REFLECTIONS ON INNOVATION NETWORKS: CONTRACTUAL VS. "CONVENTIONAL" NETWORKS

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ABSTRACT

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This paper helps to define the concept of innovation networks, in the context of urbanregional development. Faced with the Schumpeterian theory of innovation, a concept based on cumulative actions within innovation processes tends to emerge. These processes are presented as forms of "organization" which more or less explicitly link several different hierarchical organizations, without merging them, according to rules and requirements which are not limited to those of the market.

The first part of the paper outlines some important characteristics of innovation processes. These complex processes need to be supplied with various resources, especially information resources which are produced in rapidly increasing quantities nowadays. This increase in turn causes an increase in both the purchase and transaction costs of information resources. A possible way of reducing these costs is to work towards cooperation between firms or institutions possessing complementary resources.

The second part of the paper examines the concept of innovation networks. Within these innovation networks there are, on one hand, networks established on a contractual basis, often trans-territorial, and, on the other hand, networks established on a "conventional" basis (in the sense of the "economy of conventions"). It is believed, generally speaking, that the latter type of network can only develop within "districts" according to the Marshallian theory of the concept, and only after a long process of collective learning.

> But cities cannot be "explained" by their locations or other given resources. Their existence as cities and the sources of their growth lie within themselves, in the processes and growth systems that go on within them. Cities are not ordained; they are wholly existential (Jacobs, 1969, p. 141).

INTRODUCTION

The breakdown and stagnation of heavily industrial regions in the 1970s forced a reassessment of development theory in the search for a new understanding of the conditions for success. New research focused on success stories like Third Italy, Toyota City in Japan, and Silicon Valley, using micro-level analyses and case studies. The *Groupe de Recherche EuropÈen sur les Milieux Innovateurs* (GREMI), which has been at the forefront of the search for a new paradigm, found that the emergence and growth of innovative firms and behavior is fostered primarily by innovative environments—spaces that provide for a synergistic process of collective learning. The process of innovation is seen as both the creation of something new *and* the creation of the technical, financial, organizational, and commercial conditions necessary for its marketing.

There is a general acceptance that the Schumpeterian tradition has long tended to present the "innovator" or entrepreneur as a more-or-less isolated individual who successfully struggles against a hostile environment to introduce a new and efficient idea, method, product or production method. In this view, innovation is the result of the individual efforts of an entrepreneur (and his organization) who triumphs in a ferocious Darwinian process of survival of the fittest.

However, given the various contemporary techno-economic evolutions, which are partially inspired by the theory of transaction costs, it will be argued that innovation tends to be promoted by, or the result of, collective processes of alliances, agreements, partnerships, cooperation, mutual

aid and synergies globally developed within "innovation networks." These innovation networks are presented as forms of "organization" which more or less explicitly link, but do not merge, various "hierarchical organizations" according to rules and requirements not limited to those of the market, and which lead their member organizations to positive innovation results.

The purpose of this paper is to contribute to the debate over the concept of innovation networks, which recent literature tends to give a general meaning[1]. In the first part of the paper, several important characteristics of techno-economic innovation processes will be briefly outlined. These processes are particularly complex as they are multifunctional, dynamic, irreversible, systemic, uncertain and competitive. They need to be supplied with a variety of resources, particularly information resources given the fast growth and rapid change in that area. The rapid growth of information is causing an increase in both innovation resource purchase costs and the transaction costs they entail. A possible way of reducing these costs is to work towards cooperation between firms or institutions which possess or create complementary resources.

The second part of the paper discusses the concept of innovation networks. The concept should be used for those forms of innovation process organization that are based *neither* on company hierarchy *nor* on instantaneous market relationships. Within these types of innovation networks, there are, on one hand, monofunctional networks often regulated by contracts and often trans-territorial, and, on the other hand, multifunctional innovation networks which often seem to be regulated by "conventions" (in the sense of the economics of conventions). According to Marshallians, the latter type of innovation network, the most productive in terms of creativity, can seemingly develop only on a territorial basis, in specific types of territories or "districts," after a long process of collective learning.

SOME CHARACTERISTICS OF INNOVATION PROCESSES

Techno-economic innovation is a complex process. It involves the creation and coordination of an entrepreneurial culture, skill training, environmental amenities, information flows, basic population services, and territorial synergy. It also requires an understanding of how an environment influences its internal components (Proulx, 1992, pp. 149-150). To successfully carry through a techno-economic innovation process is to create something new (a product or service) and put in place the technical, financial, organizational and commercial conditions needed for the new invention to be successful in the marketplace[2]. Innovation is an economy-oriented social activity characterized by extreme complexity. It is a fundamentally dynamic, collective, multifunctional, multisectoral, multilocal, and timely co-production process. The complexity of the innovation process is mainly due to the following factors (Planque, 1996).

First, the process requires simultaneously mastering various "resources" (including informational, technical and financial), at highly diversified functional levels (technological, organizational, commercial, etc.) which must be articulated, in order to succeed in a competitive environment and limit the omnipresent risk of failure. These resources, which must be marshalled, accessed and combined to foster or effect innovation, are, however, dispersed among different owners, actors, decision makers, and places which may be difficult to access due to location and expense.

The complexity of innovation is also due to the fact that the processes or dynamics necessarily involve a series of harmonized stages that are not linearly successive but rather overlapping in time, with multiple feedback between R and D, technology, financing, organization, production, promotion and marketing (Maillat et al., 1988).

These are processes whose dynamics lead to dangerous and irreversible choices in a competitive context, as Roberto Camagni (1991b) writes: "…it is an irreversible, path-dependent and evolutionary process…" (p. 126). Another result is a high risk of unforeseen events that causes

a constant stage-by-stage alteration not only of the array of appropriate resources but also of the efficient combination of resources useful to each functional plan given both the progress of the innovation process and the new context created by the completion of previous stages, resulting new knowledge and, eventually, environmental changes. Time often modifies the form, the contents and even the objective (i.e., the market orientation) of an innovation. As the project progresses, it changes. The process of creating a technology, as well as the other stages of the innovation process, go beyond the normal operating routines of organizations. These are progressive learning processes of which the outcome will only be known later.

Under such conditions, it is clear, as Camagni (1991b) puts it, that "the key concept in this respect is the concept of uncertainty in its various forms. Uncertainty, and the correlated presence of imperfect 'information', prevents a pure price mechanism from allocating resources in an optimal way…" (p. 131). All economic activity involves some degree of uncertainty, some deficiency of information, and some risk. The creation of "something new" to be launched in competitive market conditions of course multiplies this uncertainty, and therefore the cost of obtaining resources, especially the information capable of reducing the ever-changing complexity of the environment by improving the quality of forecasts regarding its evolution.

The complexity of innovation processes is also due to the fact that such processes are characterized by their "systemic" organization, in that the different functional structures to be articulated for successful completion of the process are linked not only by the feedback effects mentioned above, but also by the dependence of the whole process on the efficiency of each of its component parts. Should one of these functional structures be incorrectly organized and supplied with the wrong resources, the whole process would be threatened. There are many examples of technological marvels that have never reached the market[3], and many attempts at innovation that were aborted because of unsatisfactory organization of the production process, or the lack of an

adequate distribution network or appropriate financing plan. From this point of view, the attention too often given exclusively to the technological dimension of innovation in the literature[4], (but thankfully not in business circles in general), and sometimes focused simply to the R and D phase, helps to mask the richness, difficulty, and multidimensionality of the phenomenon, and, consequently, the reality of the organizational and environmental conditions favorable to the emergence and success of the innovation processes (Akrich *et al.*, 1988; Planque *et al.*, 1987).

This quick presentation of the complexity of innovation processes emphasizes a central fact: these complex processes involve resource purchase costs and transaction costs that are potentially unaffordable for individual innovators and actors with limited rationality, and limited cognitive capabilities and investment potential. Very often in the contemporary context, competition, the complexity and cost of the innovation process, uncertainty, and possibly the hostility of the environment, motivate potential innovators to look for allies or partners so as to share risks, make the environment less aggressive, obtain resources at less cost and reduce transaction costs. "Far from being stubborn, a good innovator knows how to use compromise to seal alliances with actors who can help him complete his project, or to disarm real or potential opponents" (Fridenson, 1989, p. 23). According to authors such as Akrich, Callon and Latour (1988), innovation "can be mainly defined as a game of alliances and oppositions …a succession of decisions and coalitions…" (p. 14).

Today, many firms undertaking innovation processes are submerged under a flow of information, not only in the technological and scientific domains, which are growing faster than ever[5], but also in related areas such as knowledge of markets and the rapid and uneven change in their rules and regulations. These very complex multidimensional information packages, from a variety of sources, must be sorted out, decoded, translated, adapted, verified, understood, synthesized and transformed by a firm: internalized, and customized to achieve its goal; (according

to its culture and system of representation; see, for example, Lemoigne (1977). In other words, firms must turn enormous information potential into knowledge and skills useful in a competitive environment.

Compared with such great potential quantities of information, individual processing ability remains very limited. However, in an open and competitive context, the stock of information held or potentially accessible creates the need for additional refinement and personalization of information so that each individual can comprehensively optimize the information choices necessary for rational, or at least economically viable, decision making.

Selecting the appropriate elements for a given situation or project from the constantly expanding and changing mass of information available is costly; probably increasingly so given that the overall mass of knowledge potentially available is growing exponentially in our "information society." This is particularly obvious with small and medium-size businesses, which are often successful in just one technique or market and encounter serious difficulti es making good decisions about related functions such as financing, organizing internally, entering a new market, or hiring appropriate personnel in response to a new problem. In large organizations, the common strategy of specializing in a single activity is also related to the information purchase costs outside the firm's main sphere of activity.

The field of economics ascribes perfect rationality to the economic actor, but a consideration of scientific history shows that even the scientific disciplines have developed their own distinct approaches to rationality. There is no single analytic model that applies to the resolution of every economic problem (Perrin, 1992, pp. 157-158). In any case, the basic economic actor has only limited rationality[6], and because his time is limited he is incapable of optimizing, of obtaining "perfect information," or of synoptically picturing his environment and its dynamics. He

is restricted to a short and costly sequential search for information and scattered expertise based on which he builds his impressions, judgments, decisions, and action.

The actor has both limited capabilities and external constraints. The system requires him to make choices that are not too irrational compared to those of his competitors and to the potential optimum in a given information context (time, place). The actor is pressured by the system to reduce the uncertainty and risk of error with which he must organize his activity.

Given the increasing quality, complexity and multidimensionality of information needed to remain competitive, it is extremely important to know the methods used by economic actors to offset their deficiencies and overcome the limits of their cognitive capabilities to increase the quality of their rationality. Among these methods, those based on different forms of networking between firms and organizations (more specifically during innovation processes) have been relatively rarely analyzed, although they appear to be determining factors.

Paradoxically, "over-information" (expansion of information potential) increases the necessity (competitiveness constraint) and the cost of efficient or appropriate information. The innovation imperative in a world economy that creates, disseminates, incorporates, and quickly uses new knowledge, in an extremely open, interconnected, and competitive world economy, forces all actors to join organizations likely to limit both the risk of misinformation and information costs through sharing, specialization and complementarity (voluntary or not).

This is a requirement that might lead to the creation of certain forms of "innovation networks." Parallel to this necessity, the need to innovate gives a greater probability of success to those who, by historical chance or because of a strategy, have joined or know how to join organizations capable of significantly reducing multiple transaction and information extraction costs. These organizations allow basic actors to participate in the design or reorganization of their environment to make it capable of fostering the creation and implementation of new production

options in satisfactory competitive conditions: an innovative "environment" more innovative than others (Amendola and Gaffard, 1988). Conversely, this innovation imperative (which is a result of the opening of new territories and the need to be competitive) leads to an additional handicap, a greater probability of error and elimination for those who, by historical chance or inadequate strategy, try to operate in environments and/or forms of networks not structurally equipped to reduce those costs (Grossetti, 1995).

INNOVATION NETWORKS

The concept of "network" (Antonelli, 1995) has recently made a remarkably powerful entry into the vocabulary of territorial (and industrial) economy, after being abundantly used in different forms and meanings by various disciplines (particularly anthropology and sociology)[7]. We shall note immediately that the metaphor "network" initially suggests any form of interdependence between elements, units or subsystems that are interrelated. Any social activity and thus any economic activity can, in this sense, be a visual representation in which there is a relationship linking individuals or organizations that are themselves structured as networks; as any network is connected or integrated into a multitude of other networks… society and economy constitute a network with neither beginning nor end[8].

The generally metaphorical aspect of the network concept[9] and its virtually unlimited sphere of application doubtless largely contribute to both the wide consensus on its use and the "unclear, fragile and ambiguous [character of this] concept" that Lecoq (1991, p. 327) highlights. Marc-Urbain Proulx, who devoted his studies (Proulx, 1990) to networks and networking activities, concludes after careful examination of the literature of various disciplines that "If the network is represented as a conceptual link between the complex reality of interactive relationships and their abstract representation, the methodological difficulties of concretely understanding the multiple facets of the networking phenomenon have greatly limited the gathering of data to verify the numerous postulates proposed" (p. 89).

Although it is worthwhile to emphasize the limits and ambiguities of the over-generalized metaphor of network, we should not throw the baby out with the bath water because, if correctly defined, the concept of network may become fertile and pertinent. Such a definition can only be attempted if we first specify the limits of our area of investigation. Of the infinite number of

possible social and economic networks, we are exclusively interested in those which, in some way—and especially by involving relationships not solely governed by competitive principles and price regulation—are likely to participate in the creation of techno-economic innovation processes in the most complete and precise meaning of the concept as suggested above: innovation networks (INs).

The scope of innovation networks remains very broad. They range from the innovation networks promoted by large European programs, which link firms and other institutions from different countries, sectors and sizes in a competitively innovative environment, to personal relationships networks used by small and medium-size businesses to carry out their specific projects. They also include institutional networks geared towards innovation generated by any local government, associations between two firms and a research laboratory to develop a technological input for a specific production process, professional or local organizations monitoring technology for their members, ventures involving risk-capital/private services/large businesses/small and medium-size businesses …created on a one-off or more global basis, family alliance networks generating an emerging innovation here and there, planned or spontaneous technopolitan organizations, dissemination networks, etc… and all the alternative forms, and a variety of interconnection possibilities between networks which differ in form, substance, scope and stability.

Very different meanings are given to the concept of innovation network by each author in the literature, as illustrated by the following examples from the conference on "Networks of Innovators" held in Montreal, Canada in May 1990. Peter Clark (1990) analyzed two types of network which are involved in the diffusion, adoption and use of "Production and Inventory Central Systems (PICS)" in British industry: on one hand, professional association "networks," with their national and international representations; on the other hand, the intra-firm networks-mainly relationships and communication networks in large firms.

To further explain his theory of "inter-firm cooperation and the fidelity to link," Foray (1990) built his argument on two bases. First, cases of R & D cooperation in which positive sum games enable those forms of intermediate R & D organizations between intra-firm cooperation and market coordination to prosper (forms of strategic networks purposefully created by innovative firms). Second, the analysis of Marshallian industrial districts reviewed by Beccatini, in which "the continual reallocation of men and machines, facilitated by the socio-territorial unity of the district, thus constitutes the basic principles which enable the reconciliation of the existence of specific resources with the reduction of irreversibility costs" (p. 21). These are forms of *de facto* "geographical proximity networks" without any real strategic intention, which provide a favorable environment for a rapid and global adaptation of the district to face competition and changes in demand: "The secrets of industry are in the air".

At the same conference, De Bresson and Amesse suggested four categories of innovation networks. First, inter-industrial networks, which refer to a web of input-output relationships. "But identifying innovation clusters on an input-output matrix, however sophisticated and refined the methods, has inherent limits inasmuch as the actors are directly apparent" (De Bresson and Amesse, 1990, p. 6). Second, inter-individual networks: networks of relationships between individuals, both within and between firms. Third, inter-firm or inter-organization networks, which can be of numerous types: " …in most cases an inter-industry network will necessarily imply an inter-firm network, although multi-industry firms can internalize inter-industry networks; networks may also be intra-firm… These inter-firm networks can encompass joint ventures, consortia, strategic alliances, technical cooperation…" (*Ibid.*, p. 7). Fourth, inter-technical networks ("The networks combine many techniques"). The authors noted that no matter what the network components are, the analysis is not about the individual components of the network but "the interaction (or transaction) and the set of interactions, its shape and size" (*Ibid.*, p. 7).

Midgley, Morrison and Roberts (1990) were interested in communication networks through which information flows in the innovation diffusion process, including an empirical study in the area of life insurance when firms from this sector progressively adopt office automation techniques to improve their performance. The question here is not about a technological creation but about processes in which various actors intervene to change a service production process by introducing new techniques.

Lundwall (1990) mainly emphasized the interaction and exchange of quality information between the producers and the users of an innovation. "Every step in the innovation chain, from basic research to the development of new consumer goods, can in principle be seen as an interaction between producers and users" (Lundwall, 1990, p. 29).

Rothwell (1990) presented an analysis of the extremely open and multifunctional networks that small and medium-size businesses use to overcome difficulties they have in trying to build sufficient internal skills in all the useful sectors, drawing from large client firms, suppliers, universities, public research centers, etc. The concept of innovation network here is an extremely open multipolar one, which includes both inter-industrial relationships and relationships with other types of partners, mainly aiming at enabling small and medium-size businesses to get information, skills and expertise, both in their local environment and further afield (Alecian *et al.*, 1993).

Saxenian (1990) investigated Silicon Valley "production networks" (which are also innovation networks, since innovation and production seem to be difficult to disassociate in the area of computer systems that she analyzes) as "increasingly complex networks of autonomous but interdependent firms" (p. 9); long-term partnerships between computer system producers and their suppliers based on a mutual trust in such a way that "As they increasingly treat their suppliers as equals in a joint process of designing, developing and manufacturing innovative systems, the

suppliers themselves become innovative and capital-intensive producers of differentiated products" (p. 10).

The Silicon Valley networks Saxenian presented are fundamentally centered on the relationship between a producer-innovator and its suppliers, who are forced to innovate in order to keep pace with the evolution of their client (ordering power). This relationship does, however, differ from traditional subcontracting in three ways. First, in establishing long-term relationships leading to a collective skills-base more creative than the sum of individual skills ("S.V. systems now view relationships with suppliers as long term investments…" p. 11). Second, in creating mutual interdependence rather than unilateral dependence-domination. Third, because of the importance given to "learning from one another" (p. 30), it remains a conception of innovation networks as vertical inter-industrial networks that are mainly local—networks that are oriented towards a rapid and permanent recombination of extremely specialized and complementary knowledge and skills necessary to the creation of complex and competitive computer systems.

J.C. Perrin (1990a), in his suggested typology of INs, basically contrasts two major categories of innovation networks: "innovation networks which exploit technology and innovation networks which create technology" (p. 5). In the first category, Perrin makes a distinction between "networks which exploit technologies by developing them," and "technology-creating Innovation Networks".

Networks which exploit technologies by developing them are networks which: (a) can be structurally similar to large firms (or their various operational units), among which specializations are distributed according to the phases of the production cycle: an intra-firm network of complementary specializations that can plan over time the development of a product and its associated technologies (and related functions); and (b) can be centered on an autonomous small or medium-size business which adopts one or more new technologies in the market and eventually

modifies them marginally: networks of technology suppliers and technology users, networks in which relationships between the technology and/or equipment suppliers and the small or mediumsize business are regulated by the market; and (c) in certain cases, networks can be centered on a client who calls for tenders and controls the sub-contractors and specialized equipment producers he needs to successfully carry out the planned innovation of market relationship networks through an hierarchical inter-firm structure.

Technology-creating Innovation Networks are networks in which" relationships are multilateral and questions are collective, systematic communications relate to the creation of a common project in which all partners share the risks and profits" (Perrin, 1990a, p. 9). These technology-creating innovation networks, in which relationships are not primarily market relationships (instantaneous transactions) but require close collaboration and a combination of knowledge and skills, assume that "each participant's rights and duties must be defined and guaranteed within an appropriate institutional framework." The latter applies to networks which institutionalize multilateral inter-firm relationships in the medium to long term.

It is fairly clear, and more examples could be given, that the concept of INs in the literature does not refer (at least not yet) to a unified concept; each of the suggested definitions, each of the meanings given either implicitly or explicitly to this concept, is legitimate. Each one emphasizes one (or several) facet(s), dimensions, or aspects of the interaction involved in complex and diverse techno-economic innovation processes.

If the concept of an IN is to be scientifically operationalized, it is probably better that it not encompass too large and heterogenous a range of phenomena. Among the most commonly accepted definitions of the concept, there are three main categories of networks of actors that are likely to generate an innovation process, if we eliminate physical information networks, whose structure can

certainly influence the diffusion of innovations—and even the maturation of innovation processes—but which are not themselves likely to generate innovations.

The first category is intra-firm networks whose organization (the hierarchical regulation of transactions), although evolving and worthy of analysis, is relatively well-known and does not need to be renamed INs in order to be understood. The second category is inter-organizational networks that can simply be reduced to market relationships (in which the price dynamic mostly regulates transactions) 10; these networks are well-known in general economic analysis and also do not need to be renamed INs. Finally, there are inter-organizational (non-hierarchical) networks, in which, parallel to the instantaneous market transactions, implicit or explicit conventions between firms (and eventually other types of organizations)[10] contribute in a decisive manner to the birth and development of innovation processes, to the time management necessary to implement these processes and the progressive appropriation of resources required, and to the management of the disruptions that often occur during the process.

It is this latter category of networks which is a problem and which has not yet been correctly identified in the usual economic analyses; it is this category that should be called *innovation networks if* the meaning of this concept is to remain clear. IN are thus defined as forms of "organizations" (Menard, 1989), explicitly or implicitly oriented towards innovation, that associate several hierarchical organizations[11] by means which are not purely and exclusively instantaneous market or competitive relationships (without being structured like an hierarchical/integrated type firm, they are "between the market and the hierarchy")[12].

In such networks cooperative relationships can take various forms, which can, however, be to manage uncertainty and time (see the characteristics of innovation processes in Part I above). They are closer to the traditional practice of certain services rendered to firms. They differ from instantaneous market transactions governed by price mechanisms-not by eliminating the

commercial relationship between partners but by placing this commercial relationship within a conventional framework. This convention—which may sometimes be explicit and contractual, but may also be implicit, especially in the case of small units—ensures the necessary continuity and stability of the relationship over time and strives to warn each partner (or at least the dominant partners in the network) of the risks inherent in the launching of any innovation project.

Partnership practices, unlike instantaneous market transactions, do not aim at regulating exchanges of common goods and services whose characteristics are supposedly known *a priori* to the parties, but instead regulate exchanges of information (flows) and information capitalized in the form of knowledge and skills built up through collective learning processes during transactions. The exact result of their combination is therefore a product of the interaction process of which the characteristics cannot be known *a priori*[13]. But this group of possible innovation networks is evidently still too heterogenous, scattered, insufficiently defined and orderly to be useful. It is therefore necessary at least to try to identify networks that have different contents, different forms and different ways of participating in innovation processes.

The most commonly used distinction is that of "formal" vs. "informal" networks. After examining INs identifiable in various case studies[14], such a distinction, although suggestive, seems obsolete. Any true network is formal in the sense of "having a form" composed of connections or actors and relationships between them (which forms can obviously vary). At a given time, all networks are more or less readily identifiable and fully describable from the way they operate. One may therefore wonder, beyond the simplicity of the language, what this common distinction of formal networks vs. informal networks refers to. Doubtless it is an attempt to clarify the range of possible (and real) forms of networks by showing the relationship between two extreme cases using intermediate or composite cases (Antonelli, 1995).

Thus the distinction is made between two forms of networks. Formal networks, or rather, visible networks, are composed of clearly identifiable actors (closed networks) stabilized in a static relationship governed by contract for a specific purpose: there is a written agreement setting out a planned procedure, during which each actor's contributions and gains can be directly measured or at least evaluated by observers. Informal networks, or hidden networks, are composed of various mobile actors that are difficult to locate (open networks), and maintain uncertain and volatile relationships with no clearly defined contents. These are episodic relationships, with no unique, clear and permanent objective, which affect innovative capability. These relationships, which follow a mysterious and synergistic social, economic and cultural alchemy, are somewhat uncertain and contingent but undeniably positive.

Both of these "forms" probably exist but the reality is rarely dichotomous and all the intermediate forms are possible. Often, the most apparently formal networks can only function because they also possess, parallel to their visible structure, an informal dimension and relational content that is not directly discernable, not written, and not contractual. For instance, J. H. Gaudin, an experienced practitioner in the field of technical and industrial agreements of large multinational groups, noted in a short article published in Jacquemin and Remiche, eds. (1988) that within Interfirm cooperation," one of the most formal types of networks one can imagine—and one central to the viability, efficiency and effectiveness of joint ventures and other inter-firm cooperations—"is that of the personalities involved, be it the personalities of members of contracting corporate bodies or those of the individuals who are to work together… Therefore, it is not easy to have a large and a small firm cooperate… or firms with very different cultures.…"[15].

This seems a way of stating that no matter the apparent degree of formal relationships in a network, there is another dimension of relationships within the network that is not apparent and is often unconscious or only vaguely conscious yet essential (even though informal) in animating and

fertilizing (or disrupting and sterilizing) formal relationships. This is the human or cultural dimension, built on the little things that create a relationship of trust that is often only partial and temporary but always necessary—over and above formal agreements—for effective cooperation.

In the same vein, A. Jacquemin (1988, p. 18) emphasized the "effects of reputation and apprenticeship resulting from prior interactions," which play a particularly significant role between firms involved in "the multiple versions of partial cooperation that create certain common interests while preserving numerous divergent interests".

Rogers and Larsen (1984), in their analysis of Silicon Valley USA[16] in the country of lawyers and wrangles, rightly and strongly emphasized the fact that non formal effects of reputation, rumor, gossips and contacts—what the authors call the "village" effect, through which everybody knows or can identify who knows what and who is reliable-intervene in the innovation processes, influencing formal contracts and often substituting for them. This non formal dimension of innovation networks does not, of course, prevent the creation of a more discernable and apparent form of network, but it is not certain that the latter will maximize the efficiency of innovation networks[17].

Discussing Silicon Valley, Saxenian writes that while non-disclosure agreements and contracts are normally signed in these alliances, few believe that they really matter (especially in an environment of high employee turnover like Silicon Valley). "Rather, firms accept that they share a mutual interest in one another's success and that their relationship defies legal enforcement. In short, they recognize that the strength of the relationship is trust, not a contract" (Saxenian, 1990, p. 15). Along the same lines, De Bernardy and Boisgontier (1988), in their analysis of the Grenoble, France, technological park, compare "trust" to a "capital" good which transcends formal contract relationships, although it neither avoids nor eliminates them.

Clearly one cannot distinguish between formal and informal networks (except for extreme cases), but, as a general rule, networks possess both formal and informal dimensions with each one playing a role in regulating transactions[18]. More specifically, most networks involve both relationships formalized by contract and other relationships which, although less apparent, are just as important. This distinction is referred to shortly below in contrasting "contractual" innovation networks, in which formalized relationships predominate, with "conventional" innovation networks[19], in which supplementing contractual relationships with less explicit relationships between partners is critical to generating innovation.

Monofunctional and Multifunctional IN

Without prejudice to other possible typologies, notably those based on organizational criteria (Perrin, 1990a), it is useful to clarify and organize the concept of innovation networks by making a functional classification of INs in relation to the innovation processes they are involved in. We can thus distinguish two types of innovation networks, monofunctional and multifunctional.

Monofunctional INs. Monofunctional INs are centered on one of the major functions or stages[20] of techno-economic innovation processes. The most commonly observed monofunctional networks are perhaps those located at either ends of the innovation process (R & D and marketing).

Research and Development partnerships link firms that may otherwise be competitors, both with each other and with other types of organizations (public authorities, universities, the EU, etc.), through a contract of which the duration and provisions are generally determined *a priori*. The contract, in the absence of much advance knowledge of the final product, sets out the behavioral rules along with fairly precise cost and profit sharing rules for each partner (see, for instance, Jacquemin, Lammerant and Spinoy, 1990). Marketing partnerships are often joint ventures or joint

subsidiaries. This is especially so when the inventor of a new technology or new product needs to access an unfamiliar market, and is therefore looking for "additional assets" (Poncet and Prades, 1989). The inventor is looking to acquire a resource he doesn't possess, such as a distribution network in a foreign market.

Another type/form of monofunctional INs is a technology transfer partnership. These are the most complicated types of monofunctional innovation networks, because they include some elements of multifunctionality. A new product or technology is transferred in order to be adapted and introduced in new markets. Transfers are done through licence-agreement procedures (Poncet and Prades, 1989), patents or technical package agreements[21] under which the parties collaborate to make necessary changes to the initial technology. The technology owned by one party is transferred to another, which makes use of it in a new market. There is, in this type of IN, a limited phase of close cooperation governed by contract (even if mutual trust is often necessary, see note 1 above), followed by a looser "cooperation" when one partner launches the product on the market and the other one collects royalties.

Finally, there are other types of monofunctional networks that can be created between various partners by combining their resources and expertise to ensure the completion of a specific part of the innovation process[22]. We can, therefore, include among monofunctional networks involved in the techno-economic innovation process the various types of financial partnerships that may either partially or totally finance an innovation for firms, various public partners and other private partners.

Multifunctional INs. Multifunctional innovation networks link a large number of partners throughout the whole process (often for interrelated successive innovation processes), as opposed to monofunctional innovation networks which participate in a specific function of a techno-economic innovation process at a specific time. Multifunctional innovation networks are

those often described in Silicon Valley and some other technopoles and industrial districts; they are those in which there is not simply contractual cooperation to obtain a useful resource for an innovation process, but rather a true multilateral interaction which itself generates a permanent innovation process. Some technological parks may have the *appearance* of a multifunctional innovation network while failing to achieve the multilateral interaction that would make them true innovation networks. For example, the prestigious technopole at Sophia Antipolis in France resembles more a collection of well-known firms than an integrated whole capable of synergistic innovation (Planque, 1992, pp. 259-260).

Contractual innovation networks and conventional innovation networks

Experience shows that, contrary to monofunctional innovation networks, multifunctional innovation networks do not frequently exist outside the few developed regions of the world always cited in the literature (Silicon Valley, Road 128, Third Italy, Cambridge, Grenoble, France, etc.). For this we can offer an element of explanation related to the difference in the transactions regulation process in each form of innovation network (monofunctionl/multifunctional). In monofunctional networks, a limited number of participants is often bound by a contract to limited objectives within a preset time frame; each participant's rights and obligations are set out in writing and misconduct is punished by law. These networks are contractual. Under such conditions, once the contract is negotiated and established, partners involved may rarely see or get to know each other outside the area in which they decided to collaborate. This contractual dominance of the relationships in a monofunctional network[23] leads to the possibility (and frequent occurrence) of trans-territorial or sometimes trans-national monofunctional innovation networks. The role of the

monofunctional IN is to provide each partner with innovation resources that are developed by or available from another source at the lowest cost.

In multiftinctional INs like those operating in the specific districts listed above, the complex multilateral relationships in INs-with variable geometry according to the stage of the innovation process--cannot be managed efficiently through contract alone. These cases are governed by a larger and more general agreement; although there is still a contract, it is somewhat secondary[24]. This general agreement is equated with mutual trust. The question here is what makes partners, in some cases and places, trust each other. The concept of "convention" (Lewis, 1969), recently developed by a number of authors[25], can help answer this question.

Salais (1989, p. 213) suggests the following definition of a convention:

> a set of elements which constantly go together for the participants to the convention, and about which they therefore all agree. However, this common agreement is not based on a written document in which each detail is explained and which reflects a shared identical and conscious rationality and intentionality. A convention is a system of mutual expectations about expertise and behavior… the expected behaviors do not need to be defined in advance, written down and then coordinated to be achieved. There lies the difference between the convention and the contract, and the convention's greater generality…[26]

My hypothesis is that, in the area of innovation, only a few specific regions of the developed world have experienced the emergence of a *specific convention* binding members of their *local economic community* and generating the *relationships of trust* necessary for the development of long term multifunctional innovation cooperation. In other words, *only specific regions of the developed world have become capable of generating an environment favorable to the development of conventional multifunctional innovation networks, as opposed to common contractual monofunctional INs* (Ohmae, 1995; Gonda *et al.,* 1994).

This hypothesis implies two complementary arguments. First, "long term geographical proximity is an irreplaceable factor of synergy among various partners… Consequently, a network whose components are geographically close to each other… has a qualitative advantage that may

well be a determining factor… That is why innovation networks need an environment where other potentially complementary specializations exist, i.e., other technological skills; in short, other networks" (Perrin, 1990b, pp. 281-282). Conventional INs (in which a global convention reinforces eventual multilateral contract relationships) can probably exist only in a polarized territorial form which ensures the frequency of relations and the ongoing mutual knowledge among partners that is necessary to the maintenance and mutual adaptation of the convention over time.

Second, as not all territories have developed a specific convention in the area of innovation, we must observe that such a convention cannot be established instantaneously under just any conditions but requires a convergence over time of very specific factors (Lecoq, 1984). These factors, over and above the skills transmitted (Maillat *et al.,* 1988) through experience, precedent and repetition, enable the creation of an original type of coordination of innovation partners' behaviors and expectations. Such territorial innovation conventions are not intended to eliminate conflicts and competition or to regulate commercial exchanges, but to organize cooperation. This cooperation, by reducing the transaction and purchase costs of resources, and through the new combinations that it creates, increases the level of creativity and the global competitiveness of the INs involved.

These types of conventions could be presented as the outcome of, and the cement for, some territorial environments—a central element for the definition of an *innovative environment*[27] (IE). Such conventions, resulting from long collective learning processes (cooperation), could be a "Specific localized asset" (Gaffard, 1990, p. 307) and a specific non-transferable resource (see Ravix and Torre, 1990) for those environments and their actors. *It is a non-transferable resource because it is "existential, " part of the origins of the environment in question and progressively adapted to its functioning*[28].

It is the existence of this convention inherited from history that, in some environments, enables various actors to coordinate their efforts through the creation of an organization regulated implicitly, perhaps unconsciously, by the convention. In these environments, rigid interorganizational contracts-which can sterilize the essentially dynamic and uncertain field of techno-economic innovation-are not absent but rather "regulated" and made flexible by convention. The convention makes these relationships flexible by making possible at any moment the unexpected adaptations (in a contract) demanded by creative dynamics, thanks to the trust inherent in the convention. In other words, in environments where it is forged, the territorial innovation convention introduces the capacity to achieve flexible integration as well as flexible forms of cooperation (INs) in the face of environmental and innovation process uncertainties.

This type of cooperation, which has proved to be efficient in some innovation poles throughout the world, is, however, difficult to establish. It supposes a very long experience of repetition and collective learning that shows all partners that the potential gains from cooperation outweigh the risks of loss ("disloyal" conduct). It supposes a "Common Knowledge" (Lewis, 1969) which, beyond a system of common representation, includes a conviction borne of experience that the fact that those who do not respect the rules (often implicit) are the final losers.

The problem with establishing such conventions is not solely due to the time needed to acquire this indispensable common knowledge. It is also related to the objective conditions needed to prove that cooperation strategies are more efficient than non cooperative strategies, so that consequently a territorial environment is likely to develop among its members a *specific convention* that is necessary to regulate conventional multifunctional innovation networks.

These objective conditions merit specific analysis, and we can suggest some elements on which they depend. The first element is the economic structure of the territorial environment, which must be both sectorally (or technologically) specialized (i.e., have a clear global specialization as in

the semiconductor industry of Silicon Valley), and have very diversified functions so that all or most of the innovation processes can be owned by members of an eventual conventional IN, not only in terms of technology creation but also in terms of services, financing, production and marketing. This functional diversity supposes, among other conditions, that the local specialization has achieved a high level of momentum.

The second element is the "cultural" structure[29] of the territorial environment (Lecoq, 1989). "Cultural and social proximity" must be "specialized," because common systems of representation, language and values facilitate agreement and cooperation. These common systems of representation must also be "diversified," since it is probably necessary to the emergence of a convention that there be a great diversity of complementary knowledge and skills in the environment.

Such conditions, only roughly outlined here and in need of further development, are not to be found together outside particular areas marked by a particular economic history and an equally particular cultural identity. The difficulties encountered by the developers of planned technology parks in establishing real innovation cooperation within such a structure show that a convention between innovation partners cannot be decreed, and that multifunctional INs, like the cities in which they are created, are not "ordained" but wholly existential" (Jacobs, 1969, p. 141).

The attempt to more clearly identify conditions leading to techno-economic innovation, and to determine the best methods of creating them, is being spearheaded by the *Groupe de Recherche EuropÈen sur les Milieux Innovateurs* (GREMI). The results of its work could have profound implications for the future of regional development policy, because the more we know about the factors contributing to innovation, the more imperative it becomes to allocate resources in ways that promote those factors and to encourage the structure of inter-firm and intra-firm activity most conducive to their dynamic development.

Bibliography

Akrich, M., Callon, M., & Latour, B. (1988). A quoi tient le succËs des innovations? *Annales des Mines, June.*

Alecian, S., & Fabre, R. (1993). RÈseaux bancaires: la course aux guichets. In M. Savy & P. Veltz (Eds.), *Les Nouveaux Territoires de l'Entreprise.* Paris: DATAR-L'AUBE.

Amendola, M., & Gaffard, J.L. (1988). *The Innovative Choice: an Economic Analysis of the Dynamics of Technology.* Oxford: Basil Blackwell.

Amin, A. (1989). A model of the small firm in Italy. In E. Goodman (Ed.), *Small Firms and Industrial Districts in Italy.* London, New York: Routledge, pp. 111-122.

Antonelli, C. (1994). Natural monopoly, increasing returns, and networks: the case of telecommunications. In G. Pogorel (Ed.), *Global Telecommunications Strategies and Technological Changes.* Amsterdam: North Holland.

Antonelli, C. (1995). Economie des rÈseaux: variÈtÈ et complÈmentaritÈ. In A. Rallet & A. Torre (Eds.), *Economie Industrielle et Economie Spatiale, pp.* 253-272. Paris: Economica.

Aos, Z., & Audretsch, D. (1990). *Innovation and Small Firms.* Cambridge, MA: MIT Press.

Archibugi, D. (1991). Sources of innovative activities and industrial organization in Italy. *Research Policy, 20(4), pp.* 299-313.

Aydalot, P., & Keeble, D. (Eds.). (1998). *High Technology Industry and Innovative Environments: The-European Experience.* London: Routledge.

Barnes (1972). *Social Networks.* Addison-Wesley Modular Pub. 26.

Bellandi, M. (1989). The industrial district in Marshall. In E. Goodman (Ed.), *Small Finns and Industrial Districts in Italy.* London, New York: Routledge, pp. 136-152.

Bergman, E., Maier, G., & Todling, F. (Eds.). (199 1). *Regions Reconsider Economic Networks, Innovation, and Regional Development in Industrialized Countries.* London: Mansell Publishing Ltd.

Best, M. (1990). *The New Competition: Institutions of Industrial Restructuring.* Cambridge, MA: Harvard University Press.

Bramanti, A., & Senn, L. (1991). These are not Marshallian times. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 105-120.

Brusco, S. (1989). A policy for industrial districts. In E. Goodman (Ed.), *Small Firms and Industrial Districts in Italy.* London, New York: Routledge, pp. 259-269.

Camagni, R. (Ed.). (1991a). *Innovation Networks.* London: Belhaven Press.

Camagni, R. (1991b). Local "milieu", uncertainty and innovation networks towards a new dynamic theory of economic space. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 121-144.

Coase, R.H. (1987). *La Nature de la Firme* (1937). C. Thiebault (transl.), Revue FranÁaise d'Economie.

Crevoisier, 0., & Maillat, D. (1991). Milieu, industrial organization and territorial production system: Toward a new theory of spatial development. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 13-34.

DeBresson, C. (1991). Networks of innovators: A review and introduction to the issue. *Research* Policy, 20(4), pp. 363-379.

Fridenson, P. (1989). Les organisations, un nouvel objet. *Annales, Economie, SociÈtÈs, Civilisations, 6.*

Gaffard, J. L. (1990). *Economie Industrielle et de l'Innovation.* Dalloz: Paris.

Gonda, K., Sakauchi, F., & Higgins, T. (Eds.) (1994). *Regionalisation of Science and Technology Resources in the Context of Globalisation.* Tokyo, Japan: Industrial Research Center of Japan.

Goodman, E., Bamford, J., & Saynor, P. (Eds.). (1989). *Italy.* New York, London: Routledge.

Gordon, R. (1991). Innovation, industrial networks and high-technology regions. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 174-195.

Granovetter, M. (1985). Econornic action and social structure: The problem of embeddedness. *American Journal of Sociology,* 9](3), pp. 481-5 10.

GREMI (1989). *Innovative Milieux and Transnational Finn Networks: Towards a New Theory of Spatial Development.* International workshop EADA, Barcelona.

GREMI-AIRSA (1989). X Conferenza di Scienze Regionali, Roma, November 1989.

Grossetti, M. (1995). *Science, Industrie et Territoire.* Toulouse, France: Presses Universitaires du Mirail.

Higgins, B., & Savoie, D. (Eds.). (1988). *Regional Economic Development.* Boston: Unwin Hyman.

Johannisson, B. (ed.) (1987). *Organizing: the Network Metaphor.* International Studies of Management and Organization, XVII, no. 1.

Kamann, D.-J. F., & Strjker, D. (1989). *Concepts of Dynamic Networking in Economic and Geographical Space and their Application.* GREMI, Barcelona, EADA.

Kamann, D.-J. F., & Strjker, D. (199 1). The network approach: Concepts and application. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 145-173.

Keeble, D., & Egbert, W. (Eds.). (1986). *New Firms and Regional Development in Europe.* London, Sydney, Dover, NH: Croom Helm.

Larsen, J., & Rogers, M. (1984). *Silicon Valley Fever. Growth of High Technology Culture.* New York- Basic Books.

Lecoq, B. (1991). Organisation industrielle, organisation territoriale: une approche intÈgrÈe fondÈe sur le concept de rÈseau. *Revue d'Economie RÈgionale et Urbaine, 314, pp.* 321-341.

Small Finns and Industrial Districts in

Markusen, A. (1994). Studying regions by studying firms. *Professional Geographer, 46(4), pp.* 477-490.

Menard, C. (1989). Les organisations en Èconomie de marchÈ. *Revue d'Economie Politique, 99a(6), pp.* 771-796.

Nohria, N., & Ecclers, R. (Eds.). (1992). *Networks and Organizations: Structure, Form, and Action (I* ed.). Boston: Harvard Business School Press.

Oakey, R.P., & Cooper, S.Y. (1990). *The Relationship Between Product Technology and Innovation in High Technology Small Firms.* Colloque Networks of Innovators, HEC, Montreal, May 1990.

Ohmae, K. (1995). *The End of the Nation State.* New York: The Free Press.

Perrin, J.-C. (1991). Technological innovation and territorial development: An approach in terms of networks and milieux. In R. Camagni (Ed.), *Innovation Networks.* London: Belhaven Press, pp. 35-54).

Perrin, J.-C. (1992). Pour une rÈvision de la science rÈgionale: I'approche par les milieux. *Canadian Journal of Regional Science,* 15(2), pp. 155-197.

Planque, B. (1992). Milieux locaux et politique technique locale: Ètude de cas. *Canadian Journal of Regional Science,* 15(2), pp. 255-27 1.

Planque, B. (1996). DÈveloppement local, mutation Èconomique et dynamique spatiale. In Cote, S., Klein, J.L., & M.-U. Proulx, *Le Quebec des RÈgions: Vers Quel DÈveloppement?* Rimouski, Quebec, Canada: GRIDEQ-GRIR.

Powell, W. (1990). Neither market nor hierarchy: Network forms of organizations. *Research in Organizational Behavior,* 12(3), pp. 295-336.

Proulx, M.-U. (1990). *ActivitÈ rÈsilliËre, organisation de l'espace et dynamique Èconomique.* Ph.D dissertation, University of Aix-Marseille III, CER-Aix en Provence.

Proulx, M.-U. (1992). Innovative milieus and regional development. *Canadian Journal of Regional Science,* 15(2), pp. 149-154.

Roux, C., & Sivelle (1999). *Les Entreprises "High-tech" en Pays d'Aix: I'Organisation de I'Environnement Local pour une Ouverture Internationale.* CER, Aix en Provence.

Russo, M. (1989). Technical change and the industrial district: The role of inter-firm relations in the growth and transformation of ceramic tile production in Italy. In Goodman, et al. (Eds.), *Small Firms and Industrial Districts in* Italy. New York, London: Routledge, pp. 198-222.

Saxenian, A. (1988). The Cheshire Cat's Grin: Innovation and regional development in England. *Technology Review,* 9](2), pp. 66-75.

Saxenian, A. (1991). The origins and dynamics of production networks in Silicon Valley. *Research Policy,* 20(4), pp. 423-437.

Saxenian, A. (1994). *Regional Advantage.* Cambridge, MA: Harvard University Press.

Schumpeter, J. (1974). Capitalisme Socialisme et DÈmocratie. G. Fain (transl.). Paris: Payot.

Simon, H.A. (1976). From substantive to procedural rationality. In Latsis (ed.), *Method and Appraisal in Economics.* Cambridge: Cambridge University Press.

Solow, R. (1986). Economics: is something missing?. In Parker (ed.), *Economic History and the Modem Economist.* London: Basil Blackwell.

Storper, M. (1992). Regional worlds of production: Learning and innovation in the technology districts of France, Italy and the USA. *Regional Studies,* 27(5), pp. 433-455.

Storper, M., & Harrison, B. (1991). Flexibility, hierarchy and regional development: The changing structure of industrial production systems and their forms of governance in the 1990's. *Research* Policy, 20(4), pp. 407-422.

Williamson, O.E. (1975). *Markets and Hierarchies: Analysis of Antitrust Implications.* New York: The Free Press.

Notes

1 Especially around the work of the *Groupe de Recherche EuropÈen sur les Milieux Innovateurs* (GREMI), see GREMI, 1989, and GREMI-AIRSA, 1989.

2 "...the entrepreneur's role is to reform or revolutionize the production routine by expoiting an invention, or, more generally, a new technical possibility (production of a new good, or a new production method for an old good, or the exploitation of a new source of raw materials or a new outlet). This function does not consist essentially of inventing an object or creating conditions to be exploited by the business, but rather in getting things done" (Schumpeter, 1974, pp. 186-187).

3 Gaffard (1990, pp. 368-369), considering back-to-back the conceptions of the entrepreneur's role of Schumpeter and Kirzner, writes: "we must deduce that it is wrong to distinguish the entrepreneur from the manager, and if the entrepreneur's role is to create technology he cannot ignore the market constraints that affect the manager."

4 And also by public policies which encourage innovation: "Thus, the qualification of industries for high technology status depends largely on the resources they devote to innovation inputs (e.g. R&D) and not the commercially viable products that may result from the innovation process. This is particularly ironic, given that most Western governments are not interested in industries that spend large amounts on R&D, but seek to promote those sectors that, through competition in world markets, produce a good return on R&D investments, yield high profits, and employ many workers" (Oakey and Cooper, 1990, p.2).

5 This evolution, combined with the pressure of competition, is one of the explanations for the considerable shortening of the life-cycle of products in many sectors; one of the explanations which renders greater flexibility of production tools a necessity.

6 To be more precise, we can use the terminology proposed by Simon (1976) who compares a "procedural" concept of rationality (given the informational restrictions of place and time, the procedure which leads to a decision is the "best" one possible) to a "substantial" concept of rationality.

7 See, for example, the work of the "International Network for Social Network Analysis", which held its 17th international conference in San Diego, California, in February 1997.

8 "All real economic activity is inserted into a network of social institutions, customs, beliefs, and attitudes. The economic consequences are undoubtedly affected by these factors..." Solow, 1986, p.

9 "A terminological jungle in which any newcomer may plant a tree!" Barnes, 1972, as quoted by Proulx, 1990, p. 42.

10 To quote Williamson, relationships in which "spot contracts", simple transactions, and low cost transactions dominate.

11 In the sense of the theory of transaction costs, as developed mainly from the works of Williamson; see, for example, Williamson, 1975.

12 "Outside the firm, price movements control production, which is coordinated via a series of transactions on the market. Inside the firm, these market transactions are eliminated, and the contractor/coordinator who controls production replaces the complicated structure of the market and of its exchange transactions", wrote R.H. Coase in 1937; certain types of "networks" could refer to intermediate or complementary methods of controlling transactions.

13 As numerous observers have already noted, this collective learning of new know-how during partnership relationships is a main product of "INs" and, at the same time, is the cement, if one considers that each partner needs the know-how of the other partners to establish and develop his own know-how. In this way, Ludwall, 1990, suggests the notion of "learning by interacting" to summarize the idea that there is not simply an "exchange of information" but also creation, insofar as exchange of information itself creates a new combination whose result may be synergetic.

14 Planque, 1985; Planque, Proulx, Py and Radjama, 1987; Planque, 1988; Radjama, 1986; Roux and Sivelle, 1989.

15 "Practically, the analysis of objectives, the choice of means, reflection on the bringing together of reciprocal interests and on the maintenance of communal interests over time, must include the preparation and negotiation of a charter of reciprocal rights and obligations. This charter is commonly called a "cooperation agreement", a "joint venture agreement", or a "shareholders' agreement", Gaudin, 1988, p. 34; see the extremely exhaustive checklist of this type of agreement in the author's appendix to this article.

16 "Information-exchange" is a dominant, distinguishing characteristic of Silicon Valley. Because innovation entails coping with a high degree of uncertainty, such innovation is particularly dependent on information... One ought to think of Silicon Valley not as just a geographical place, nor as the main center of micro-electronics industry, nor even as several thousand "hightech" firms, but as a *networks."* Larsen and Rogers, 1984, p. 79.

17 There are, for example, a multitude of extremely formal networks, perfectly structured around committees and commissions, meetings and presidents, vice-presidents, secretaries, members and subscribers, that are often operated on an associative basis by semi-public or public groups whose aim is to encourage innovation. Innovative firms, or those that wish to be so, participate because they can make new contacts, obtain general information, and be on the lookout for opportunities. These networks, if they do not succeed in creating a second "informal" relationship alongside the first composed of interpersonal relationships--conversations in the hallways, can remain purely formal networks operating in the general environment far from innovation processes as extremely indirect participants in these processes.

18 Kamann and Striker, 1989, quoting Johanisson, 1987, write: "The formal structure is defensive, instrumental, and exists apart from streams of activities. It consists of regulations, contracts and rules. Informal structures fulfill the social needs and are dynamic..." (p. 4) **"informal structure represents the sedimentary organizing capacity of a collectivity",** Johanisson, 1987, p. 4.

19 "Convention" according to Lewis, 1969: the recollection of precedents and the repetition of behavior can result in "conventions" which enable efficient coordination between behavior types and expectations, a more efficient type of coordination than that of perpetual negotiation or prior setting-down in a contract of each detail of the partners' relationship.

20 "Step" is perhaps more suggestive than "function" but gives the idea of a linear process, of a logical sequence, which is not often the case with innovation processes.

21 "Technical dossiers" refers to innovations that are non-patentable, generally because they are a particular combination of elements that are well-known in another field: know-how, often very efficient know-how, that is technologically advanced in its mastery of (for example, chemical) processes and of (for example, mechanical) combinations, and economically viable, but extremely difficult to protect other than by absolute confidentiality. Unlike patented products, fraudulent copying or imitation can therefore not be punished by law. For example: technical studies by a nuclear research center on thermal and hygrometric regulation led to the use of these findings in greenhouses, for certain types of intensive agriculture. The pipes, watering system, energy supply, type of captors and control systems used, are by no means revolutionary; it is simply the way they are put together that makes them much more efficient than previously. This case illustrates one of the most important reasons why, despite having signed a contract of confidence, a transfer of this type of know-how is only possible when based on a relationship of trust, that is itself generally due to prior inter-institutional or interpersonal relationships.

22 Of the thousands of cases of monofunctional networks which participate in innovation, the example of the FIRST network in Toulon, France, can be cited. Here, about a dozen firms working in the field of marine tests and measurements, each with its own specialized and complementary equipment and personnel, have formed an association under French law. The aim of this association is to offer the coordinated services of its members in a specific part of the innovation process to firms in the offshore field that are working on innovation techniques. A specific contract is written up for each job, but the technical and commercial cooperation between the members of the association remains.

23 Even though, above and beyond the contract, mutual confidence is always favorable to noninstantaneous relationships built up over time.

24 "We have found you don't always need a formal contract.... If you develop trust with your suppliers, you don't need am-lies of attorneys…", Tom McGeorge, Apple's Purchasing Manager, quoted by Saxenian, 1990, p. 15.

25 L'Economie des Conventions, *Revue Economique,* 40(2), 1989.

26 The term "convention" may seem ambiguous because of its polynimic nature; here it means a collection of "rules", only slightly or not at all explicit, which must nevertheless be, followed-a social "convention".

27 Another central and complementary defining element of "innovative environments" is their capacity to organize their own opportunities. These are the environments which, by linking their members through a territorial innovation convention (which permits the emergence of conventional "innovation networks"), allows them to draw maximum benefit (because diffusion is in the network and by the network) from interterritorial contractual networks through which members access external resources.

28 "On the other hand, specific resources are resources that exist only through their participation in particular production processes to which they are essential, and they are therefore completely non-transferable from one process to another", Gaffard, 1990, p. 333.

29 Just as it has become common to compare the relative efficiency of the Japanese and American models of organization--differences largely related to divergent systems of representation, cultural models, and behavior-it is also legitimate to question the effect of "cultural" differences and behaviors among territorial environments on their relative techno-economic innovation performances; a nice area for multidisciplinary research.