

***SOCIAL CAPITAL AND CLUSTER DEVELOPMENT IN
LEARNING REGIONS***

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INTRODUCTION

Two recent approaches to the study of innovation stress similar aspects of the innovation process in knowledge-based economies — the systemic and interrelated nature of innovation, and its grounding in dense networks of geographically proximate firms engaged in related types of economic activity. The first is rooted in the innovation systems approach at both the national and regional or local level. It is well represented in the research and publications of members of the Innovation Systems Research Network (Braczyk, Cooke, and Heidenreich 1998; de la Mothe and Paquet 1998; Holbrook and Wolfe 2000). An important variation on this theme links this analytical framework with that of the knowledge-- based economy. Recent research sponsored by the European Union suggests that even the most specialized forms of knowledge are becoming a short-lived resource, due to the accelerating pace of change in the global economy; it is the capacity to learn continuously and adapt to rapidly changing conditions that determines the innovative performance of firms, regions and countries (Lundvall and Borrás 1998). The offshoot of this work on the learning economy has its parallel at the regional level in the literature on learning regions (Florida 1995; Morgan 1997; Asheim 1998).

A second approach is found in Michael Porter's work on the process of cluster development (1998; 1999; 2000) and more applied studies carried out by the former Nordicity Group for the National Research Council (1996), the Boston Consulting Group for the Canadian E-Business Opportunities Roundtable (2000), and ICF Kaiser, a San Francisco-based consulting firm (1997). Although they each operate at slightly different spatial scales of analysis, both approaches identify a number of key factors that contribute to the way in which a complex set of institutions and actors, comprising the innovation system or the cluster respectively, contribute to

the process of innovation and economic growth. However, both suffer from the same limitation — a tendency to focus on the descriptive and analytical level at the expense of the dynamic and explanatory level. What local economic authorities and policy-makers at regional levels of government are interested in is the process by which clusters take hold and expand in the context of local and regional economies. This paper sets out to explore what we currently know about this process and lays out a research agenda to further our collective efforts in the field.

SYSTEMS OF INNOVATION AND LEARNING REGIONS

The challenge of competing in a global, knowledge-based economy accentuates the need to understand how the context of diverse regional and local economies influences the innovation process. The “systems of innovation” approach is used to analyze the network of relationships among firms and the broader institutional setting that supports their innovative activities; the framework emphasizes the dynamic and cumulative nature of the innovative process. Analyzing these relationships involves tracing the flows of knowledge among institutions, both public and private, that comprise this innovation system. Studies of these systems point to the interdependence of economic, political, and cultural factors, and the increasing importance of proximity, in influencing the innovation process.

Much of the early work on innovation systems was conducted at the national level (Lundvall 1992; Nelson 1993; Edquist 1997), partly in response to the issue of whether the globalization process was undermining the ability of individual nations to influence their own technological sovereignty. More recent work has explored how innovative capabilities are sustained through regional communities of firms and supporting networks of institutions that share a common knowledge base and benefit from their shared access to a unique set of skills and resources (Wolfe 1997). This body of work attests that innovation is fundamentally a *geographical* process: facilitated, though not necessarily contained, by spatial clustering of the involved parties within the same region (Amin and Thrift 1995; Saxenian 1994; Storper 1997).

Competitive advantage is not limited to the acquisition of codified knowledge and capital that are available world wide; it is dependent on the institutional and social capital that fosters the acquisition and utilization of codified and tacit knowledge. Increasingly, both the institutional and the social variables that affect this capacity are found at the regional and local level. A regional focus provides a better way to understand the innovation process within the diverse economic, social, and political realities that comprise the larger, and more geographically diverse, industrial economies, such as Canada (Holbrook and Wolfe, 2000).

The current period of growth is thus characterized by a *paradoxical consequence of globalization* in which the ever greater integration of national and regional economies into the global one accentuates, rather than minimizes, the significance of the local context for innovative activities. Analysts recognize that while the process of globalization poses new challenges for regions and localities, it simultaneously creates new opportunities which arise from their unique capacity to serve as centers of learning and innovation. Factors such as access to a highly skilled pool of local labour, unique support services for local industry, the establishment of trust relations among networks of suppliers and buyers, and the interactive learning effects that emerge in a regional or local setting all contribute to strengthening the importance of local agglomeration effects and untraded interdependencies. These qualities confer crucial advantages on localities which achieve the right conditions for competition in the emerging global economy. Multinational firms, despite their global reach, are learning to exploit the richness and benefits of those geographically concentrated, innovative, regions in a fashion that concentrates R&D activities in both their home base and those overseas centres that are rich knowledge-based resources. Large firms with the potential to engage in production in a wide range of different locales are drawn to invest in those places providing the best prospects for learning and innovation. As Morgan (1997, 495) puts it, “we are now beginning to appreciate that globalization and localization, far from being mutually exclusive processes, are actually much more interwoven than is generally acknowledged.”

Over the past decade, key policy bodies, such as the OECD, and many national governments, have come to believe that the global economy is increasingly a knowledge-based one. Since competitive success depends on the ability to produce knowledge and utilize it effectively, there is a pressing need for firms, communities, regions and nations to invest a greater share of resources in education and training than they have in the past. However, it may be more appropriate to describe the emerging paradigm as that of a “learning economy,” rather than a “knowledge-based” one. Recent work indicates that innovation is a *social process* triggered by consumers (or “users”) who engage in a mutually beneficial dialogue and interaction with producers. In this way, users and producers actively *learn* from each other, by “learning-through-interacting” (Johnson 1992; Lundvall 1992). Learning in this sense refers to the building of new competencies and the acquisition of new skills, not just gaining access to information. The easier and cheaper access to information reduces the economic value of more codified forms of knowledge and information. In tandem with this, forms of knowledge that cannot be codified and transmitted electronically (tacit knowledge) increase in value, along with the ability to acquire and assess both codified and tacit forms of knowledge, in other words, the capacity for learning (Maskell 1999).

The production paradigm of this “new economy” is highly dependent on localized, or regionally-based, sources of knowledge and learning. Given the social nature of learning and innovation, these processes work best when the partners involved are close enough to one another to allow frequent interaction and the easy, effective exchange of information. Innovative capabilities are sustained through regional communities that share a common knowledge base. The regional level is critical because the factors of space and proximity contribute to the kind of tacit knowledge and the capacity for learning that support innovation (Maskell and Malmberg 1999).

The reasons for this are threefold. Spatial proximity facilitates frequent, close and face-to-face interaction. Such interaction, both planned/formal and unplanned/informal, fosters

and enables learning—through—interaction. Second, firms clustered in the same region often share a *common regional culture* which can act to facilitate the process of social learning. Research indicates that such firms build up a common language or code of communication through repeated interaction over time. As Patel and Pavitt argue, because much of the most important knowledge transmitted between parties in the innovation process is *tacit* rather than codified, this characteristic confers a crucial advantage on firms which participate in such networks of exchange (Patel and Pavitt 1994). Finally, this interaction—facilitating common language or code of communication is further supported by the creation of *regional institutions* which help to produce and reinforce a set of rules and conventions governing local firms' behaviour and inter—firm interaction.

The constellation of institutions at the regional level that contribute to the innovation process is labeled the *regional innovation system* (Braczyk, et al. 1998). This set of institutions, both public and private, produces pervasive and systemic effects which encourage firms within the region to adopt common norms, expectations, values, attitudes and practices — in short, a common culture of innovation that is reinforced by the process of social learning. Definitions of a “regional innovation system” vary, but for present purposes, it is defined as “the set of economic, political and institutional relationships occurring in a given geographical area which generates a collective learning process leading to the rapid diffusion of knowledge and best practice” (Nauwelaers and Reid 1995).

The most dynamic regional levels of government have experimented over the past two decades with a wide range of innovation policies. Differences in economic performance between the relatively more or less successful regions has prompted a corresponding interest in the mix of regional innovation policies and institutions that foster this dynamism. While these studies are still in their infancy, their conclusions have begun to coalesce into a new heterodox policy framework. This framework has many different variants, reflecting the prescription that regional innovation policies must be context sensitive, i.e., they must reflect the multiple realities created

by different industrial cultures and institutional milieu in different regions (Wolfe 1994; Storper 1996, 272).

A critical component of the innovation system of a region is the infrastructure of R&D institutions located within it, as well as the internal and external networks of relationships within and between public agencies and private actors. A number of recent schematics set out the parameters of a regional innovation system. One suggests that the innovation system of a region should be conceptualized in terms of both the demand and supply side for innovation. On the supply side are located the institutional sources of knowledge creation in the regional economy. Closely linked to these are the institutions responsible for training and the preparation of highly qualified labour power. The demand side of the system subsumes the productive sector — firms which develop and apply the scientific and technological output of the supply side in the creation and marketing of innovative products and processes. Bridging the gap between the two are a wide range of innovation support organizations, which play a role in the acquisition and diffusion of technological ideas and know how throughout the innovation system. These may include technology centres, technology brokers, business innovation centres, organizations in the higher education sector that facilitate the interface with the private sector and mechanisms of financing innovation, such as venture capital firms (Nauwelaers, et al. 1995, 15–16).

Less obvious, but equally important are the “background” institutions that define the fundamental incentive structures guiding firms’ decision-making: capital market institutions that shape time horizons and expectations concerning paybacks from investment; labour market and industrial relations institutions that determine rates of labour force turnover (and hence, possibilities for workers to engage in learning-by-doing), the strength of incentives for private firms to provide training, the degree of participation of shopfloor workers in firms’ decision-making, and other conditions that create or limit the possibilities for intra- and inter-firm learning (Gertler 1997).

Flowing directly from this analysis, the concept of the *learning region* has emerged to describe those places that offer the right institutional environment to encourage both private and social learning at four different scales: the individual worker, the individual firm, within groups of related firms, and within governmental bodies themselves. However, the literature on *learning regions* also contains a number of ambiguities and inconsistencies that have not been fully reconciled. In the North American context, *learning regions* are associated with the presence or absence of a dense network of research institutions and the broader set of social and environmental amenities that attract highly skilled workers to a locale and keep them there. In this sense, Richard Florida defines *learning regions* “as collectors and repositories of knowledge and ideas, and (that) provide an underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning” (1995, 528). Florida’s conception of the *learning region* focuses on the extent and quality of the institutional infrastructure that constitutes a key element of the regional innovation system. In recent research, he takes this definition a step further by focusing on talent as the critical factor of production in the emerging new economy. He argues that regional growth depends on the ability of locales to generate, attract and retain the highly skilled workers that are essential for establishing and growing technology-based companies. Their ability to do so, depends, in turn, on the presence of a high degree of tolerance and a wide variety of social and environmental amenities attractive to high technology workers (Florida 2000).

In the European context, by contrast, the analysis of *learning regions* focuses more on the contributions that social capital and trust make to supporting dense networks of inter-firm relationships and the process of interactive learning. From this perspective, the social and cultural context of both the research infrastructure and the network of inter-firm relations are much more critical for successful innovation, both in the “old” and the “new” economy. Bjørn Asheim defines *learning regions* as “representing the territorial and institutional embeddedness of learning organisations and interactive learning.” The promotion of a suitably supportive

environment for the innovation process depends on the ability to link together cooperative relationships, ranging from work organizations within individual firms to different sectors of society joined in regional development coalitions. Development coalitions are here understood to mean cooperative relations between a wide network of social actors, including workers and managers, but also broader sets of social resources in aid of the process of innovation. Thus his definition of the *learning region* emphasizes “the role played by cooperation and collective learning in regionally based learning organisations understood as regional development coalitions” (1998, 3).

Other authors emphasize that although the geographic basis of proximity is necessary for the constitution of a “learning” region, it is not sufficient. Learning depends on the presence of two key factors: a certain degree of business intelligence that serves as the demand trigger for new knowledge and the access to, or availability of that knowledge. But what is crucial to the success of this process is an “intelligent cell” to trigger the learning process. In most European contexts, the regional government and its development–related agencies play a key role in animating the regional innovation system to stimulate the learning process. Thus regional governments provide the central stimulus to spark the transition to a “learning region.” For this to succeed, however, regional governance structures must undergo a cultural and organizational shift away from traditional bureaucratic structures towards more flexible and less rigid institutional forms that can develop effective partnerships with private sectors organizations and associations. This requires a willingness on the part of government agencies to resort less to command and control forms of imperative order and rely more consensus building and inclusiveness in the policy process. This shift in governance style is seen as necessary to promote the qualities of “institutional thickness” and “social capital” associated with “learning regions” (Landabaso, Oughton, and Morgan 1999).

The dynamic of institutional relationships underlying such forms of governance requires a greater capacity for social capital and trust among a wide range of social and economic actors

within the region, including erstwhile competitors. Social capital refers to various features of the social organization of a region, such as the presence of shared norms and values that facilitate coordination and cooperation among individuals, firms, and sectors for their mutual advantage. The use of the term capital indicates that it involves an asset, while the term social connotes that the particular asset is attained through involvement with a community. The existence of social capital depends upon the ability of people to associate with each other and the extent to which their shared norms and values allow them to subordinate their individual interests to the larger interests of the community. It secures the conditions that enhance the benefits derived from more tangible investments in physical and human capital. Without its supportive functioning, high levels of these more tangible forms of investment may fail to produce the benefits that should potentially flow from them (Putnam 1993, 167-76; Maskell 2000). The networks that constitute social capital in this sense comprise a rich and dense social community in which the business relationships of the local economy are embedded. Social capital tends to be accumulated as an unintended consequence of other activities that people are engaged in; its presence or absence is linked to the vitality of civil society in that region. Civil society is here defined as “an aggregate of institutions whose members are engaged primarily in a complex of non-state activities — economic and cultural production, household life and voluntary associations — and who in this way preserve and transform their identity by exercising all sorts of pressures or controls upon state institutions” (Keane 1988, 14).¹

A key element that underpins the social capital of a region is the degree of trust that exists among the various members or groups that comprise it. Trust is one of those rare commodities that can neither be bought, nor imported; many studies suggest that it can only be built up painstakingly through a prolonged process of interaction. A growing number of studies identify the existence of trust relations among a network of regional firms as critical for their competitive success, but the factors that contribute to its presence trust remain difficult to pinpoint. Some of these studies attribute its presence to historical and cultural factors, sometimes buried so far in

the past that their origins are clouded in varying interpretations (Putnam 1993, 121-151; Fukuyama 1995). A different explanation suggests that a common feature of many regions displaying a high level of trust is a distinctive “story” or “folklore” about the region that purports to explain its unique trust conditions. This “folklore” portrays the high degree of trust as a natural fact of the region, unique to it, and virtually impossible to reproduce elsewhere. Yet, closer study of these regions suggests that the “folklore” itself often emerged when previous conditions of conflict and lack of cooperation resulted in a crisis situation which the members of the region were forced to settle. The “folklore” purporting to explain the basis for its unique conditions of trust masks the negotiated compromise that overcame the conflicts and resolved the crisis (Sabel, 1992, 225-29).

The concepts of social capital and trust help explain why certain kinds of economic activity tend to cluster despite the opposing trend towards dispersal brought on by the spread of globalization. Peter Maskell suggests that it may also explain why some regions continue to be “sticky” in attracting strong concentrations of firms in related activities. The process of globalization transforms what were previously localized inputs into *ubiquities* readily accessed by many firms at a variety of locations around the globe. Firms faced with this shift search for alternative inputs on which to base their competitive advantage. Such inputs must have a high potential value and be difficult to imitate or replicate (Maskell 1999). Social capital represents one such input. It becomes progressively more valuable as the process of globalization continues; it is not equally available in all communities; it cannot be purchased or transferred; and it is difficult to imitate or replicate. Trust, as a component of social capital, helps overcome market failures or reduce the level of market costs for firms in densely related networks, by supporting stable and reciprocal exchange relationships among them. Partners involved in these relationships establish a willingness to exchange information on something more stable and enduring than a “barter” basis. Both sides of the relationship can benefit from lower costs and improved quality in the knowledge thus attained. As these relations grow and develop, a larger

component of the knowledge shared and transmitted becomes “tacit,” rather than explicit with a concomitant increase in the level of understanding gained through the exchange. Ultimately, the relationships can be extended to include other partners of the respective firms, further enhancing the extent and the value of the network (Maskell 2000; Lorenz 1993).

It is important to distinguish between two aspects of social capital identified here: one attributable to historical and cultural factors, whose roots are buried deep in the region’s past and the other built up through the dense interactions of firms engaged in interrelated economic activities that have developed a high level of trust in their mutual dealings. While the two are not mutually exclusive, it is important to note key differences between them. The problem with the first approach is the difficulty of reconciling the analysis of the origins of social capital with the general prescription of the need to build it. If social capital requires centuries to build and its roots are buried deep in the cultural and social history of a region or locality, then how can it be reproduced in regions or localities trying to establish a basis for their own competitiveness in the current globalizing era (Maskell 2000). Equally problematic is the fact that the historical, and communitarian concept of trust espoused by Fukuyama, and to a lesser extent, Putnam, overlooks the complex and multi-dimensional aspects of the relational variety. It fails to allow for the kind of experimentation and interactive learning that builds the second kind of trust and social capital (Leadbeater 2000, 149-68).

To those familiar with the economic environment and business culture of North America, this point is highly relevant. Stephen Cohen and Gary Fields have warned that trying to apply European conceptions of trust or social capital, primarily in the historical and cultural sense, to North America is of limited utility. The social capital found in successful North American regional economies is much closer in nature to the relational variety described above. Social capital in Silicon Valley is grounded in the collaborative partnerships that emerge out of the pursuit of economic and institutional objectives related to innovation and competitiveness. It grows out of collaborative networks of interacting firms, driven essentially by their mutual

self-interest in maintaining their innovative edge. The trust found in Silicon Valley is based on assumptions about the reliability and reputation of key actors — a performance-focused trust, grounded in the expectation of how prospective partners will perform in a network relationship (Cohen and Fields 1999). Brown and Duguid reinforce the point that people are remarkably well informed about what other firms are up to in Silicon Valley — who's good at a particular task, who's not, who can be relied upon, and who can't. The variety of trust found in Silicon Valley is characterized as "swift trust," a form that develops through close, interdependent interaction and reciprocity over short, intense periods of time. "(R)eliable performance (or practice) builds communities and networks, and out of this can come trust. But these are not the familial communities of Northern Italy. They are the workplace communities developed as people work together" (2000, 36).

The networks of social capital in Silicon Valley are based in the productive interactions between a concrete set of social institutions and economic actors. The principle elements comprising these networks include: the core research universities that encourage close relations with outside firms that can adopt or commercialize the outputs of their research programs; US government institutions, especially in the formative period, that funded much of the critical research underlying the Valley's core innovations, or even more important, served as the demanding first user for its outputs (Mowery 1997); an unparalleled aggregation of venture capital firms that serve both as an essential source of start-up capital, but also as a repository of technical and managerial expertise to assist high-tech companies; legal firms with specialized knowledge and experience in key services invaluable to the high-tech firms; business networks that reinforce the patterns of interaction among the firms; a labour market that doesn't penalize, even values, a high degree of mobility, thus helping to circulate ideas among the network of firms and ensure that hard-won experience, whether it results in success or failure, is quickly redeployed in the service of other firms; and finally, an industrial structure rooted in the specific characteristics of the technologies that it is producing (Cohen, et al. 1999, 111-12).

Other regions eager to emulate the success of Silicon Valley must differentiate between the specific character of social capital and networked relations that underlies its success. To the extent that similar conditions conducive to generating high levels of trust and social capital exist in Canada's regional economies, it is likely that they conform to the performance-based variety in Silicon Valley, rather than the more associative and developmental variety evidenced in some European regions.

CLUSTER DEVELOPMENT IN THE REGIONAL ECONOMY

This discussion of the role of trust and social capital in learning regions, such as Silicon Valley, leads directly to the second key approach considered here: namely the nature of dynamic, regional clusters emerging in key locales around the globe. Clusters clearly operate at a smaller spatial scale than regional innovation systems. Is the experience of cluster development found in Silicon Valley a unique phenomenon, as much of the recent writing on the subject suggests, or can the experience be generalized to other regions and locales, as a growing number of locale governments and regional development agencies are trying to do. If so, what are the key factors necessary to generate the growth of dynamic and innovative clusters? How much of the process is a unique product of the past history and factors specific to the individual locale? And how much of the experience is common to all similar clusters? Most critically, what is the role for public policy? And what is the most relevant level of government to stimulate cluster development — national, state and provincial, or locale?

Michael Porter defines a cluster as “a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities” (1998, 199). They include concentrations of interconnected companies, service providers, suppliers of specialized inputs to the production process, customers, manufacturers of related products and finally governmental and other institutions, such as national laboratories, universities, vocational training institutions, trade associations and

collaborative research institutes. The existence of clusters, or more precisely, the tendency of firms engaged in related fields of economic activity to cluster across a range of industrial sectors, suggests that some of the key factors that determine competitive advantage lie outside the boundaries of individual firms. Clusters can consist of both high–tech concentrations of firms, which often centre around research intensive universities, as is clearly the case in Silicon Valley, as well as those based in more traditional industries, such as the ones studied by Maskell and his colleagues in Denmark (Maskell and et al. 1998).

Porter suggests that clusters can be identified through a four stage process that begins with the identification of a large firm, or concentration of large firms and then searches for the forward and backward linkages to other firms that feed its activities. The second step is to locate horizontal industries or firms that produce complementary products or services, which usually make use of similar specialized inputs or technologies or share common supply side linkages. The third step involves locating the key institutions that provide this network of firms with specialized skills, technology, information, capital or infrastructure. The final step concerns the role played by government and other economic development agencies that stimulate or support the activities of the cluster. Porter's analysis of the key elements that comprise a cluster recognizes the importance of "untraded interdependencies" among firms and supporting institutions which arise from the co–location of critical inputs to the innovation process, such as R&D facilities, training institutions, specialized service providers and suppliers of key components (Dosi 1988, 1145-47; Storper 1997). These criteria for identifying the presence of clusters in a region subsumes many of the same elements that comprise a regional innovation system covered in the preceding discussion.

Like a number of the other writers reviewed above, Porter views social capital as an essential part of the glue that holds clusters together. The competitive advantages that flow from the presence of clusters are closely linked to the value of the information and knowledge that firms are willing to share. The networks and relationships, and the degree of trust, in the second

sense considered above, constitutes the social underpinning of the cluster. The firm's identification with the cluster, and its sense of membership in the broader community that comprises the cluster are essential parts of this social capital. These values flow from a sense of civic engagement that it has with this broader community. The analysis of social capital in relation to clusters thus provides a valuable mechanism for helping analyze how the structure of networks with a given geographic area generates concrete benefits for individual firms.

Improving the strength and quality of ties within the cluster is often a by-product of building the relationships within the cluster. Trade associations and other civic organizations can become the social animators of this type of relationship building (Porter 1998, 226).

Porter provides a compelling analysis of the way in which the existence of clusters affects competition. The first is by increasing the productivity of their constituent firms and industries. Location of a firm within a cluster contributes to enhanced productivity by providing it with superior or lower cost access to specialized inputs, including components, machinery, business services and personnel as opposed to the alternative, which may involve vertical integration or obtaining the needed inputs from more remote locations. Sourcing the required inputs from within the cluster reduces the transaction costs in a variety of ways. It reduces the need to maintain costly inventory and the consequent delays that can arise with shipments from distant locations. It also facilitates communication with the key suppliers in the sense that repeated interactions with the supply firms in the value chain creates the kind of trust conditions and the potential for conducting repeated transactions on the basis of tacit, as well as more codified, forms of knowledge. Finally, local sourcing, especially for advanced and specialized inputs that often involve embedded technology or service content and may depend on the understanding of a common industrial culture (as in the case of machine tools), eases the costs associated with installing, debugging, training and troubleshooting the costly new equipment (Porter 1998, 214; Gertler 1995).

Clusters also offer distinct advantages to firms in terms of the availability of specialized and experienced personnel. The cluster itself often acts as a magnet drawing the skilled labour to it. Conversely the location of specialized training and educational institutions within the cluster can provide a ready supply of new labour to the firms in the cluster. This element of a cluster's characteristics is revealed in numerous accounts of the speed with which laid-off personnel are snapped up by others firms in the cluster, or the need by firms outside the cluster to locate a part of its research activities within the cluster's territory in order to attract the specialized skills that it requires.

Clusters also enhance productivity by facilitating the complementarities that exist between member firms. Membership in the cluster makes it easier for participants to source needed parts and components, thus enhancing the technological and productive capabilities of members firms. The knowledge of how to create or produce certain parts and components is a critical enabler or constraint on the firm's overall capabilities. If the requisite knowledge and skills are not part of the firm's "core competencies," the knowledge of where to locate it readily and in a trustworthy and reliable manner is often a more than adequate next best solution. In the best known case of Silicon Valley, Bahrami and Evans argue that it achieves a high degree of flexibility through "diverse specialization." Each firm focuses on its own area of expertise and draws upon the capabilities of other firms in the cluster for complementary activities. The resulting ecosystem of firms is "a constellation of specialized enterprises and complementary alliances" (2000, 178). However, it is more than just the network of highly specialized business services that supports rapid firm formation and early growth in a dynamic cluster. Equally valuable is the supporting infrastructure of related institutions that these firms draw upon: supplier networks, including specialized contract manufacturers, proximity to research institutions, both public and private, high labour mobility, specialized business services, venture capital, and entrepreneurship (Bahrami and Evans 2000, Kenney and von Burg 2000).

The mutually beneficial activities of the firms in a cluster generate a number of common assets that can be viewed as quasi-public goods. The general level of knowledge and information built up in the cluster can act as such a good, if the level of trust is sufficient to generate an easy and mutual exchange of both tacit and codified knowledge. Similarly, the mobility of personnel between firms in a cluster can constitute a similar source of knowledge flows. Even more important, the strength of the cluster can provide an important stimulus to public investment in specialized infrastructure, such as communication networks, joint training and research institutions, specialized testing facilities and the expansion of public laboratories or post-secondary educational institutions. As the depth and value of such investments increase, so do the economic benefits flowing to firms located in the cluster. Thus the strength of the cluster and its supporting infrastructure of quasi-public goods and public institutions create a mutually reinforcing positive feedback loop (Porter 1998, 218-19).

The second important effect of clusters is on improving the capacity of the member firms to innovate and thus enhancing their potential for productivity growth. Membership within the cluster affords firms a clearer view of current and prospective technology trends, allowing them to identify more rapidly new market opportunities for product or process enhancements through better information about buyer needs. On the supply side of the equation, cluster participation provides the firm with early information about new technology trends, component and machinery capabilities, thus allowing them to perceive opportunities for improving or enhancing their own products or firm capabilities. Even more important than these valuable sources of information, membership in the cluster allows firms to act on it quickly by providing them with the ready source of supply they need to bring the new product or service to the market. These other advantages are strongly reinforced by the sheer competitive pressure that comes with membership in the cluster. The presence of multiple rivals in the cluster all competing to take advantage of similar market opportunities and supply capabilities pushes firms to excel at innovating. However, these internal competitive pressures are strongly reinforced by the potential

for cooperation. Competition and cooperation are both present within the cluster because they work on different dimensions and between different economic actors (Porter 1998, 220-23; Best 1990).

The third key benefit of clusters arises from the formation of new firms, further contributing to innovation and expanding the size and significance of the cluster itself. The role played by larger, anchor firms within the cluster can facilitate the process of new firm formation. Large companies often generate new ideas and research findings that they are constrained to commercialize or bring to market. New firm spin-offs provide a ready mechanism for these ideas to be developed. Similarly, the presence of specialized and knowledgeable service providers ensures that these spin-off firms have access to the requisite skills and expertise needed to assist their rapid start-up (Porter 1998, 225). In the most dynamic clusters, such as Silicon Valley, a high rate of failure among startups can contribute paradoxically to the overall dynamism as the demise of one firm results to the creation of new ones, both directly and indirectly. This form of “flexible recycling” often accelerates the innovation process as preexisting knowledge is combined in novel ways by the founders of the new firms. This process occurs through a variety of networking forums or often previous relationships developed as suppliers, customers or service suppliers (Bahrami and Evans 2000).

In some respects, these aspects of the cluster-based model of development are part of a larger shift in the form of business organization to an open-systems model of networking. In his analysis of the factors that contributed to the rapid resurgence of the Route 128 cluster in Massachusetts during the 1990s, Michael Best sees the shift to this form of business organization as the critical factor. Open-systems networking is the counterpart found at the inter-firm level to the increasing degree of specialization witnessed in many highly innovative and entrepreneurial firms. It facilitates the process of new product development and innovation. Increasingly, rapid product development is not simply a question of developing a new product in-house, but entails a sophisticated process of coordinating activities among a group of

specialized companies operating at different points along the value chain. Open–system networking reduces both the costs and uncertainty associated with new product development for individual firms by sharing the risks and the benefits along the network of firms in the value chain. Best argues that historically, this model of industrial organization was more prevalent in the design–led industrial districts, such as the Third Italy (Best 1990). However, the development of new systems integration capabilities in technology–based industries has promoted their adoption of the open–systems networking model as well. The relevant point for the analysis presented here is that the internal dynamics of the open–system model enhances the potential for regional growth within the cluster of related firms. An individual firm’s dilemma may prove to be the cluster’s opportunity. The benefits arise from the fact that inter–firm networking offers greater flexibility in new product and process development. Foregone opportunities at one firm may be seized upon by a partner firm as better suited to, or more appropriate for, their core competencies. The exploration of new development opportunities may also lead to new partnering relations or to a broadening and deepening of relations among existing partners (Best 2000).

This discussion of the productivity–enhancing benefits of co–location in the cluster echoes similar points made in the discussion of the supply architecture of regional innovation systems. According to this analysts, the capabilities of a specific firm or industry are determined by the network of suppliers and related firms to which it is linked — what can or cannot be made by the firms in question is often a function of their ability to obtain the critical inputs required for the product. The range of technological capabilities within a national or regional economy is strongly influenced by this set of linkages. These linkages include both the demand drivers and the supply base. The demand drivers are pressures from leading edge and innovative users in the marketplace that stimulate firms to innovate. The supply base is the local capability to supply the component, machinery, materials and control technologies that producers need to support new product and process development — it includes parts, components, subsystems, materials and

equipment technologies. The architecture of supply defines the structure of the markets and other organized interactions through which underlying technologies reach the producers. The supply base and architecture of supply prescribe the possibilities available to firms as they make choices about the paths to follow in developing new technologies (Borrus 1993, 47). The two elements combined — demand drivers and the supply base — influence the pattern of innovation firms are likely to pursue, which projects are likely to succeed and the overall probability of success. Together, they define a set of constraints and opportunities in charting technological trajectories. These factors combined determine the technological specializations of individual countries and regions; and that pattern of specialization may actually be increasing, despite the spread of globalization (Zysman 1996, 167–68). However, one danger with these interlinked concepts is that they can serve as a double-edged sword — to both explain the social and technical bases of success for certain regions or clusters, but also to suggest the existence of constraints on the potential for others.

This brief review of the key characteristics of both regional innovation systems and cluster development affords an overview of the common features and differences of both approaches. The comparison of the two approaches raises an important question about the levels of spatial analysis involved and the interrelation between the two approaches. While they are sometimes used interchangeably, the approaches involved are best viewed as part of an emerging set of nested relationships within a form of multi-level governance. Both are subsumed within the existing framework of national systems of innovation. Although cluster development occurs primarily at the civic or local level, the process is embedded within a complex set of economic, social and institutional relationships at both the regional (RIS) and national level (NIS). It is impossible to fully appreciate the process of cluster development in isolation from the interaction that necessarily occurs between these multiple levels of governance.

Nowhere is this point more evident than in the case of Silicon Valley, often taken as the ideal illustration of the strength and influence of largely local factors in the process of cluster

formation. However, the cluster exists within the distinctive features of the US system of innovation — with its unique system of laws, regulations and conventions governing the operation of capital markets, forms of corporate governance, research and development and other relevant factors. A number of these features are absolutely central to the story of Silicon Valley's growth and development, as well as that of many of the other clusters studied in the US. Among these are the highly decentralized nature of the post-secondary education system with complementary and interlocking roles for both the federal and state governments (Feller 1999). Changes introduced in the 1970s and 1980s in capital gains rates and the tax treatment of stock options, as well as the rules governing investments in venture capital by pensions funds, stimulated the growth of the venture capital industry, a factor critical to the development of many clusters. The federal government also played a central role as the initial customer for many of the early products of the high tech clusters. And finally, it was the most important source of funding for much of the critical research and development that has underpinned the growth of these clusters (Rowen 2000).

BEYOND PATH DEPENDENCY — IN SEARCH OF A NEW DYNAMIC

The key questions that concerns most policy-makers at the regional and local level — is how to generate the growth of cluster-based development within the context of dynamic innovation systems or learning regions. The answer to this question requires a brief exploration of the role of both history and path-dependency in the evolution of regional innovation systems over time. Questions about the role that various factors have played in their innovative capacity, or lack thereof, also need to be examined. While policy-makers seem increasingly interested in answers to these questions, research, both in Canada and abroad, has just begun to explore some of the underlying dynamics that can provide the answers to their questions.

A key issue underlying this analysis is the concept of path dependency. While the concept has its origins in analyses of the more technological dimensions of the innovation process

(Arthur 1994), it has been applied with increasing frequency to studies of the social and political environment that influences and facilitates innovation (Zysman 1994). One difficulty with the extension of the concept from its original use is the problem of overdeterminacy. The concept of path dependency is effective in a technological setting in explaining why and how certain technologies prevail in the competitive setting of the marketplace, although they may not always be technologically superior. It also helps explain why certain technological possibilities envisaged at an initial point in the development or evolution of a new paradigm may not ultimately be pursued, due to the economic effects of lock-in and increasing returns.

However, the extension of the concept from the purely technological to the social and political level raises a number of problems — both for academic researchers and active policy-makers. The concepts of path dependency and lock-in imply that the technological trajectory of specific regions and localities is historically determined by the factors that influence their economic development over time. The presence, or absence, of key institutional elements of the local or regional innovation system may affect both their innovative capacity and their potential to serve as nodes for cluster development. Similarly, the ability, or inability, of the local or regional economy to develop the underlying conditions of trust and social capital that contribute to the presence of a learning economy may create a condition of lock-in to a specific innovation trajectory. The critical question that remains unexplored through most of the literature is whether the conditions that influence the trajectory of growth for specific regional or local economy can be altered by direct intervention, and if so, how effectively.

A body of recent research and policy-related work has contributed some initial insights into these questions. Research undertaken for the National Research Council situates the process of industrial clustering within the systems of innovation approach (Nordicity Group Ltd 1996). This analysis identifies a set of eight factors that contribute to cluster development, including: the presence of local champions with greater vision than single firm success; the existence of a strong S&T knowledge infrastructure — which includes research universities, government

laboratories, cooperative research centres; sources of motivated learners and technology, knowledge and skills; the presence of at least one exporting firm, with some global reach; involvement by local networking facilitators who promote the growth of relationships within the cluster; involved, knowledgeable local sources of innovation financing; sustained, aligned development strategies by local institutions and governments; and a supportive business climate, and policy conditions favourable for innovators.

Recent analysis by ICF Kaiser International for the Economic Development Administration of the US Department of Commerce identifies a similar set of factors that contribute to regionally-based cluster development. In addition to the basic prerequisites for cluster development — a strong concentration of related industries, as well as specialized suppliers and services — clusters also benefit from access to specialized economic inputs referred to as “economic infrastructure.” The seven major categories of economic infrastructure include: adaptable skills, accessible technology, adequate financing, suitable physical infrastructure, advanced communications facilities, an acceptable regulatory and business climate and an attractive quality of life (Information Design Associates and ICF Kaiser International 1997). This last point is strongly reinforced in the recent report prepared by Richard Florida for the National Governors’ Association in the US (Florida 2000).

Porter also identifies a number of contributing factors to the growth of clusters that resemble those presented in the analyses above. However, he views them in more of a dynamic perspective, rather than just as a snapshot of the present. Prominent among the conditions leading to the early formation of a cluster is the presence of a strong pool of critical factors, such as a set of specialized skills, a strong research base, or a particularly good infrastructure. The emergence of some of the more successful clusters has been attributed to the role played by leading research institutions, such as Stanford in Silicon Valley and MIT in Route 128. Clusters may also emerge out of the role played by a core or leading firm. The location of a dynamic lead firm with strong linkages to the global economy, such as Hewlett Packard in Silicon Valley or Nortel Networks in

Kanata, can have a demonstration effect for other firms in the cluster, as well as provide a continuous source of spin-offs, feeding the process of new firm formation. Chance events may also play a critical role. The relocation of William Shockley from Bell Labs in New Jersey to the west coast had totally unforeseen consequences for the future development of the semiconductor industry, just as the forced divestiture of Northern Electric by Western Electric in the 1950s was crucial for the future development of the telecommunications and fiber optics cluster in Kanata.

Maryann Feldman also highlights the underappreciated role played by entrepreneurship in seeding the growth of clusters. Her detailed study of the development of the ICT and biotechnology clusters in the US Capital region suggests that many of the conditions identified above for cluster development appear to lag rather than to lead the crucial role of entrepreneurship. "Looking at a successful region in its full maturity, however, may not provide prescriptive information about the process of how such regions do develop." The emergence of a significant entrepreneurial impulse in the Capital region in the 1970s and 1980s was a response to exogenous factors, such as the downsizing of the federal government, the presence of considerable slack in the supply of highly skilled human resources and the demand for new products and services created by outsourcing of government services. Once seeded, the clusters became part of a self-reinforcing cycle as successful entrepreneurs contributed to the funding of angel investor networks and venture capital firms in the region, engaged in institution building to support further entrepreneurship and stimulated the development of new teaching and research programs at local universities to support the growing clusters. The emergence of the established clusters was the result of "a sustained effort at capacity building that involved human agency, adaptation and evolution." Supportive government policies contributed by increasing the demand for cluster services and products and stimulating the flow of new ideas from research laboratories to entrepreneurial firms (Feldman forthcoming).

The preceding analyses raise important questions about the role for government in seeding the growth of clusters. Even Porter concedes that the list of explanatory factors raises

questions about whether clusters can be seeded in locations where no significant advantages already exist. The most appropriate policy he suggests should be to build on existing or emerging fields that have already passed a market test (Porter 1998, 240). Fundamentally, it should reinforce and build on established clusters and emerging clusters, i.e., those where a foundation of locational advantages are present. Governments can contribute by removing regulatory and other barriers to the expansion of the cluster, sponsoring fora to bring together cluster participants, encouraging efforts within the cluster to attract potential suppliers and service providers to locate to the cluster's region, establishing or improving specialized education and training facilities to maintain the steady flow of skilled labour essential for the cluster's development, expanding local university-based research efforts in cluster-related technologies, providing improvements to the transportation, communications and other infrastructure needed by the cluster and gathering specific sources of information of direct use to the cluster (Porter 2000).

Other experiences suggest that it is also possible for local communities to formulate strategies to alter their economic trajectory and improve their chances of cluster creation. The impact of one recent initiative, the creation of Joint Venture: Silicon Valley, on improving the quality of civic engagement in the Valley has drawn some attention. Three of the participants argue that even in established clusters, the concentration of a large number of firms is not sufficient to transform a particular locale into a vibrant and dynamic cluster linked into the global economy. What is required is the presence of an "economic community" — places with strong, responsive relationships between the economy and community that afford both companies and the community a sustained advantage. These relationships are mediated by key people and organizations that bring the economic, social and civic interests in the community together to collaborate. According to these authors, "the distinguishing feature of economic communities is not just that they have clusters but that they have mechanisms to engage their clusters and understand what they need from the community" (Henton, Melville, and Walesh 1997, 7).

Based on their experience with community-based initiatives such as Joint Venture: Silicon Valley, Henton *et al.* agree that social capital is a critical ingredient in the success of the most dynamic clusters. But they reject the deterministic explanations offered by Putnam and Fukuyama. In their view, social capital can be created and the basis for doing so is the establishment of collaborative networks between various elements of the business and civic communities. The catalyst for doing so is a new breed of civic entrepreneurs, individuals who lay the basis for social capital by finding the opportunities for others to work together on projects to promote the community's economic prospects. The essential criterion for success is finding the appropriate mechanisms to engage key members of the community in a sustained effort to advance its opportunities. Not just Silicon Valley, but similar efforts in Cleveland, Austin and other centres over the past two decades provide illustrations of how this process works (Henton, *et al.* 1997, 31; Gibson and Rogers 1994). The Regional Innovation Strategies run by DGXVI of the European Union is also predicated on the notion that key actors at the regional level can organize to stimulate innovation and some results have been promising (Landabaso, *et al.* 1999; Henderson and Morgan forthcoming).

One of the key virtues of this approach is the emphasis that it places on involving key actors at the local level in thinking about how to design effective innovation strategies within the framework of existing national and regional policies. Building trust among economic actors in a local or regional economy is a difficult process that requires a constant dialogue between the relevant parties so that interests and perceptions can be better brought into alignment. Authors, such as Charles Sabel (1992) and Michael Storper (1996) underscore the critical role played by soft factors, such as talk, in building trust. Storper suggests that talk and confidence are more likely to succeed when they occur in a setting that is geographically localized and that small, repeated low-cost experiments can generate interactive learning between parties in an environment which has previously been characterized by distrust or antipathy. These same concerns lie at the heart of the regional innovation experiments in Europe. The need for

institutional learning, at the local and regional level is critical to the success of such efforts.² Regions and communities interested in stimulating local economic growth may find these experiences critical to the process of promoting cluster-based development.

NOTES

1. A somewhat more restricted definition is provided by Fukuyama as “a complex welter of intermediate institutions including businesses, voluntary associations, educational institutions, clubs, unions, media charities and churches. . .” (Fukuyama 1995, 4).

2. For a fuller discussion of these issues see the Gertler and Wolfe, 2001, and Wolfe, forthcoming.

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