

Chapter 2

Local Innovation Systems in Emerging Countries

Abstract Rather than being a spontaneous phenomenon, the creation of local innovation systems (LISs) in emerging nations typically involves a process driven by an individual actor. The actions of some lead organisation bring about the involvement of other ones, with mechanisms of linkage between them. Empirical evidence shows different types of lead actors, including cases of LIS formation driven by governments, by firms, and by universities or research centres.

Keywords LIS · Emerging nations · Governments · Firms · Universities · Dynamic approach

2.1 The Theoretical Basis for the LIS Concept

The concept of innovation has undergone profound changes since its first appearance in the literature of the early 20th century. In recent years there has been decisive shift away from an essentially linear conception of the development of innovation towards ideas of interactive and systemic processes, which involve not only the different functions of the firm itself (Kline and Rosenberg 1986), but also its relations with other organisations.

In fact, innovation does not originate in any single organisation, but as the result of a systemic process (Fagerberg 2004). The firm collaborates with other actors, such as additional firms, research institutions and government agencies, both in the development stages and in the implementation of innovation. Government usually assumes a particularly important role, since the implementation of State policies to incentivise or block the processes of innovation inevitably conditions the results, often to a remarkable extent.

The recognition that government institutions play an important role, and that interactions in the development process can take place more easily if the actors are in geographic proximity, has underlined the relevance of the territorial variable in stimulating innovation (Lundvall and Johnson 1994; Etzkowitz and Leyedsdorff 2000).

Studies on the role of the territorial variable in firm interaction and in innovation development descend from the original Marshallian literature on the industrial district (Marshall 1930), which eventually gave rise to studies concerning both economic geography (Asheim 2000; Feldman 1994, 1999, 2000, 2001; Gertler 2003; Clark et al. 2000; Howells 1999, 2002) and what are called “national innovation systems”, or NISs. This latter current of study integrates numerous contributions from quite disparate fronts, including the works on “learning regions” (Asheim 1996), on the “innovative milieu” (Crevoisier 2004; Camagni 1995), and the triple helix model (Etzkowitz and Leydesdorff 1997; Leydesdorff 2000), as well as on business clusters (Porter 1990, 1998; Swann and Prevezer 1996; Baptista and Swann 1999).

According to Freeman (1987), the national innovation system is essentially “a network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies”.

Throughout the 1990s, scholars advanced numerous theoretical and empirical studies illustrating important characteristics of NISs.¹ In particular, Lundvall (1992) examined the features of the learning process in such systems, which he stressed as developing from institutional roots. Nelson (1993) instead took an approach of comparing the experiences of different NISs, in studies that brought out the complexity and heterogeneity of the different cases. Edquist (1997) contributed an identification of the economic and social determinants that permit development of NISs.

However in these same years, several authors began to question the advantages of considering innovation at the national level and in fact departed from the NIS concept, substituting it with analyses of the regional system (Cooke et al. 1997). The region is considered as an entity smaller than the nation, yet still with significant governance capacities over local territories, as well as a level of cohesion that distinguishes it from the overall state and from the other regions (Cooke et al. 1997: 480). Observing the functionality of this conception, authors such as Todtling and Kaufmann (1999) argue that it is at this level that analysis of innovation systems will be more fruitful.

According to some authors the systemic interactions among actors at local levels are intrinsically unique, and thus hard to measure and compare across different systems. A potential solution to this problem is the “evolutionary integrated” view of regional innovation systems (Iammarino 2005). Under the broader theory of evolutionary economics, an effective analysis of innovation processes can be developed by studying the mid-ground between the macro-level of national systems and the micro-level of the individual actors. This meso-economic approach serves to

¹ Studies of national innovation systems can be roughly divided into “broad” and “narrow” approaches. The narrow approach considers NISs as composed only of firms and research institutions, such as universities and R&D centres, as well as local government. This conception coincides with the “triple helix” model (Etzkowitz and Leydesdorff 2000). The broader approach considers that the elements composing the NIS also include all the economic-structural and institutional-contextual aspects that influence the research and business spheres (Asheim and Isaksen 1997).

describe “the essential thing that is changing in a process of evolutionary economic change” (Dopfer et al. 2004, p. 269) and can thus account for local and regional variety in terms of absorption, diffusion and generation of new knowledge. A number of fundamental concepts, such as those of industrial districts, learning regions, innovation systems and others, can all be referred back to this “meso” perspective, under the general evolutionary economics point of view. Further, an integrated micro-meso-macro approach to the socio-institutional determinants of innovation performance offers a means of dealing with the heterogeneity and path dependency observed in empirical studies of regional and local economies, particularly in terms of “local structural regularities from past knowledge accumulation and learning” (Iammarino 2005, p. 503). These are in turn the factors that shape and constrain the innovation processes and growth opportunities.

Thus in recent years the concept of the regional innovation system, or RIS, has gained ever more ground. The RIS is defined as a social system that features systematic relationships between different groups of actors, from both private and public sectors, for purposes of increasing and improving the learning capacities localised in a particular region (Doloreux 2002).

However certain studies examining the definition of RIS identify that the region could be a geographic entity too small or alternatively too large to host an innovation system. Some authors propose an enlargement of the concept of the regional innovation system to also include the extra-regional relationships that influence the innovative process (Coe and Bunnell 2001). Other studies instead illustrate that the region is an entity too large for the consideration of innovation systems that are in fact often localised in a more restricted area (Rantisi 2002).

To bypass the problem of the spatial configuration of innovation systems, Oinas and Malecki (2002) propose the concept of a spatial innovation systems (SISs), which consist of “overlapping and interlinked national, regional and sectoral systems of innovation which all are manifested in different configurations in space”. In introducing this concept, the authors suggest that innovation systems are worked out differently in space and can exhibit different spatial configurations. They may originate in one place, but often spread beyond local, regional, and even national borders. Technological evolution then occurs through the interplay between elements of national, subnational, and transnational innovation systems, which produce flows of innovation and have different inherent capabilities in keeping up with state-of-the-art practices on the various technological frontiers.

Moulaert and Sekia (2003), in a critical review of studies that explain the localised nature of the innovative process, illustrate that the different conceptions of systems are often interrelated. Apart from the differences in territorial contexts, all the analyses seem to confirm the existence of certain common aspects. From these results we identify any innovation system as: (i) the spatial concentration of specific actors and the localised nature of the innovation process, such that innovation originates and develops in the same territory; (ii) the coexistence in the single territory of firms, research and government institutions, representing the three types of actors that participate equally in the innovation process; (iii) the existence of

inter-meshed relations between the actors, which stimulate a process of learning by interacting and thus favour the development of innovation.

Local and regional innovation systems are spatial configurations that emerge as covenants of identity, and as frameworks for belonging and learning. Thus what contributes to making an NIS, RIS or LIS is not only the aspect of geographical concentration but also the process of collective learning (de la Mothe and Paquet 1998).

Consequently many scholars use the term “local innovation system” to identify a place where a process of collective learning is localised, but where this process is not necessarily limited to occurring within the local geographical borders. The main function of LISs is to generate new, practical knowledge and to commercialise it. The local economy gains evolutionary momentum through the generation of innovation, produced by recombining various types of endogenous knowledge with externally sourced new knowledge. The interaction of the local actors with the external environment determines the extent to which the economy is subject to positive or negative lock-in, and the creation of new paths of development. Thus the degree to which the actors in a local economy can access, understand and convert leading-edge knowledge to new products and services determines their capacities to generate new pathways and renew old ones. On the other hand, where the local actors are far behind the new knowledge frontiers, there will be an increasing likelihood of the economy becoming locked into ageing technologies and going into decline (Martin and Simmie 2008).

2.2 Local Innovation Systems: The Search for a Definition

The literature offers various conceptual definitions of the local innovation system. Cooke et al. (1997) define the LIS as a system “in which firms and other organisations are systematically engaged in interactive learning through an institutional milieu characterised by embeddedness”. Asheim and Isaksen (1997) add that “a [local] innovation system consists of a production structure (techno-economic structures) and an institutional infrastructure (political-institutional structures)”. Doloreux (2002) instead concentrates on the aspect of the LIS as a social system, which features relations among different groups of public and private actors, acting in a systematic manner and resulting in increased learning potentials within the given region.

Various authors have also proposed criteria that identify and define the component elements of an LIS. Todtling and Kaufmann (1999) stress that the central elements are the firms that belong to the region’s principle industrial sectors, flanked by those that operate in complementary sectors. These firms compose different types of networks that operate both within the region and beyond its boundaries, based on supplier-client relationships, cooperation and information exchange. The relational networks created are the vehicles for knowledge and information exchange, and thus enrich the territorial knowledge base.

In addition to the firms, LISs include research institutions and universities, which serve as knowledge creators and training centres. However these will create wealth in the territory only if the knowledge generated is actually transferred to the local firms.²

Another important aspect influencing the local system's capacities is the quality of the workforce. This component is understood not only as the individuals engaged in research, but also the entire spectrum of personnel in production, marketing and human resources management. From this perspective, activities in education and training represent another important factor in the LIS.

In addition to the fundamental elements of the firms, workforce, and research and educational organisations, financial institutions must also play a role. These assist the firms to take on the substantial investments involved in innovation processes, and thus activate their projects. Still further components are the industrial associations, and the agents roughly grouped as "business innovations centres". These are the hubs of scientific research and the centres for scientific and technological transfer, organised in different manners and with different specific targets, but with the consistent aim of supporting firms in the general goal of overcoming barriers to innovation.

Much as in the above scheme advanced by Todtling and Kaufmann (1999), Doloreux (2002) identified the component actors of the LIS as the firms, government institutions, research and training institutes that interact and receive support from the regional policies intended to promote innovation processes. Cooke (2001) emphasises that what distinguishes a local innovation system is not so much the firms and educational institutions that compose it, but rather their capacity to interact for the achievement of a sort of collective learning, similar to what occurs in Lundvall's (1992) "learning region".

According to Martin and Simmie (2008), local innovation systems have the following characteristics: (i) sectorally and institutionally diverse knowledge-generating businesses and institutions, able to draw innovative ideas from many potential sources; (ii) firms at high levels of specialisation, capable of supplying the best to national and international markets; (iii) commercial and marketing know-how, based on awareness of international markets and technological conditions; (iv) a social culture that demonstrates and tolerates diversity, and offers new ideas and ways of doing things; (v) firms that are able to exploit knowledge and to support knowledge applications by others; (vi) high levels of technical sophistication among producers and users of technology; (vii) economies of scale; (viii) international knowledge spillovers from sophisticated customers, including locally-represented multinational companies, which provide the LIS with information on leading-edge knowledge, products and services. While all these characteristics are objectively possible elements of an LIS, individual localities will have different

² This very important consideration establishes that even in areas with advanced research centres, if there is no dialogue with local enterprise and such a situation continues, then the territory will not develop a local innovation system.

combinations and strengths in each of them. In many cases one or more of these phenomena will be missing altogether.

Some scholars have given definitions of the LIS that are much broader, however certain of these risk a confusing level of overlap with other well-known concepts, such as the industrial district,³ science parks and technopoles, the innovative milieu, or the learning region (Doloreux and Parto 2004).

Asheim (1998) attempted to systemise the various contributions and propose a definition of the LIS that would reflect the conceptual variation and the empirically observed multiplicity of relationships seen to exist in regional productive and institutional structures. He distinguished three types of system (see also Asheim and Isaksen 2002; Asheim et al. 2003; Asheim and Coenen 2005): (i) the territorially embedded local innovation system; (ii) the regional networked local innovation system, and (iii) the regionalised national innovation system.

The territorially embedded system type is characterised by an interactive network of firms that base their innovation activity on processes of reciprocal learning, stimulated by geographic and relational proximity, but in absence of direct links with government institutions and research institutes. The best examples of territorially embedded LISs are the networks of small-medium enterprises found in industrial districts.

The second type of LIS, the regionally networked system, is again characterised by the presence of a network of firms and organisations embedded in a specific region, which interact and generate reciprocal learning. However in this case government intervenes to develop more systematic networking through the strengthening of regional institutional infrastructure. There is also a greater role on the part of regional R&D laboratories, as well as structures and organisations for professional education, and other local organisations involved in various aspects of the firms' innovation processes. These systems have a more planned, systemic character, originating in constant public-private cooperation. Various authors consider the regionally networked system, as originally observed in Germany, Austria and the Nordic nations, as the ideal type of LIS.

The regionalised national innovation system differs from the first two LIS types in two aspects. First, there is greater functional integration between the firms and the national or international infrastructure of the innovation system. In this type, innovation activity develops primarily through cooperation with actors outside the region. In this development model the exogenous actors and inter-systemic relationships thus play more important roles. A second difference is that cooperation between organisations within such systems less often involves incremental types of innovation, and instead fits more closely with linear models of innovation, meaning innovation that takes place primarily around specific projects capable of developing radical innovations, which in turn ultimately proceed from formalised scientific and analytical knowledge. Specific examples of regionalised national innovation

³ Hommen and Doloreux (2003) in fact argue that Marshall's historic study on industrial districts can be viewed as the earliest conceptual approach concerning local innovation systems.

systems include technological and science parks or technopoles, composed of R&D laboratories of large companies, at times flanked by government agencies, universities and technical institutes localised in very close proximity, but where all these actors generally present weak links to local firms.

The above tripartite classification system, initially advanced by Asheim, is similar to one proposed by Braczyk et al. (1998). In their classification, the three typologies of LIS are “grassroots”, “network” and “dirigiste”, distinguished on the basis of their governance styles and the modes of enacting the technology transfer processes.

The “grassroots” model describes a region where technology transfer is primarily organised and promoted at the local level, within the region’s own organisations and government structures. The “network” model is the result of interaction of local, national and global-level institutions in the governance of technology transfer at different levels. Finally the “dirigiste” model envisions a situation where the governance of technology transfer is essentially centralised under national institutions. France is cited as the type example of the “dirigiste” model.

Howells (1999) offers a definition of national innovation systems that distinguishes two typologies of LIS, in a somewhat similar sense to the preceding tripartite model. In this conception, the classification criteria are “top-down” or “bottom-up”, depending on the connections between the local and national systems. The top-down LIS takes form as a subsystem of the national system, stimulated by national policies at the local level. In the bottom-up case, the local systems originate autonomously and it is their independent interaction that ultimately leads to the development of the national innovation system. The bottom-up LIS presents three specific elements: a local structure of autonomous governance, strong local industrial specialisation, and high capacities for innovation among local firms.

2.2.1 Towards a Narrow Definition of the Local Innovation System

The numerous definitions and classifications of LISs, as well as the overlap with other important concepts such as the industrial district, learning region, innovative milieu and economic cluster (Asheim et al. 2011), risk confusion for the practical application and usability of the entire concept.

In order to understand how a local system can develop in a specific geographic area it seems more useful to draw on a narrow definition of LIS that permits immediate comprehension of its specificities and constituent elements.

For this, we identify four elements as defining the existence of a local innovation system:

- a network of innovative firms, localised in the same area and bound by horizontal and vertical relationships;
- a set of research and educational institutions, such as universities and research centres, which generate scientific knowledge that contributes to innovative processes;

- a series of infrastructure provisions that incentivise the localisation of innovative firms within the given area;
- the presence of cooperation mechanisms among all these actors, capable of stimulating reciprocal learning and thereby processes of innovation.

The last of these four aspects is particularly important. It is the cooperation between firms and research institutions that favours not only the exploration and development of the existing knowledge base, but also experimentation in new knowledge through “learning by interaction” (Noteboom 2001). The interactive learning process is favoured by the existence of social interaction mechanisms, which develop readily among actors in close cultural and geographic proximity (Antonelli 1999). Thus the level of social embedding of the various actors represents an important element in the birth of an LIS.

However the identification of social embedding as a fundamental variable still does not resolve the problems of the origins or definition of local innovation systems. For example if we look at industrial districts, there are numerous cases of groups of socially embedded firms, with interaction between them that clearly serves in improving the efficiency and effectiveness of the production process, but where the interaction still does not generate significant innovation. In fact in these systems, the participation of research institutions and universities is very limited or lacking. The nature of the knowledge that is produced and applied in fact does not require modification of any base paradigms. Instead the innovation that arises is an incremental type, which does not permit the kind of break-through in technical frontiers that should represent the true objective of local innovation systems.

Given these considerations, and to distinguish the LIS concept from other types of local systems, we apply two variables indicating the level of social embedding (high or low) and the character of the knowledge base (synthetic or analytic).

2.2.1.1 Level of Social Embeddedness

The concept of “social embeddedness” was originally applied in the study and understanding of personal relationships, more so than economic ones. In the former case, embedding permits easier management of personal relations, through encouraging trust and discouraging development of opportunistic behaviour (Granovetter 1985). Social embeddedness also contributes to trust between firms, and the two variables are positively and very closely related.

Although Granovetter’s (1985) original application to economic contexts did not specify the factors that determine embeddedness, the phenomenon is clearly influenced by cultural and geographic proximity between firms (Lyons 2000). Increased proximities favour social interaction, and consequently stimulate the process of knowledge transfer.

In this sense, the phenomenon of collective learning or learning through networking takes place more easily when proximity and levels of social embeddedness are high.

The aspect of social embedding distinguishes the LIS from other territorial concentrations where interaction is based only on market relations. In the case of primarily market types of relations, interaction requires only passive rather than active involvement of the group members (Oughton and Whittam 1997).

2.2.1.2 Type of Knowledge Base

This variable indicates the type of knowledge that circulates within the innovation system, and is thus linked to the type of industrial sector or sectors where the system operates, as well as the innovativeness of the actors within it. The dichotomy between synthetic and analytic knowledge serves as a useful classification for understanding the local system's knowledge base (Asheim and Gertler 2004; Asheim et al. 2011).

Analytic knowledge is fundamental in industries that are heavily based on scientific research, where knowledge is created through rational cognitive processes and formal models. The innovation strategy in such industries is based on access to explicit codified knowledge ("science, technology and innovation", or STI-mode). This is a science push/supply-driven high-technology strategy, able to produce radical innovations. Basic and applied research, as well as systematic development of new products and processes, are all important activities in these industries. The firms belonging to such systems usually have their own R&D departments, however it is not uncommon that they also draw on research results from universities and other institutions. In systems featuring an analytic knowledge base, industry-university relationships are of fundamental importance for innovation development.

A synthetic knowledge basis is typically found in industrial contexts where innovation takes place primarily through recombination or reapplication of existing knowledge. The process can be defined as "doing, using and interacting", or DUI-mode. It relies on informal processes of learning and development of experience-based know-how. The DUI mode is a user or market-driven model based more on competence building and organizational innovations. It produces mostly incremental innovations. R&D activity is primarily concentrated on physical improvement of the product or production process. Industry-university links exist but primarily concern training activities.

A narrow definition of LIS implies the development of the analytic knowledge type (Asheim et al. 2011).

Combining the dimensions just illustrated, and on the basis of the existing literature, we can identify four typologies of local systems (Fig. 2.1). The typologies are described in detail below.

Cluster (Quadrant A): This quadrant represents a class of local systems characterised by low levels of social embeddedness between actors and by a synthetic knowledge base. In this case the situation is not one of a true local system, but simply a group of firms that operate in the same geographic area and that have relationships exclusively of the supplier-client type. This description is coherent

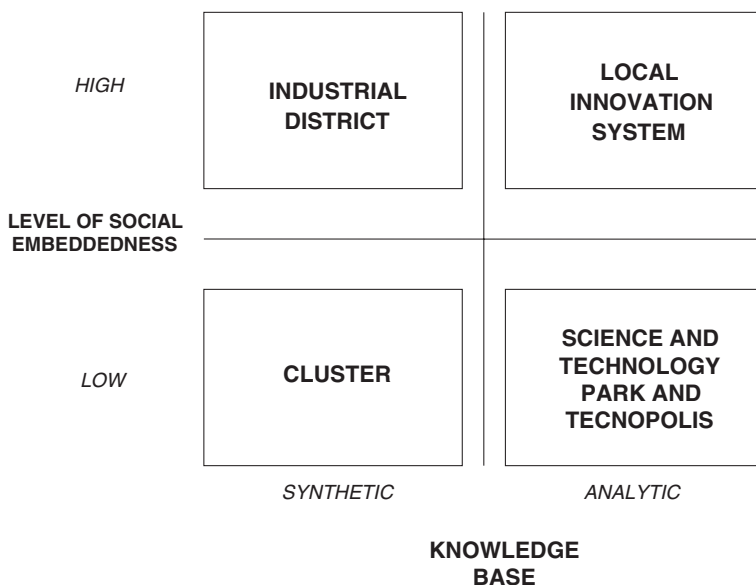


Fig. 2.1 Definition of local innovation systems. *Source* Ferretti and Parmentola (2007)

with Porter's (1998) description of the industrial cluster, understood as a geographic concentration of firms and institutions. Industrial clusters are characterised by the existence of a vast set of firms, connected in a network of primarily supply-type relationships that do not implicate true knowledge exchange between the actors. Porter's definition does not imply the existence of any trust-based relationship between the companies, which would signal profound social embeddedness, or the presence of any explicit attribution of importance to the links between firms and research institutions. Such links would represent the precondition to realising a system with an analytic knowledge base.⁴ In fact in conveying the concept of industrial cluster, Porter (1998) cited the example of Californian wine producers. This cluster included 680 winemaking firms and many independent grape growers, as well as a large number of firms belonging to sectors that support both the grape-growing and wine-producing processes. The relationships between firms were of the supplier-client type and did not involve higher levels of knowledge exchange, nor were there relations with local universities.

Industrial district (Quadrant B): This quadrant represents a class of local systems characterised by a high level of social embeddedness between actors and a synthetic knowledge base. These features are typical of the systems of Italian firms traditionally defined as "industrial districts". The classical definition of industrial district is a concentration of firms in which it is difficult to distinguish

⁴ In literature the term "cluster" is often used as a synonym of local system, with both terms applied in describing different phenomena such as productive cluster, technological cluster, etc. In this study the term "cluster" is used in the stricter meaning as originally defined by Porter (1998).

the boundaries between the community of companies and that of individuals (Becattini 1989), and where economic success is strongly dependent on the socio-cultural context. The existence of reciprocal trust and an “industrial atmosphere” are necessary components in the definition of an industrial district. Geographic and cultural proximity ease the personal relationship between firms and increase the level of social embeddedness. Although some studies (Saxenian 1994) in fact use the expression “industrial district” to describe various local systems that operate in high-tech sectors characterised by an analytic knowledge base, such as Silicon Valley, the classical definition of industrial district does not include the presence of research institutions. Such presence would be necessary for firms to develop the relationships needed for creating an analytic knowledge base. In fact it is only necessary to identify the occurrence of two elements to define a local system as an industrial district: the presence of a community of firms localised in the same area, and the “industrial atmosphere”. These considerations are confirmed by the analysis of Italian industrial districts, which demonstrate innovation development of incremental character and scarce relationships with research institutions.

Scientific and technology park, technopole (Quadrant C): This quadrant groups a class of local systems characterised by a low level of social embeddedness between actors and an analytic knowledge base. These characteristics are typical of the so-called “applied-science research hubs”: proprietary ventures engaged in the development and management of a series of physical or service infrastructures that support the embedding of firms and research institutions in a specific territory, such that these inter-relate and favour economic development in the area (Shearmur and Doloreux 2000: 1066).⁵

The “technopole” is a concept similar to the science and technology park, which arose in the late 1970s following the initiation of the “Technopolis” programme in Japan and the Technopôle policy in France. A technopole consists of a physical and social infrastructure intended to support industrial innovation activity and technological transfer, for purposes of favouring institutional collaboration between universities and industry (Shearmur and Doloreux 2000). The science park and technopole definitions highlight the role of the university and the university-firm pairing as fundamental requisites for the birth of systems based on analytic knowledge. The inter-firm and firm-institution relationships are highly formalised and lack the social embedding that would favour birth of learning by interacting (there is physical proximity among the actors, but not cultural).

⁵ According to Shearmur and Doloreux (2000, p. 1066), the full definition of a scientific or technological park is: “a property-based venture which has: existing or planned land and buildings designed for private and public research and development facilities; technology and science based companies relating to support services; a contractual and/or operational relationship with a university or other institution of higher education; a role in promoting research and development by the university in partnership with industry, assisting in the growth of new ventures, and promoting economic development; a role in aiding the transfer of technology and business skills between the university and industry tenants”.

Local innovation system (Quadrant D): This quadrant represents the class of local systems characterised by a high level of social embeddedness between actors and by an analytic knowledge base. The high level of social embeddedness supports mechanisms of social interaction, which stimulate processes of knowledge transfer. The existence of an analytic knowledge base implies the presence of educational institutions and a strong link between firms and universities.

With the meaning of the local innovation system clarified, it is now necessary to analyse its components in detail, in order to understand the potential features of LISs in emerging nations.

2.3 Types of Actors in a LIS

To identify the actors in an innovation system we must first begin with an understanding of the characteristics of “innovation”. According to Giacometti (1987), innovation “... involves processes of discovery and creation, fed by both universal and public scientific input and by forms of specialised and tacit knowledge that are generated within the innovating institution.”

This conception implies that it would be impossible to assign firms the entire responsibility for the innovation process. In fact, a firm would be able to produce micro-innovation through independent action, but for structural reasons, in the absence of relationships, it cannot create profound changes in the technological paradigm. Indeed, size represents a critical variable for the production of innovative technology. In this case, size is to be understood both in terms of productive and financial capacity. Particularly relevant are the possibilities for substantial capital investment in a risky process, and the availability of competencies covering the entire innovation process.

In the context of innovation, the firm thus becomes a link in an enlarged cognitive system⁶ of a social type (Rowe 1987). The systems tend towards network forms, which involve both profit and non-profit organisations, and above all link the firm to the local system that furnishes the resources essential to firm performance (entrepreneurialism, stimuli for innovation, channels for knowledge circulation, “trust” relationships). The knowledge produced by the firm is added to the other knowledge produced in the network, to which the firm has access, and to that produced in the local environment, where the firm is embedded.

⁶ In some very recent literature, the process of value creation refers to the firm’s capacity to grow its own knowledge heritage. Even in this case the process still cannot be activated by the firm in an isolated, autonomous manner. Rather it must be inserted in a broader system of social relations that link the firm with its environment. From this point of view, the firm’s capacity to generate value does not depend on the mere governance of internal relations, but also and above all on the coordination of external relationships, with the objective of maximising the process of knowledge generation.

From this, we can derive the identification of the three types of macro-actors found in all innovation systems. Each type represents different potential sources of knowledge. Any one actor or type alone would settle into low-entropy processes,⁷ destined to close on themselves, while in a systemic approach they can succeed in orienting towards synergic production of knowledge.

The actors are:

- firms;
- non-profit research organisations;
- local institutions.

The first actor in the innovation system is the firm,⁸ in its most generic form. The firm moves forward on its own path of value creation through processes of product innovation and of seeking sustainable competitive advantage.

The task of a firm engaged in an innovation process is obviously not to analyse the innovation choices of other individual firms, but to understand the links between their innovation path and other specific and highly contextualised variables.

Rendering this difficult are the facts of the flexibility in sectoral boundaries, of research processes that increasingly surpass the sizes of innovative firms, and of circularity in knowledge, all of which tend to decontextualise the innovating company. The object of analysis is thus no longer the firm per se, but its decision to innovate, to share in an innovation path, to look to the long-term benefits that can derive from the process.

Alongside the firm in the innovation-creating system there is a second actor, namely the non-profit research organisation. Here we refer to universities and research centres devoted to basic research, often managed in a manner independent of the field of potential application.

In the innovation process, public institutions carry out a coordinating function in the realm of national and local technology policies, as well as in diffusing technology through public research centres, and in purchasing innovative goods through government demand. The aspect of public education and training systems plays a fundamental role in technological capacity.⁹

⁷ Economists measure the degree of dispersion of knowledge, or chaos, as the relation between “energy used” (i.e. knowledge actually used) to potential energy, with the value of this ratio in a range between 0 and 1. In measurement, high degrees of entropy indicate high degrees of use (concentration) of energy (knowledge), and indicate risks of entropic death, if not countered by policies for knowledge exchange that lower the entropic index (increase the potential energy). On the other hand, cases of high levels of entropy indicate a high degree of usable energy, and a situation where there is a lack of structural potential to actually use the energy (knowledge).

⁸ The distinction between invention and innovation includes the concept that the former stops at the research stage, while the latter is subject to testing and selection in context, and ultimately to diffusion (Schumpeter 1971). Given this, the firm clearly plays an implicit role in the process of creation and diffusion of the invention.

⁹ “The character and effectiveness of a nation’s system of schooling, training, and retraining, determines not only the supply of skills, from engineer to machine operator, but also influences the attitudes of workers towards technical advances” (Camagni 1992).

Universities in particular play an important role in educating human capital that is capable of generating basic knowledge relevant to technological advancement in industry. Public research organisations contribute to basic research, and in some case also to applied research. Research associations and private consultants play a significant bridging role between the basic science of universities and research centres and the applied research of the firms (Rullani 1989). Universities can contribute directly to local innovation processes in multiple ways. The possibilities are not limited to the patenting and licensing of discoveries made in university laboratories. In addition, universities can help to attract new knowledge resources from elsewhere; adapt knowledge originating elsewhere to local conditions; help to integrate previously separate areas of technological activity in the region and to unlock and redirect knowledge that is already present in the region but not being put to productive use. Most of these university contributions presuppose the presence of local industry (Goddard et al. 2007; Goddard 2011).

However in many innovation systems the role of universities has added remarkably different directions (Lester 2005). Recently, the most innovative strategies for universities and research centres have moved from the model of the closed university to that of forms that are highly attentive to enterprise situations. This changes the objectives and management of university structures, orienting them towards continuous and constant connection with the market. With this type of university policy, now taking hold in most of the world's major innovation systems, the university assumes the role of the central innovator, promoter and incubator of innovative ideas, transforming the approach from pure invention into innovation and from big science to small science.

A similar path is also activated in the case of non-profit research centres, when the invention they produce features characteristics of economic productivity, meaning costs of production and management that permit its broader diffusion in the system of firms. Once again, these inventions are transformed into innovation.

The last actor in the innovation system is represented by the substrate of local institutions, in which the system embeds. This can be summarised, in broad lines, as:

- the scientific and technological infrastructure;
- institutional and socio-political characteristics (e.g. antitrust regulation);
- the characteristics of the labour market;
- the financial system;
- the size and sophistication of demand in the internal market.

However studies have also shown that other institutional factors specific to each nation and geographic area have a determining influence on the rates and procedures of technological progress.¹⁰ Interest is therefore focused not only on

¹⁰ Becattini (1989) defined the entirety of these country or region-specific variables as the national (or local) innovation system. His intention was to propose a concept analogous to that of the "technological regime", which could synthesise those factors that influence patterns of innovation at the geographic level. He thus defined the national (or local) innovation system as "a set of institutional actors that, together, play the major role in influencing innovative performance".

the behaviour of firms on the technological frontier, and not only on the institutions that carry out the most advanced scientific research, but is enlarged to consider all the factors that influence a nation's or region's technological capacity.

In brief, the national innovation system results as composed not only of firms, even if these are the principle actors, but also of other actors and institutions that carry out a relevant role in generating and diffusing technology. Among these are the universities, the public research institutions, research associations and private consultants.

2.3.1 The Relationships Between the Actors and Their Effects in Innovation

Defining the nature of the relationships between the actors in the system implicitly requires the identification of their individual objectives. These inevitably condition the management of the relations and the roles of the partners. Roles and objectives change significantly according to the pairings involved in the relations: university-firm; firm-local environment; university-local environment.

University-firm relations are the most interesting and fruitful in terms of generating innovation. Historically, university-firm relations have followed a continuous growth trend ever since the birth of the first science-based companies in the years after World War II.

Modern cooperation relationships between university and business systems have significant influence on the paths for the creation and diffusion of innovation, from which both actors can gain benefits, although in different manner.

Wherever the paths have been simplified in their mechanisms and reduced in the times required, then the innovation process has resulted as faster and more fertile. Such simplification and easing of times emerges through closer forms of cooperation between the actors, through establishment of spin-off processes, or the presence of further institutions in support of cooperation (e.g. science and technology parks) (Rothaermel et al. 2007).

Silicon Valley is a well-known case where the universities' specific relational capacities, directed at promoting and financing entrepreneurial initiatives, progressively created a relational network where the universities have been both cause and effect of strongly innovative processes.

Where instead the university-firm relations have remained one-sided and non-systematic, or where "artificial" connections develop between actors that have no subjective, structural or contextual motivations for relations (e.g. due only to cooperation incentives), the relationships have not yielded innovation.

Firm-environment relations have also been shown to be fruitful for innovation. Here we again view the environment as the system of social and economic relations that link the firm to the place, as discussed in the previous subsection. The

entire literature on industrial districts, and more recently on technological parks, illustrates the reciprocal stimulus and hindrance effects from the relationship that the firm develops with its environment. In fact the processes of creating value through innovation produce positive effects both for the firms and the socio-economic systems that host them.

The observation of this fact has stimulated growing interest in local contexts for the processes of industrial concentration. With such interest in mind, local administrations tend to enhance whatever spontaneous localization of industry might occur by drawing on local policy actions for further stimulus, such as with the offer of serviced properties and areas, technical services and infrastructure.

If we adopt a still broader understanding of “environment” as involving not only the firm and its local place, but also the clients and suppliers, it becomes even more clear that innovation processes cannot simply move from the firm towards the market. In fact the process has stimuli other than the final demand, found in the relationships with suppliers and distributors and in other horizontal relations (Rullani 1989). The process moves in a circular path, rather than a linear one.

Lastly, university-local environment relations have historically been the least interesting of all regarding innovation, except that these tend to grow where university-firm relationships have also been fruitful. The spin-off processes that move from the university to the free market and transform the invention into innovation are indeed stimulated by the relations of the university within the local context. However here the case is not one of relations with reciprocal utility or relevance, but instead seems to take shape in a unidirectional form, where the university maintains an ample margin of control.

Even if the actors involved in an innovation system interact through the three categories of relationships described here, all actors together still feel the systemic effect that the network of relationships generates around them. It is thus appropriate to now shift the analysis from the interpretive logic of the single relationship to an examination of the dynamics that guide the innovation processes, within the overall systems of relations. In effect we now shift the discourse from “bipartite” reasoning to network reasoning. One of our particular objectives is to understand the discretionary margins that might remain to the firm in deciding if and how to participate in an innovation system.

2.4 The Territorial Variable

It is now widely accepted that innovation is a territorially embedded process, which cannot be fully understood independent of the social and institutional conditions of individual places (Lundvall 1992; Asheim 1999). The “territorially embedded” factors influencing the innovation process have thus become the focus for a number of theoretical perspectives (Crevosier 2014): from that of the innovative milieu (Camagni 1995) and industrial district (Becattini 1987) to those of the

learning region (Morgan 1997) and innovation system (Cooke et al. 1997; Cooke 1998). These approaches are often interrelated, and as a whole they offer powerful insights that aid our understanding of the mechanisms and necessary conditions for innovation processes (Moulaert and Sekia 2003).

Some of the most relevant findings deriving from these approaches concern the significance of territorial proximity, local synergies and interaction (Camagni 1995, p. 317), and the importance of local inter-organisation networks, financial and legal institutions, technical agencies, research infrastructures, education and training systems, governance structures and innovation policies (Iammarino 2005, p. 499) in shaping innovation.

The “territorial” approach provides a flexible theoretical tool for the identification of a series of external conditions under which learning and innovation occur (Cooke et al. 1997, p. 485), and that can then be applied to analyses across innovation systems and as a basis for actual innovation strategies. These external conditions render some courses of innovation action easier than others (Morgan 2004) or serve as “social filters”, meaning unique combinations “of innovative and conservative elements that favour or deter the development of successful regional innovation systems” (Rodríguez-Pose 1999, p. 82) in specific places.

Territories draw on their internal capacities to produce innovation, through direct inputs in the research process or through the creation of innovation-conducive systems in the local environment. At the micro-level of a territory, innovative units (company R&D departments, universities, research centres), as well as local institutions and individuals, interact with each other and with their external environment through the networks of actors described previously. Such interactions stimulate the transmission of knowledge in the form of knowledge spillovers (Jaffe 1986; Acs et al. 1992) that are reaped by the same local actors.

Territories also have capacities to attract and assimilate innovation that has been produced elsewhere. Knowledge spillovers can originate locally but they can also be generated from outside the local or regional borders, as “there is no reason that knowledge should stop spilling over just because of borders, such as a city limit, state line or national boundary” (Breschi and Lissoni 2001; Audretsch and Feldman 2004, p. 6).

The potential for knowledge spillovers beyond regional or national borders depends on the nature of the knowledge concerned. According to Leamer and Storper (2001: 650) codified information can be transferred inexpensively because its underlying symbol systems are readily disseminated through the information infrastructure. It can also be moved over long distance and does not suffer from heavy distance decay in the process.

However, not all information is completely codifiable, and certain features can make codification too costly or even impossible. In these cases, the firm’s acquisition of the codification “symbol system” or the physical infrastructure related to an innovation will not be sufficient to achieve successful transmission of the knowledge (Storper and Venables 2004: 354). Instead there is a need to disseminate tacit knowledge through intrinsically “spatial” communications technologies, where

face-to-face interaction is at times essential. Face-to-face contacts, as discussed in Storper and Venables (2004) and Charlott and Duranton (2006), not only serve as a means of communication but also fulfil other functions that make communication possible and effective. Face-to-face contacts thus ease the innovation process.

However, in contrast with codifiable information, the transmission processes for tacit knowledge are costly and suffer from strong distance decay effects. Face-to-face contacts are maximised within relatively small territories, because of a combination of proximity and the presence of common socio-institutional infrastructures and networks. The potential to reap knowledge spillovers will thus be maximised within the region. Some of this knowledge will nevertheless spill over beyond the borders of the region or locality and flow into neighbouring areas, due to different forms of inter-regional contacts. Flows of inter-regional knowledge are thus important agents of innovation, but their influence will tend to wane with distance and the accompanying decay of effectiveness in face-to-face and other forms of interaction (Anselin et al. 1997; Adams and Jaffe 2002; Adams 2002).

2.5 Local Innovation Systems in Emerging Nations

During recent decades, newly industrializing economies such as Korea, Taiwan and Singapore have experienced intensive technological learning and made much progress in closing the gap with developed countries (Kim and Nelson 2000; Lee and Von Tunzelmann 2004). This transformation has promoted the growth of a body of empirical literature focused on explaining how developing countries, including the newly industrializing economies (NIEs), have gained ground on the advanced countries, particularly by assimilating and adapting the mature technology of the advanced countries (Vernon 1966; Utterback and Abernathy 1975; Kim 1980; OECD 1992; Dahlman et al. 1985).

A large part of the studies address the process of technological development in emerging nations by adopting a micro-level perspective that compares the innovation process of firms from developed countries with the process adopted by late-comer firms.¹¹ Beginning from this approach, Kim (1980) argues that the innovation process in emerging nations is fundamentally different from that of developed countries, and he proposes a three stage model to explain innovation processes in emerging nation firms. During the early phase (duplicative imitation) firms acquire mature foreign technologies from advanced countries, including packaged assembly processes that only require some limited local production

¹¹ Latecomer firms are companies in developing countries that “are able to exploit their late arrival to tap into advanced technologies, rather than having to replicate the entire previous technological trajectory. They can accelerate their uptake and learning efforts, utilizing various forms of collaborative processes and state agencies to assist with the process, bypassing some of the organizational inertia that holds back their more established competitors” (Mathews 2002: 470).

engineering. In the second phase (creative imitation), process development and product design technologies are acquired. In the third phase (innovation), R&D is applied to produce new product lines. According to this model, true innovation occurs only in the final phase of the process, which begins with the simple acquisition and imitation of innovations realised by others.

This scheme seems substantially similar to that of a three-stage model proposed by Lall (1992), who observed the process of innovation development in Indian multinationals. The first stage is based on a learning process that the author defined as “learning within a given technology”, based on the imitation of an existing technology acquired from foreign multinationals by means of knowledge gathered through reverse engineering. During a second stage, called “learning by embodied technology”, the Indian firms began to modify the products of the first stage through small adjustments that made them better suited to the demands of local consumers. In stage three, the Indian firms took advantage of the knowledge acquired in the preceding stages to develop new capacities to achieve incremental innovations, which they could also export to other developing nations, thus obtaining a lasting competitive advantage.

Hobday (1995, 2005), studying the process of technological development in NIE firms, showed that in such firms process innovations preceded product innovations. The author proposed a three stage model of overall development. The first stage is “original equipment manufacturing” (OEM), in which firms of latecomer nations exploit their low labour costs and assemble standardised products on order and according to instruction from other firms, generally foreign multinationals, who market the products in the rest of the world under their own brand. In the second “original design manufacturing” (ODM) stage, latecomer firms develop autonomous production capacity but the products are still designed and marketed under the brands of multinational principals.¹² In the final “own brand manufacturing” (OBM) phase, the latecomer, thanks in part to continuous investment in R&D, acquires independent capacities for designing and producing new products that they market under their own brands.

Further authors have described how moving from the OEM to OBM phase does not always occur in the same manner. In some cases the learning processes are so rapid that the local firm skips the ODM phase and immediately arrives at creating products under its own brands (Lim and Lee 2001; Lee et al. 2005).

Applying a resource-based view, some authors (Mathews and Cho 2007; Mathews 2002; Huang et al. 2010) have underlined that the core competencies of NIE firms do not derive from possessing specific resources but rather from the capacity to identify innovative firms in developed nations, and then cultivate links with these for acquisition of missing resources and competencies.

¹² An excellent example is the USB flash drive, largely produced by Chinese firms like Huawei and ZTE, and then branded by local operators under ODM contracts.

Many subsequent authors have based their work on the approaches just outlined, using them to explain technological development of firms from particular geographic contexts, but without adding significantly to the actual theories. These studies have benefited the understanding of the specificity of processes in developing-nations firms, but offer only a partial understanding of the overall phenomena of innovation development in emerging nations. This is because just as in developed nations, the development of innovation in single firms is closely tied to the system of relations in which they are inserted, and is not the result of individual choices that can be made by independent actors, but rather of collaboration among different actors, such as firms, institutions and research agencies, found in the territorial context (Bell and Albu 1999).

Some authors have attempted to explain the innovation development process in emerging-nation firms through analysis of the relations between the technology donor, which is usually a foreign multinational, and the developing-nation company. This category includes studies on the “global value chain” (GVC) (Gereffi et al. 2005) and the “global production network” (GPN) (Ernst 2002), which show that learning in developing-nations firms springs principally from their insertion in the global production network of foreign multinationals, which often externalise some activities of their value-added chain to developing-nations firms in order to reduce production costs. GVC literature stresses the role played by leaders in the chain in terms of transferring knowledge to their suppliers (Giuliani 2005; Pietrobelli and Saliola 2008). For small firms in least-developed countries, participation in value chains is a crucial means of obtaining information on the type and quality of products and the technologies required by global markets, and of gaining access to those markets. However this information needs to be combined with local technological capabilities, which requires substantial technological and learning efforts (Morrison et al. 2008). GVC analysis is limited because of the lack of attention to the institutional context within which local firms are embedded. This limitation is highlighted in the literature on global production networks, which deals with how actors in various networks are embedded, including the geographical dimension from national to local scale (Ernst 2002; Hess and Yeung 2006).

But even the GVC and GPN perspectives offer a limited vision of the innovation development process in emerging-nation firms, since they neglect to illustrate the effects of relations with other types of actors belong to the innovation system, such as government institutions or research centres (Pietrobelli and Rabellotti 2011). While firms are the primary actors in the generation of technological objects, their activities are supported by the accumulation of knowledge and skills in a complex milieu of other research and training institutions. Such systemic factors also apply in developing countries, where technological effort is embedded in the specific economic, policy and institutional context of each country. Policy on technology must necessarily encompass this wider context. The component institutions of the system are of course the private firms, working individually or in collaboration, but also universities and other educational bodies, professional societies and government laboratories and research institutions, private consultancies and industrial research associations (Lall and Pietrobelli 2005).

This aspect has been highlighted by scholars examining the characteristics and specificities of national and regional innovation systems of some developing nations (Intarakumnerd et al. 2002; Patibandla and Peterson 2002; Finegold et al. 2004; Lee and Saxenian 2008). Their contributions are primarily descriptive in character, not offering alternative theoretical models, but have the benefit of showing certain peculiarities of developing nation innovation systems that clearly distinguish them from the models proposed for developed nations (Park and Markusen 1995; Yeung and Lin 2003).

First of all, foreign firms and their direct investments play a much more prominent role in the innovation systems of developing countries than they do in developed countries (Diez and Berger 2005). In a way, the innovation systems of developing countries are significantly globalised: the majority of new knowledge and technologies is acquired from extra-regional sources via direct investment or technology licensing (Ernst 2002). Further, innovation systems in emerging nations generally seem to appear as forms of “learning systems” rather than “innovation systems”, since their fundamental aim consists of supporting processes for the learning and acquisition of pre-existing technological knowledge rather than stimulating new production (Mathews 2001; Viotti 2002; Lall and Pietrobelli 2005).

Also, developing-country innovation systems are characterised by the fragmentation of actors and their linkages (Intarakumnerd et al. 2002). Some actors are still missing or incapable of contributing to innovation activities, and embeddedness and trust among these actors are still insufficient to support the evolution of strong linkages. Finally, the State plays a significant role in building successful innovation systems in developing countries (Yusuf and Stiglitz 2001). Basic investments in the innovation infrastructure are necessary, and have to be made by the public sector. The investments include human capital development, academic capacity building, and the promotion of industrial innovation, local content, and technology transfer. The interventionist governments of the so-called developmental States tend to dominate what are in effect centralised innovation systems. At the same time, these governments face the challenge of also allowing competitive forces to take effect.

The role of universities as alternative sources of knowledge appears to be marginalised in developing contexts. While research into the industrialised economies strongly emphasises phenomena such as science-based industries, university spin-off firms and entrepreneurial universities, in the developing countries it seems that the role of universities is less central to national economic upgrading and technological progress. Universities contribute solely to education (Liefner and Schiller 2008; Altbach and Salmi 2011).

These specificities generate much scepticism among scholars about applying the LIS concept to developing countries. The main concerns regard the very concept of innovation, given that developing countries are not able to realise “true” innovation. Some critics also claim that the concept of localization is no longer particularly relevant in a globalised world. However Lundvall et al. (2009) affirm that the LIS concept can be applied to developing countries if we substitute the traditional STI model (Science-technology-innovation) with the DUI model

(Doing-using-interacting), which represents innovation as the result of interactive processes not necessarily based on science and technology. In this sense it is then possible to apply the concepts of NIS, RIS and LIS to developing countries.

Another area of doubt concerns the supposed systemic aspects of the LIS, given that in developing countries the relationships among the different actors of the innovation system are seen as weak or absent (Chaminade and Vang 2008). Chaminade and Vang (2008) thus affirm that the concept of LISs is applicable to developing countries only if they are conceived in an evolutionary perspective that distinguishes between emerging and mature LISs. In the emergent LIS the market transactions dominate the interactions between the building blocks of the system (firms, universities and other knowledge providers and users). Additionally, emergent RISs frequently show weak inter-sectoral links, the absence of university-industry interface structures, and universities that specialise mainly in the supply of manpower (Galli and Teubal 1997). In emergent LISs, firms and other building blocks of the system are still engaged in accumulating the competences and capabilities necessary for different forms of interactive learning. The emergent RIS might gradually evolve into a mature RIS. In the mature RIS, interactions between the building blocks take place through market and non-market mechanisms such as information links, personal interactions, and other kinds of formal and informal networks. Firms and other organizations in the system have developed their absorptive capacity and are engaged in continuous interactive learning with other firms, users, universities and other organizations in the system. It follows that the university-industry linkages are strong and involve various forms of knowledge transfer.

Arocena and Sutz (2000) also call for an ex-ante perspective in the analysis of innovation systems in developing nations, which could identify potential initiatives and trajectories for construction of such systems in areas where they do not exist, rather than the typical ex-post approach of those that focus on developed nations, and which concentrate analysis on the functional logic of pre-existing systems. Consequently the specificity of LIS in developing countries need not be considered as a failure to achieve the traditional model of innovation systems, and should instead stimulate a reinterpretation of the model in dynamic mode (Lundvall 2007).

To understand the dynamics of innovation development in emerging nations, it would be useful to outline a sort of evolutionary route in which the development of a local system of innovation, as it is structured in developed nations, would in fact be the arrival point.

To do this it seems useful to integrate the contributions on developing nations that analyse the processes of innovation for single firms with those on global value chain and local innovation systems, which investigate the relational dimension of innovative process. This integration should concern both the binary relation between developing-nation firms and foreign multinationals, and the broader view referring to the entire network of actors in which the company is inserted. Given the entirety of the theoretical and empirical literature, we can reasonably hypothesise that the traditional configuration of innovation systems, with three typologies of actors (firms, research centres and local institutions), which interact to facilitate

the processes of innovation development, only appears in developing nations in the last phase of the innovation process. Further, during the initial phases of acquisition and assimilation, we can hypothesise the existence of other types of systemic structures and interactions of actors. Also, in accord with the global-value chain and global-production network perspectives, we can consider that in the phases that precede innovation, there is an important role for multinational corporations. Such companies are in fact more or less aware of serving as the principle source for developing nation firms to acquire the knowledge necessary to launch their own innovative process.

2.5.1 A Theoretical Model for the Emerging Nation LISs

Integrating the various analytical perspectives summarised in the previous paragraph, we can imagine a sort of ideal path for the constitution of innovation systems, depending on the actors involved and the development level of the local entrepreneurial system.

In the case that the development of the entrepreneurial system is at very low level and demonstrates a lack of actors that can participate in creation of an LIS, the only means to engage such creation mechanism lies in strong government intervention. This implies appropriate policy, aimed above all at attracting the actors lacking in the territory and also favouring their geographic concentration. Government in this case assumes the role not as the sole driver of the system, but as the key actor in guiding the process of LIS creation, in a top-down logic.

In a first stage the government actor implements policies to support the in situ construction of the system of missing actors. Policies to attract foreign actors in particular would only be enacted to guarantee sufficient concentration of the appropriate actors in the given region. Such policies can be directed at both foreign companies and foreign research institutions, although it is usually preferable to target the companies. Attracting companies is easier than attracting research centres and provides immediate results in the creation of local systems.

Once foreign actors are in place, government must also provide specific policies for the generation of mechanisms of knowledge spillover between the newly inserted actors and the local ones. In fact the existence of foreign actors does not engage mechanisms for LIS creation if they do not transfer their knowledge to the local actors. Indeed in many cases government policies have failed, precisely because they ended at providing for the attraction of foreign actors, and did not follow up with appropriate interventions such that these would engage virtuous growth mechanisms for the benefit of the other local actors.

In the case that the local entrepreneurial systems are more developed and a large company already exists in situ, it could be that this firm, pushed by the necessity of broadening its competitive horizons, would engage virtuous mechanism for the creation of an LIS. When large companies localise in a specific territory they create

a range of strong and weak links with other local actors, which can contribute to their growth.

The large firms can interact with the other local firms, not only through instituting supply relationships, but also by establishing virtuous mechanisms for knowledge transfer through appropriate cooperative relationships. Large firms can also interact with research centres, through the financing of research or training programmes, and in establishing cooperation mechanism of various types. The large firms can even create other actors in the system through budding processes and stimulation of spin-off companies, and through creation of true corporate research centres and corporate universities.

However the process through which large companies could originate an LIS is not automatic, as might falsely be understood from reading certain literature. Instead it depends on the actual will of the firm, as well as its own capacities for innovation. If the large firm reasons from a purely opportunistic view, refusing to cooperate with local actors, or if the firm is fixed in traditional mechanisms and not sufficiently innovative and proactive, its presence will not guarantee formation of an LIS. Instead, large firms could induce closure of the system on itself, in fact limiting the growth of the other actors in the context (Ferretti and Parmentola 2010).

Thus the creation of the LIS must occur through the cultural growth of the large firm, which aims at the reduction of opportunistic behaviours and continuous stimulation of innovation. This means that the large firm must transfer a concept of cooperation to the local actor: the concept that the growth of all the firms occurs through innovation, and that innovation cannot be realised through an isolated approach, but only through cooperating with other actors.

In other cases the motor for creation of the LIS can be a university, which broadens its mission from that of a research and training institution to that of an actor that guides entrepreneurial development in an area. The enactment of the so-called “third mission” of the university can engage processes of entrepreneurial growth through the creation of academic spin-offs. Spinning off their innovation means that the university acts directly towards the implementation of local entrepreneurial systems. Concession of patents under license or direct commercialisation of research results can also provide a push towards revitalising local firms other than an opportunity to undertake activity with high innovation content. The university can also contribute to the birth of the system through individual cooperation agreements, guiding the firms in the difficult phases of research.

Thus the presence of a university with strong entrepreneurial propensities in an emerging-nation region can contribute to birth of an LIS. However contextual action is generally necessary to ensure that the university structures and personnel decide to undertake the “third mission”. In fact in many cases there is resistance from universities and academics against the idea of undertaking entrepreneurial activity, stemming in part from the false conviction that this could reduce space and time for activities of pure research. This conception is not supported by empirical evidence, which shows that the best universities in terms of research results are often those with greater entrepreneurial propensities. The various actors must conceive of and transmit the idea that the “entrepreneurial university” can

create benefits for the territory, for firms operating there, and for the university itself, to find new research opportunities and sources of private funding for its own activities.

In summary, the creation of an LIS, in the manner defined in the earlier sections of this chapter, in itself represents a “point of arrival”. The structure of the local entrepreneurial system may present a situation where one or more actors are missing, and hence require engagement of a prior creation process that in time can lead to the creation of an LIS. In this sense the LIS concept is applicable in emerging nations only if the key actors share the conception of the dynamic nature of the LIS, as the final point in a process of creation.

In this regard we can imagine the existence of three different configurations of LISs in emerging nations, representing diverse intermediate stages, all in the process of convergence towards the configuration of an LIS as traditionally understood.

The emergence of the different configurations depends on the degree of development of the local entrepreneurial system and foresees the existence of a specific actor capable of engaging the creation process. In this sense, according to the actor involved, we distinguish the three configurations of LISs:

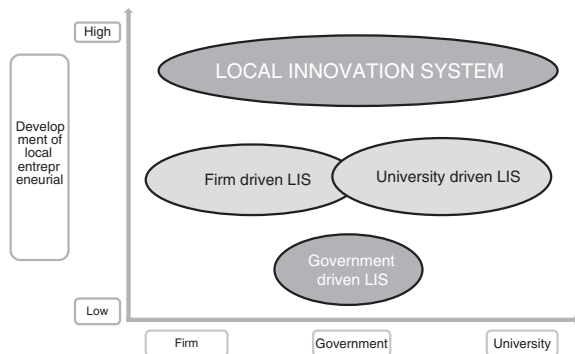
- the government-driven LIS;
- the firm-driven LIS;
- the university-driven LIS.

The government-driven LIS develops in situations where the local entrepreneurial system has a development level such that there is no other actor capable of intervening in the process of system creation. Firm-driven and university-driven LISs take hold in situations where the entrepreneurial system is more advanced.

All three configurations will succeed over time if the guiding actor is capable of engaging positive mechanisms for the involvement of other actors in the creation and construction of a true LIS (see Fig. 2.2).

Subsequent chapters will illustrate these different configurations of an LIS, in part through actual cases that describe their appearance in emerging nations.

Fig. 2.2 Classification of emerging nations LISs



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