to examine the Brazilian experience with the usage and development of this concept. At the end, the article returns to its main analytical conclusions, stressing: (i) the priority of stimulating and developing production and innovation systems which can galvanize social development – such as those in the area of health; (ii) the urgent need to move forwards in the understanding of the possibilities for developing these areas, as well as in the formulation of policies which can guide and encourage this development in a systematic and sustainable way.

Keywords

Innovation, innovation systems, Brazilian experience, social development, local productive systems

Introduction

In the final decades of the 20th century, renewed attention was paid to ways of generating, diffusing and using knowledge. One of the key advances was the development of the concept of innovation systems, increasingly used to understand the role of innovation and knowledge in the competitiveness of organizations and countries. The focus ceases to be individual innovations and organizations, and shifts instead to the systemic processes which allow businesses and other organizations to learn, use and accumulate capabilities and develop new products and processes (FREEMAN, 1982a and 1987; LUNDVALL, 1985; IMAI et al., 1989).

One of the aims of this text is to resume this discussion.

A second aim is to discuss the Brazilian experience with the usage and development of this concept, both in analysis and in the orientation of capabilities for production and innovation. The third aim is to draw attention to the urgent need to stimulate and develop production and innovation systems, such as those in the area of health, for the galvanization of social development in Brazil.

The article is structured in the following way: section 2 discusses the development of the concept of innovation since the end of the 1960s, culminating in the evolution of the concept of innovation systems in

the 1980s. Section 3 presents the evolution of this concept, discussing its advantages and challenges and pointing to some of the main connection points between the contributions of the “*cepalino*” structuralist school¹ and the neo-Schumpeter school. The conclusion points to the need to move forwards in the understanding of production and innovation systems which galvanize social development and the formulation of policies which orient and drive these systems in a systemic and sustainable way.

Innovation

The literature on innovation has its origins in Schumpeter’s contributions, and in particular his attempts to build a theory about the relationship between technological innovation and economic development. Economic growth is seen as a dynamic process which depends both on the generation and use of innovations as well as the processes of diffusing them. The advances – productive, technological, organizational, institutional, and so on – which result from innovation processes are considered to be a basic factor in the formation of the patterns of economic transformation and the development of the economy in the long term (SCHUMPETER, 1912; 1939; 1942). These contributions have been qualified and refined by a series of authors who have followed in Schumpeter’s footsteps in their efforts to understand the capitalist dynamic, focusing in particular on the innovation dynamic and its impacts on the development of organizations and countries.

Until the 1960s, innovation was associated with new products or processes and understood as something which took place in successive stages of basic research, applied research, development, production and diffusion (the linear vision of innovation). In general the discussion about the most important sources of innovation was polarized between those who (i) attributed more importance to the advance of scientific development (*science push*) and those who (ii) stressed the relevance of the pressures stemming from the demand for new technologies (*demand pull*).

Over the following decades, the understanding of innovation was requalified and widened, with far-reaching consequences for the science and technology (S&T) policy sphere. Empirical and theoretical/conceptual studies showed that there is a wide range of essential information and knowledge which favor the generation and incorporation of novelty (innovation), and that these processes are characterized by trial and error and feedback mechanisms. Innovation came to be understood as the result of a range of interlinked activities, including principally its assimilation, use and diffusion. Analysis of the innovation process began to concentrate on the underlying structures and on the connections. It was recognized, for example, that despite the process of knowledge accumulation being essentially specific to the company or business, it is fundamentally influenced by the continuous relations between firms

and other organizations. Innovation therefore came to be seen not as “*a single act, but rather a series of them... which acquire economic significance only through the extensive processes of redesign, modification and innumerable small improvements*” (ROSENBERG, 1976, p.75-76). Or, as DOSI (1988) preferred to put it, “*the search for and the discovery, experimentation, development, imitation and adoption of new products, new productive processes and new organizational systems*” (p.222).

Especially important was the understanding that innovation and diffusion processes are defined mutually and simultaneously. In actual fact it was discovered that when the process of diffusion of any technology is begun there is a set of concurrent novelties, based on technologies which are constantly and systematically changing in response to experience and the incentives which emerge during diffusion (METCALFE, 1986). According to this perspective, interaction between producers and users and the existence of a relatively sophisticated pool of qualifications in the surroundings are important elements in the process of developing a new technology. Social, economic and political selection processes linked to the generation, use and diffusion of innovations contribute simultaneously to define the technological trajectories.

This is, therefore, a biunivocal relationship in which innovation is developed and diffused according to the standard pattern of technological evolution, which in turn redefines the innovative trajectory itself. Different environments where companies and organizations meet are associated with different standards of technological progress (GEORGHIU et al., 1986). This emphasizes the national, regional and local specificities of the processes of generating, using and diffusing innovations. The innovation process is then seen as the result of a collective learning process, based on the linkages within the company and between it and other organizations (LUNDVALL, 1985; PEREZ, 1988). Innovation was no longer seen as an isolated act but rather as an interactive, non-linear, cumulative learning process, specific to the location and difficult to replicate.

The systemic character of innovation had already been recognized by FREEMAN (1982a), who pointed out that technological decisions and strategies were dependent on factors which covered the financial sector, the educational system and the organization of labor, as well as the sphere of production and sales and marketing of goods and services. This was a predecessor of the definition of the concept of the national innovation system, which was set out in a book about the evolution of the Japanese case (FREEMAN, 1987). It is interesting to note that several Latin American and Caribbean authors, at least from the beginning of the 20th century onwards, have always pointed out that an understanding of the industrial and technological dynamic, and of the policies for its mobilization, requires systemic consideration and influencing of the conditioners of the specific macroeconomic, political, institutional and financial context of each country (PREBISCH, 1949;

FURTADO, 1961). A fundamental perception that this wider context can never be ignored was the observation that it constitutes an important “implicit policy” which is capable of hampering and even canceling out the specific explicit policies (HERRERA, 1971).

It is also significant that FREEMAN’s work (1982a, 1982b), associating the understanding of the evolution of capitalism to the waves of growth and depression over the long term:

- Explores the forms of the innovative process in the new technological paradigm of information and communication technologies (ICTs)
- Criticizes the theories that free trade is disadvantageous for less developed countries
- Points to the need for government initiatives to deal with particularly high levels of uncertainties in periods of paradigm change.

The changes in the techno-economic paradigms are understood as essential for explaining the periods of growth and economic crisis. The new paradigms alter the technological frontiers and create new sets of standards, practices and production processes. In general technological change is rapid and accompanied by a high level of inertia in public and private institutions and organizations. In this way, the crisis periods are seen in the light of the conflict between the emergence of the new paradigm and the previous institutional structure, just as economic booms are associated with periods of adaptation of institutions and the economic structure and their interaction with the new techno-economic paradigm (FREEMAN, 1982c; 1998; PEREZ, 1983; 1988).

These developments led to the emphasis of the systemic vision on the political propositions and the relevance of focusing on the connections between the different actors in the different national innovation systems. The dual character of the new policies stands out: innovation becomes the most important component of development strategies (and not just in S&T policies or industrial policies) and policies directed towards innovation start to be understood as policies in support of innovation systems.

The focus on knowledge, learning and interactivity sustained the idea of innovation systems, which were conceptualized as groups of institutions which contribute to and affect the development of the capacity for learning and creation and use of competencies of a country, region, sector or locality (FREEMAN, 1987; 1988; LUNDVALL, 1992; 1995). These systems are made up of elements which interact in the production, use and diffusion of the knowledge. They do not only contain those directly related to scientific and technological development, but also several others, including forms of behavior, norms, policies and other characteristics of the context where they are located. This reinforces the idea that innovation processes – which happen at company level – are also generated and sustained by its relationship with other companies and organizations, and depend on this wider environment.

The evolution of the innovation systems concept, its advantages and challenges

As LUNDVALL (2006) points out, some authors tend to use the concept of innovation systems in a restricted way, considering it as an expansion of earlier visions about national science and technology systems (NELSON, 1993; MOWERY et al., 1995). According to this line of thought, the main points are related to mapping indicators of specialization and national performance relative to research and development and innovation activities and science and technology organizations. In relation to policy, the topics refer exclusively to science and technology policy. The analysis includes some factors which influence the production and use of knowledge, but ignores the wider set of elements: from those which make up the creation of capabilities – such as education, training, industrial relations and the dynamic of the labor market – to those other ones which are more general but which have a decisive impact on innovation systems, such as implicit macroeconomic policies and the financial sector.

The broader definition of national innovation systems includes these analytical dimensions, incorporating the role of businesses, teaching and research organizations, government (as a whole and not just science and technology policy), financing bodies, and other actors and elements which influence the acquisition, use and diffusion of innovations. This line of thought emphasizes (i) the role of historical processes, responsible for differences in development trajectories, political and institutional evolution and socio-economic capabilities (ii) the importance of the national character of innovation systems (FREEMAN, 1982; 1987; LUNDVALL, 1985). As set out above, ever since the first piece of work that introduced the concept, FREEMAN (1982a) argued that it is not just the performance of countries which is linked to innovation, but that other factors beyond science and technology organizations and research and development significantly influence the innovation performance of countries and businesses, stressing its national character. He later specifically used the broad concept of national innovation systems in an analysis of Japan’s economic and technological performance from the 1950s to the 1980s.

This approach to national innovation systems was also broadened by work which highlighted the relevance of producer/user relations for innovation and the role of the domestic market (LUNDVALL, 1988). This work revealed that an importance source of innovation is the interactive learning which takes place during production, technological development, marketing, and sales, and which involves elements not linked to price such as power, loyalty and trust. All of this reaffirmed the importance of capturing the specificity of the different actors, the type and quality of the relationships and an understanding of the role of institutions in their widest sense – including norms and rules, both formal and informal. Special

emphasis was given to this role played by institutions in the determination of (i) how people interact and how they learn and use knowledge; and (ii) the direction that they take and the rate at which the innovative activities evolve (JOHNSON, 1992; LUNDVALL, 2006; JOHNSON et al., 2003).

Obviously analysis which focuses on producer/user or university/business relations and so on continues to be of great use. However, we must not forget all of the progress made over the past three decades in the understanding of innovation – as a systemic process, with multiple and simultaneous sources and a non-linear character – which allows us to understand that while in some systems these relationships may even be the main ones, but they will never be the only ones. In addition, a key feature is that in all countries the importance of formal and informal processes of generation, acquisition, use and dissemination of knowledge is recognized. In the case of university/business relations the restriction to this particular type of teaching and research organization is stressed². A wider approach must not only consider the context of teaching and research organizations as a whole (including universities, schools and training centers at various levels) but must also be capable of grasping the informal processes involved in learning and capacity-building processes.

We reiterate here the conclusion that to explain economic performance it is necessary to consider the specific social, political and cultural dimensions of each reality. This in turn reinforces the need for a broader and more complex analytical/normative tool than that offered by traditional economic theory. Moving in this direction, both FREEMAN and LUNDVALL point to the limitations of the quantitative analysis based on abstract models, proposing a method they call 'reasoned history'. Citing Schumpeter in the analysis of economic development they stress that (FREEMAN 1982a; LUNDVALL, 2006):

"...it is absurd to think that we can derive the contour lines of our phenomena from our statistical material only. All we could ever prove from it is that no regular contour lines exist ... We cannot stress this point sufficiently. General history (social, political and cultural), economic history and more particularly industrial history are not only indispensable, but really the most important contributors to the understanding of our problem. All other materials, statistical and theoretical, are only subservient to them and worse than useless without them."

Another dimension which constitutes an important part of the broader understanding of national innovation systems – and which has a significant impact on innovation – is that of time. As an example of how institutional differences have a decisive influence on national behavior and performance, short-term corporate strategies have been confronted with long-term perspectives. This factor is even more relevant in the case of investment in activities which require maturing in the long term and involve a high level of risk, such as education and innovation. Another dimension relates

to the role of trust and the institutions related to it. The strength and the type of trust will determine how the interactive learning takes place. Formal and legal arrangements will both reflect and have an impact on this tacit social dimension. Other formal and informal institutions which are important for the national innovation system included in the wider definition are: the level of cohesion and solidarity, the role of education and training, labor market and corporative legislation, contractual legislation, arbitration institutions, etc. All are historically determined and dependent on context (JOHNSON et al., 2003; LUNDVALL, 2006).

It was particularly pertinent that the concept of the innovation system was created and developed in the mid-1980s, exactly when theories about the acceleration of economic globalization, also associated with the hypothesis of a supposed technoglobalism³, were taking shape and spreading rapidly.

As we have seen, this approach reinforced the focus on the cumulative local and national character of the generation, assimilation and diffusion of innovation, as well as the conclusion that the basis for the dynamism and competitiveness of companies is not restricted to:

- A single company or sector, being rather strongly associated with activities and capacities which exist throughout the production and sales/marketing chain, as well as involving a series of activities and organizations which are responsible for the assimilation, use and dissemination of knowledge and capabilities;
- Only the economic actors and the productive chains and complexes, but also reflects the particularities of the other social and political actors, as well as the environments in which they are located.

In this way, different contexts, cognitive and regulatory systems and modes of articulation and learning are recognized as fundamental in the acquisition, use and diffusion of knowledge and particularly those which are tacit. These systems and modes of articulation can be both formal and informal.

Another crucial and consolidated advance in the national innovation system (NIS) approach relates to the observation that innovation is not restricted to processes of radical change at the technological frontier, led almost exclusively by large companies through their research and development efforts. The consequences of understanding innovation as the "*process by which organizations incorporate knowledge into the production of goods and services which are new to them, independent of whether they are new, or not, to their domestic or foreign competitors*"⁴ are significant. This understanding helps to avoid several distortions, encouraging policymakers to adopt a broader perspective on the opportunities for learning and innovation in small and medium enterprises (SMEs) and also in the so-called traditional industries. These qualifications have significant implications for policy.

So instead of ignoring the specificities of the different contexts and local actors, the major principles of the innovation systems focus require that they be grasped and analyzed. The emphasis on treating

innovation as a cumulative process and one that is specific to the determined context makes it possible to demystify, for example, simplistic ideas about the possibilities for generating, acquiring and diffusing technologies. This emphasis makes it clear that the acquisition of technology abroad is not a substitute for local efforts. On the contrary, a great deal of knowledge is necessary to be able to interpret the information and select, purchase, copy, transform and internalize the imported technology.

Another essential aspect is the central role given to innovation in dynamic and sustained competitiveness. This contrasts with the priority usually given to the exploitation of traditional competitive advantages (such as the low cost of labor and the exploration of natural resources without a long-term perspective and the manipulation of exchange rates), which FAJNZYLBER (1998) calls spurious.

Despite these and other advantages associated with the development and use of the innovation systems approach, there have been warnings about the risk that it just represents sticking new labels on old practices. We refer here to the warning made by REINERT et al. (2003) that some attempts to use the innovation systems approach are no more than “*a thin icing on a solid neoclassical cake*”:

“We argue that by integrating some Schumpeterian variable to mainstream economics we may not arrive at the root causes of development. We risk applying a thin Schumpeterian icing on what is essentially a profoundly neoclassical way of thinking, trade theory is but one example here. ... As has already frequently been emphasized in the NIS approach, it is crucial to understand the different national contexts” (REINERT et al., 2003).

The attempt to operationalize the innovation systems concept has led several authors to propose different dimensions associated with it. Hence the idea of supranational (FREEMAN, 1999), regional (COOKE et al., 1998) and sectoral (MALERBA et al., 1996) innovation systems have been proposed by the literature. In parallel, the perception of the importance of companies' geographical proximity in explaining good performance in the competitiveness of firms has increased. Terms such as synergy, cluster economies, collective efficiency and so on have been presented as a way of expressing some of the concerns of that debate. Research into industrial clusters and the local context as a source of competitive advantages has grown significantly in the last years. The idea of sectoral clusters became associated with the concept of competitiveness from the beginning of the 1990s onwards and has been used both as a unit of analysis as well as a unit of action of industrial policies.

Obviously there are differences between a strictly sectoral vision of innovation and the systemic approach presented in this article. The sectoral vision does not capture the current situation where the frontiers of productive sectors are undergoing a process of mutation, becoming more fluid. The traditional ways of measuring

and evaluating economic activities by grouping them into sectors are also in doubt, mainly due to the heterogeneity of organizations and their structures for production and innovation which coexist within the same sector. There is also a trend towards both the incorporation of advanced and increasingly multidisciplinary knowledge, as well as the convergence of technological functions and apparatus of various segments which were previously not connected to each other. These trends are particularly striking in situations of radical and far-reaching techno-economic transformations – such as in paradigm changes (LASTRES et al., 2006). There are illustrative cases in the so-called primary sectors, such as agriculture, the extractive industries and fishing, as well as in more advanced sectors.

MARQUES (1999), for example, uses the production of tomatoes to show how new technologies affect all stages of the production cycle, suggesting that the production of this good depends on and is deeply linked to the production of various other sectors, making its classification as an agricultural product almost irrelevant: “*nowadays, many plans, designs, tables and scripts are necessary before actually planting tomatoes, in order to produce the genetically modified seeds, the fertilizers, the geometric planting, the harvester, the electronic selection system, the packaging and the means of transportation, etc. ... - the tomato is a high-tech product!*” (p.199-200).

With the wide diffusion of the new technologies which form the basis of the new standard – ICTs, biotechnology, genetic engineering and advanced materials – even sectors considered traditional may present themselves as making intensive use of cutting edge technology. This makes it even clearer that the way in which economic sectors are defined is inadequate. Although the knowledge which has already been accumulated on sectoral trajectories remains relevant, both production and innovation are increasingly influenced by knowledge and capabilities from different productive activities and areas of science and technology. Due to the difficulty in measuring the knowledge from different sources used in the different sectors, we continue to treat these sectors in the same way as when the classifications were thought up. Therefore, even if new activities and sectors are added to those which are already part of the statistical systems of the different countries, it is increasingly difficult to continue to use these categories without questioning them (LASTRES et al., 2006).

The main conclusions of this discussion help to emphasize the need for a reference which is capable of coping with the new challenges. The usual sectoral classification is related to sets of knowledge and activities which may have less weight in the added value of the sector in question. Obviously the dividing line between sectors was always arbitrary. However, we would stress that in the current scenario, the problem of capturing - using imperfect indicators – only part of the production and innovation systems has become more marked.

There is therefore a need to move forwards with the refinement of the use of the systemic vision, both in terms of analysis and the political and normative context. The aim of the next section is to briefly present the Brazilian experience with the development and pragmatic use of the national innovation system concept.

Brazilian experience with the development of the innovation system concept

In Brazil, the concept of local production and innovation systems was established and developed by RedeSist at the end of the 1990s and was quickly disseminated in the teaching and research field and the political sphere (CASSIOLATO et al., 1999; 2005; LASTRES et al., 1999; 2006). This concept brings together the contributions of the Latin American structuralist school about development and the neo-Schumpeterian vision of innovation systems⁵. Of note is the significant process of learning set in motion when this new approach was put into practice, as a tool both for analysis and for guiding policy. All the actors involved learned a great deal from their mistakes and successes and often had to innovate.

According to the definition proposed by RedeSist⁶, local production and innovation systems (LPIS) refer to groups of economic, political and social actors, located in the same territory, who are interlinked and who undertake production and innovation activities. LPISs generally include:

- Companies – producers of finished goods and services; goods and services providers (raw materials, equipments and other inputs); distributors and marketers; consumers, etc. – active in the primary, secondary and tertiary sectors;
- Organizations dedicated to the development and training of human resources, information, research, development and engineering, promotion and financing, etc.
- Cooperatives, associations, trade unions and other representative bodies.

Local production arrangement (LPA) is the term used to describe fragmented or dislocated systems.

Following the guidelines for innovation systems, this approach focuses on groups of different actors, as well as on connected activities from the different local production and innovation systems. RedeSist accompanied the development of this context and also developed a methodology which focuses on and investigates the connections between companies and between them and other actors; the flows of knowledge (in particular, in their tacit dimension); the bases of the learning processes for capabilities related to production, the organizational dimensions and innovation; and the role of geographic proximity and historical, institutional, social and cultural identity as sources of diversity and sustained competitive advantages. The final aim is to discuss the policy implications of the analysis carried out⁷.

The pioneering experiences with the analysis and promotion of production and innovation systems in Brazil confirm that this really does constitute a new way of thinking about and making policy which:

- Places the generation, acquisition and diffusion of knowledge and the creation and use of production and innovation capabilities as key factors in productivity and dynamic and lasting competitiveness of organizations, regions and countries;
- Includes different types of actors and activities, including those generally excluded from promotion activities, such as for example small and medium enterprises and their needs; the activities of the primary and tertiary sectors, the segments on the edge of formal economic life – businesses, activities and processes of acquisition and transmission of knowledge;
- Covers the space where learning takes place, where production and innovation capabilities are created and where knowledge, particularly tacit knowledge, flows;
- Allows the establishment of a bridge between territory and economic activities, which are also not restricted to classic spatial cut-offs such as those of the municipality and the micro-region;
- Aims to deal with spatial variations due to Brazil's large geographic extension, economic heterogeneity and economic, political, social and regional inequalities;
- Has enabled a wide understanding of the opportunities and challenges for productive and innovative development;
- Represents the level at which policies promoting learning and creation of production and innovation capabilities can be more effective;
- Highlights the need to link up and implement the different policies in an integrated and long-term perspective.

According to this approach, in any place where a good or service is produced, there will always be a system surrounding it, involving related activities and actors, from the acquisition of raw materials, machinery and other inputs to its sales and marketing. These systems will vary from those which are more rudimentary to those which are more complex and articulated, which function in a truly systemic way. According to this perspective, the number of local production systems which exist in any country is as large as its productive capacity allows. From both the analytical and normative perspectives, it is not enough to develop indicators and maps with the aim of identifying the number of existing systems and their different configurations and levels of development. In a similar way, because they are based on the recognition of the specificities of the different systems, policies for their promotion are incompatible with generic models based on the idea of benchmarking or best practice.

Different typologies and indicators have been developed in order to understand the processes of learning, capacity-building and innovation. However, the

use of some of these taxonomies, indicators and case studies should not in any way hinder the understanding of the different elements offered by the wealth of experiences in the real world. This is particularly important when defining and implementing policies. We would stress the conclusion that the adoption of uniform policies ignores the existence of disparities, which are a result not only of economic factors, but also of the diversity of socio-political configurations and historical particularities (FURTADO, 1998). The mobilization of a specific production system generally involves specific sets of requirements which vary both in space and in time.

Policy suggestions for the mobilization of production and innovation arrangements and systems in Brazil

The promotion of production and innovation systems has been seen as a new kind of policy for industrial and technological development which is capable of dealing with the specificities of the new pattern of accumulation. However, in order for the emphasis on LPAs to mean more than simply using new labels for old practices, in order to follow the latest fashion and gain access to funding, analytical and normative approaches must move forwards and truly incorporate the essence of the concepts in question. There is the need for a better understanding of the concepts of development, competitiveness, innovation and LPAs among researchers, policymakers and those implementing policy, in both public and private sectors.

It is particularly urgent that progress is made in the understanding and coherent use of the concept, as well as in overcoming assumptions which position (i) the promotion of innovation and competitiveness in opposition to the promotion of local development and social inclusion; (ii) local development as a synonym for the fragmentation of the national space. In addition, it is necessary to formulate and implement policies adapted to Brazilian challenges which promote wider and more inclusive development, instead of always betting on the same "winners", which helps to reinforce regional and social inequalities.

Following this thread, it is recommended that discussions about policy for the promotion of LPAs begin by moving beyond a biased and partial vision of development processes and generic policy models – which are based on the performance of the biggest and most dynamic companies of the world and the institutions of some developed countries – and with the necessary development of new conceptual references capable of both capturing the specificities of Brazilian production and innovation development and guiding it.

As well as this wider mastery and usage of the concept, there are three other larger challenges for policies for the promotion of production and innovation arrangements and systems in Brazil.

The first one concerns the need to overcome the superficiality, short-sightedness and immediatism of policy objectives; reverse the destruction of local capabilities for production and innovation; and guarantee that implicit policies are not canceled out by explicit ones. This relates both to the capacity to design and implement policies which are economically dynamic, socially inclusive and politically viable, and to the need to design and implement a pro-active and long-term development policy, to which others can be linked and which will enable them to be sustained. A large part of the failures of public and private policies, especially those for industrial and technological development, stem from the lack of this national project to guide and anchor them. Any policy, especially one related to the promotion of local production arrangements and systems, will be more effective if it represents the sectoral, regional and local repercussion of the priorities of a long-term national development project.

In second place, there is the need to (i) identify and design policies with systemic perspectives and actions, which take into consideration the needs of the different local actors and their environments; (ii) involve a range of these actors and environments in their design and implementation; and (iii) guarantee the coherence and coordination of policies at local, regional, national and supranational levels.

Thirdly, there is the aim of transforming disarticulated and fragmented productive structures into dynamic and innovative systems. In other words, how can businesses and other actors be promoted and supported so that they are transformed into a group of actors who interact and collaborate in production, innovation, design, sales and marketing, etc. A related challenge is the aim of providing these systems with conditions to be able to follow this path in a genuine and sustained way.

In summary, in the short term we recommend the development of Brazilian arrangements and systems through the mobilization of synergies, knowledge and capabilities for development. This means supporting production and innovation systems which already exist in the country, guaranteeing their sustainability as well as mobilizing their learning and capacity-building processes. The scope of the cases to be supported must be wide and involve activities from the primary, secondary and tertiary sectors. Special emphasis must be given to those systems which concentrate on social development priorities and which contribute to making up for the massive social and regional imbalances in Brazil. A key feature is therefore the need to stimulate and develop both the arrangements and systems which contribute to meeting these goals but also those which directly mobilize social development and which contribute to the improvement of the living conditions in Brazilian society. In this case the flagships are production and innovation systems in the area of health, and particularly public health, as well as those relating to food, education, housing, sanitation, and so on. This is the reason for the urgency in moving forwards in the understanding of the

productive and innovative development of these areas, as well as in the formulation of policies which guide and drive this development in a systemic and sustainable way.

Notes

1. Translator's note: *cepalino* comes from the Spanish acronym CEPAL, the short version of the Spanish name for the Economic Commission for Latin America and the Caribbean, ECLAC.
2. Studies carried out in Brazil confirm the importance of university participation in the different production and innovation systems. However, they also include cases where there are no universities, but rather technical training centers, or in some cases not even those, in which the means of generation and diffusion of knowledge are exclusively informal, but not therefore any less important or relevant for the research and policy agenda.
3. The idea of technoglobalism is that the generation of technologies would also happen globally, with the local context not being of particular importance.
4. This definition is based on that proposed by Lynn Mytelka (1993); its advantages for less developed countries are discussed in Cassiolato, Lastres and Maciel (2003) and Lastres, Cassiolato and Arroio (2005).
5. For detail on the convergence between these visions see Cassiolato et al. (2005) and Guimarães et al. (2006).
6. See www.redesist.ie.ufrj.br.
7. For a detailed description of this methodology see also Lastres, Cassiolato and Campos (2006).

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