Making connections: innovation and collective learning in small businesses

Jay Mitra

Introduction

The idea of innovation as a “system” with spatial dimensions involves the study of national and regional systems of innovation, including industrial districts, spatial networks, clusters and other “focused environments”. A fundamental point of the “systemic view” is that it allows for a connection between “technological” innovation and “organisational” innovation. This connection also suggests that the factors which foster or frustrate technological innovation are not limited to the internal jurisdiction of the firm (Cooke and Morgan, 1998). When it occurs, innovation is “new” to the firm and/or the market, and even when it is absorbed within the firm it has introduced a “new” dimension. Competitive factors of cost reduction, value added, and new market opportunities may be the spur for innovation, but in essence it has enhanced the firm’s activities or capabilities. In this sense the firm has made an extra connection with the market and the wider environment sometimes beyond the routine interactions of daily business. Additionally, the innovation process combines, inter alia, different activities of design, research, market investigation, process development, organisation restructuring, and employee development. The innovation process is, therefore, not complete without connections being made at the level of skills, functions, technologies, commercial production, markets, and other organisations (Mitra, 1999).

The resources and activities of SMEs are often embedded in the region (Granovetter, 1985; Becattini, 1989), and innovative outcomes can sometimes be seen to be the result of a symbiotic relationship between the strategies of individual SMEs and the clusters in which they operate in a region. Regional embeddedness takes both social and economic forms and is often an important determinant of learning. In this sense firms, wider communities and the region act collectively as “learning organisations” or “learning networks”. Firms co-operate and network to reduce uncertainty and maintain stability, “sensemaking” within a spatial setting to form a common set of meanings and agendas as the building blocks for “organisational learning” (Cullen and Matlay, 1999).

The author

Jay Mitra is Professor and Director of the Enterprise Research and Development Centre, University of Central England Business School, Birmingham, UK.

Keywords

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Abstract

Investigates the learning process in innovation and, in particular, the collective learning which underlines different types of innovation within the context of small-to medium-sized enterprises (SMEs). Argues that innovation is often the result of interaction of various subjects, technologies, people and organisations, and that it is the learning that is derived from such interaction which underpins innovative activity. SMEs are better able to innovate when they are part of clusters because it is through the networking process and the management of externalities (key elements in clustering) that they develop new products, processes and services.

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Competitive advantage at the level of both the firm and the region rests on the management of the interface between the “related industries”. While public policy can help to identify and support such industries, firms in each industry also need to understand and cultivate the relationships. This understanding is perhaps best developed through collective learning based on connected activities.

The web of connections

Apart from the insight into the patterns of economic change, one interesting consideration in Schumpeter’s long wave theory is the mix of factors driving the innovations. Different industries, firms in those industries, different technologies, and the interaction between them provided for the knowledge base and the learning that was sustainable for the period of the boom and its residual during period of slow expansion. At the macro level, learning (or “meta learning”) was locked into this combination of factors that generated change.

Each major innovation provided a “framework for a large number of subsequent innovations, each of which is dependent upon or complementary to, the original one” (Rosenberg, 1982, p. 15). Clearly such connections did not take place overnight but were the result of perhaps a long sequence of path-dependent activities. Path-dependent connectivity can also seen in the evolution of the technologies in the second and third waves in the sense that the technical learning and competencies acquired during the first wave were embedded in the firms and regions that generated them. Part of the decline in the innovative industries can also be attributed to the path-dependency factor as firms and industries are “locked in” by what they know best and refrain from exploring other opportunities.

Different organisational arrangements and related learning, can be identified in:

- the change from mass production to flexible production, including the flexible specialisation of firms in industrial districts and the dynamic high volume flexible production systems – affording multiple systems of production closely linked to each other and to market needs;
- the shift in management methods from hierarchical “Fordism” to flexible, co-operative “Toyotism” – suggesting a transfer of cultural values and their adoption from Japan to the West;
- the crisis of large corporations and the resilience of SMEs as agents of innovation (Castells, 1996) – leading to smaller, autonomous units of operation;
- interfirm networking and the growth of network enterprise – entrenching the idea of connectivity firmly in the operational and strategic management considerations of the firm and its stakeholders.

The different waves of innovation have affected nations and regions in different ways. The ability of firms, regions and indeed nations to learn from the waves is best considered through an overview of the systemic view in innovation literature.

Connectivity and the systemic view in innovation literature

Lundvall (1992) and others have focused on national innovation systems, while Saxenian (1994), Braczyk et al. (1998) and Cooke and Morgan (1998) have concentrated their attention on regional systems. Still others (Freeman and Soete, 1997) have studied technological systems. The basic proposition of this literature is that the study of the institutional context of the firm and its relations with other firms is as important as the study of the innovation process in a single firm.

The “systemic” view has as its antecedents the Marshallian (Marshall, 1920; 1923) notion of externalities where knowledge and its transfer to other economic stakeholders is a factor favouring spatial concentration of industries. The Marshallian idea of “knowledge spillovers” plays an important role in the regionalisation of innovation and is significant within both federal states (Audretsch and Feldman, 1994) and urban areas. Manifesting itself within supply chain relationships, horizontally related firms, transfer of people and their skills, shared pools of knowledge of markets, research, etc. – these spillovers are considered to benefit regions disproportionately. The economic rationale offered for the existence of such localisation (or indeed clusters) from Marshall (1920; 1923) to Weber (1929), Enright (1998), Krugman (1991), is to be
found in this idea of special benefits coupled with that of the unique presence of natural resources, all of which help to reduce uncertainties and risks associated with innovation.

Knowledge spillovers, inter-firm relationships, utilisation of shared resources, a well developed local skills base, and the evolution of the region through tacit and explicit knowledge exchange, are typical features of regional clusters. These features also provide the basis for social and economic “connectivity” that underlines the operation of firms in clusters.

**Clusters – comparative and competitive advantage of regions**

The definition of clusters is:

. . . groups of firms in the same industry, or in closely related industries that are in close geographical proximity to each other is meant to include geographically concentrated industries including so-called “industrial districts” (Enright, 1998, p. 337).

The geographic concentration of interconnected firms is supported by interconnected suppliers, downstream channels, customers, manufacturers of complementary products, and can also extend to companies with complementary skills (Porter, 1998). Clusters also include public institutions, including government education institutions, and support services, with cluster boundaries being defined by linkages and complementarities across institutions and industries (Porter, 1998).

The linkage between the idea of regional innovation and clusters lies in the understanding of the successful evolution of clusters whereby their formation, organisation and structure are themselves features of an innovation process. Various clusters have evolved from being “comparative advantage” (based on physical resources) players to being “competitive advantage” (based on learning and knowledge) to the way in which old clusters have overcome the loss of original locational advantage. Thus the replacement of water-power by electricity, wood by coal, and the easy availability of steel, did not prevent Solingen from continuing as a successful base for the cutlery industry. It achieved this through its reliance on the particular expertise of its workforce (Enright, 1998). At another point in the spectrum, the disadvantages of a poorer regional economy have not prevented Sialkot in Pakistan from being the second largest exporter (after Germany) of surgical instruments in the world (Nadhvi, 1998). In essence, therefore, the ability to identify, accumulate, utilise and recycle learning resources embedded in the region, has proven to be the major source of “competitive advantage” for many regions.

The consequence of innovative evolution has resulted in clusters attracting public and private finance, chambers of commerce and trade associations generating commercial market research, regional government providing industry-specific infrastructure, and local educational institutions doing industry-specific training and research. This combination of integrated and leveraged activity is often at the heart of innovation and collective learning as the literature on innovation highlights (Rosenberg, 1982; Malecki, 1991).

**Region-specific resources and activities**

What would have been regarded as the “invisible hand” factor supporting the success of specific regions in the past, can now be attributed to “softer” issues. Such “soft” issues include competitive technical and managerial expertise, explicit and tacit knowledge, the synergies derived from strong interaction in input-output linkages, collective learning, and what Capello (1998) describes as the “dynamic socialisation” process based on trust, openness, reciprocity and voluntarism. Such “softer” issues have a tangible force only if they are embedded in regional economic activity (Granovetter, 1985; Becattini, 1989) and which are almost impossible to duplicate.

The pressures, incentives, capabilities and competencies work through the collective learning, inter-firm linkages, and the play of region-specific resources that support region-specific activities. Enright (1998) building on Barney (1991) argues that just as a firm’s resource position can lead it to a position of sustainable competitive advantage if the resources are valuable, rare, imperfectly imitated and not subject to substitution, so can the region’s specific resources help to lead to sustained competitive advantage for the region:

As with firms, the region’s resources will be difficult to imitate if they depend on unique historical conditions, the link between resources and competitive advantage is causally ambiguous.
or the resources are socially complex (Enright, 1998, p. 322).

Region-specific resources are generated by the close linkages among flexible and specialised SMEs, often in the same industry contributing to the production of the same product group (Braczyk et al., 1998), as in industrial districts. The Gremi group’s idea of the “innovative milieu” posits a dynamic model in which the milieu is a complex network of informal relationships in a limited geographical area enhancing local innovative capability through “synergetics and collective learning processes” (Camagni, 1991). The “territorial ecosystem” of innovation model developed by Mitra and Formica (1997), highlights the spatial dimension to networking and learning among regional firms and institutions.

Developing a “learning system” model

The region-specific resources model does not necessarily explain how the learning relationships between firms and regions work. It is possible that a consideration of the region-specific view within what is described here as a “learning system” model can help us to address such relationships between firms and their wider regional environment.

Complexity, uncertainty and competencies

The “learning system” model is based on the notion that regional innovation, inter-firm interaction and alliances, trust and reciprocity are all part of a complex web of issues. The complexity is heightened by the considerable uncertainty in the external environment as well as within firms. Complexity and uncertainty are perhaps usefully dealt with when there is a range of competencies and capabilities within and among firms with which to use resources and generate common activities. “Competence building” (to achieve qualitative change, e.g. new firm creation, new product development), and “competency leveraging” (applying competencies to market opportunities or shared activities) are the actions taken by firms to generate learning resources. These competencies can then be utilized by “firm-specific assets” (assets exclusive to and tightly controlled by a firm) and “firm-addressable assets” (assets which it is able to draw on through networking) to manage “causal ambiguities” resulting from asymmetrical and ambiguous data gathered from an uncertain environment, and innovation. While “competency building” and “firm-specific” assets are part of the internal portfolio of a firm, “competency-leveraging” and “firm-addressable” assets are externalities which a firm is best able to manage and use through co-operation and interaction (Bellini et al., 1997). Firms in clusters learn to innovate through a systematic application of these competencies and use of these assets. The learning process is continuous and tends to take place even when innovations are not apparent (as in incremental innovations).

Learning and innovation

The generation, codification and transfer of knowledge are the essential elements of the “learning system”. Within a cluster the system is operational within and across firms through the dynamic exchange afforded by “competency building” and “competency leveraging”. As the cluster environment is conducive to innovation because of the availability of essential innovation “attractors” (skills and knowledge base, information access, capability of market conversion of ideas, knowledge and technological spillovers), learning for innovation is concerned with:

- the creation, adaptation and fusion of new ideas among firms and across the region (generation and competency building);
- re-use and reference of knowledge through continuous learning (codification and competency leveraging); and
- moving knowledge from one firm to another or between institutions and firms (transfer and co-ordination, and the move from firm-specific assets to firm-addressable assets).

SMEs and the “learning system”

The role of small firms in the “learning system” is based on both the “negative” and “positive” presumptions of SMEs. Thus the “negative” suggestions are that SMEs are too small and too resource constrained to develop adequate competencies within the organisation. Hence they are naturally dependent on externalities with their well-spring being within the firm and the company
domain. In these circumstances the core capabilities of the SME lie in their ability to learn, generate sufficient internal knowledge and to leverage their competencies with other firms, resources and institutions available externally.

Lacking in size, adequate resources and market power, SMEs have little direct control over their environment. They are, therefore, fundamentally dependent upon a series of critical relationships with both individuals and disparate organisations within a transactional or task environment, and in a social milieu. The management of this externality is a highly complex process, and unlike large firms, there is an absence of formal strategies for co-ordination and communication, and considerable dependence on supply chains and sub-contracting. The organisation and reorganisation of competencies become a function of the relationship with the outside world and of the learning process.

SMEs are critical constituents of clusters. While large firms may operate within clusters, their SME counterparts create the hub of learning often in association with large firms, and through co-operation and competition among themselves.

Convergence and paradox in clusters and the innovation process

The “learning system” approach helps us to identify a few other important features of clusters and their learning environment. The first feature is that of convergence. Longhi and Keeble (1998) have referred to the evidence of clusters found in European high-technology regional clusters in the 1990s. Convergence may be detected in sectoral structures through diversification, combination of technologies, and the rise of new micro clusters such as biotechnology, information and communication technologies, Internet applications, image processing, multimedia and computer applications. Convergence can also be detected in growth processes through spin-offs (endogenous growth) relative to external large firm investment, and in the proactive technology transfer policies and training programmes of universities, and development of regional collective enterprise.

The second extended feature is that of paradox. Clusters and SMEs in those clusters may be said to innovate through the management of paradox (Mitra, 1999). Paradox is evident in the globalisation-regionalisation tensions inherent in clusters. Successful clusters such as in the Silicon Valley, in Emilia Romagna, Basle, balance regional productive excellence with international market positioning. In fact empirical studies (Keeble et al., 1997, in Cambridge and Oxford; Formica and Mitra, 1996, in London) have found that firms with above average international links have higher local linkage intensities and frequencies than their nationally oriented counterparts. Paradox is also evident in the need to mass customise products while concentrating on core competencies, and in the existence of both traditional and high technology based industries in the same cluster. Different levels of industrial/sectoral and technological convergence also provide for both increasing and diminishing returns, depending on the industry, within the same cluster environment.

The learning process involved in the building and use of competencies and assets help firms to identify issues of convergence and paradox, and manage the complexity and uncertainty of the external environment. Every attempt at developing a new product, a new process and a new market opportunity, is a function of this learning process.

Figure 1 illustrates the “learning system” approach to cluster based innovation incorporating the above-mentioned elements discussed above.

The evolutionary trajectories of clusters of high technology SMEs – a case study

In considering the different levels of “connectivity” in high technology clusters, an example from the UK is drawn to illustrate the nature, scope and type of connections in clusters or potential clusters. This example also provides the basis for a consideration of the learning process within and outside firms and the development of a systemic view of learning which could help both firms and the regions in which they are located to adopt effective management policies.

St Asaph, Denbighshire, North Wales

A picturesque small town in North Wales, St Asaph is characterised by small businesses, some of which have benefited from the focus
on high technology and innovation. The development of the optical cluster arose from the foresight and drive of Dr Lawrence Pilkington (brother of Lord Henry Pilkington) from the 1950s onwards. In 1957 he set up a “state-of-the-art” factory, which is now “Special Glass Ltd”, based on US technology.

The cluster

The optics cluster in St Asaph has 13 key companies, employing over 1200 people, with a total turnover of £120 million. Pilkingtons still owns (or is a major partner of) five of the businesses, employing 80 per cent of the work force. Ex-Pilkington employees run all the other eight businesses.

A total of 80 per cent of the turnover is from the “high” end of the high-technology optics businesses with the key technology being the convergence of glass technology and optical instruments to create “optronics”. The global export market is the main target of all firms, and although overall employment has not grown since the 1970s, the added value of firms has more than doubled. In the 1970s the two core businesses (“Special Glass” and “Pilkington Optronics”) employed around 1,000 people. Since then 500 traditional jobs have been lost and replaced by employment through high-technology spin-offs.

A Wales Opto-Electronics Forum, which was set up in the 1990s and now has a membership of 100, supports strong networking between the firms. Table I provides a picture of the nature, scope and distribution of the opto-electronics sector in St Asaph.

Underlying issues

The Optronics cluster in St Asaphs is a sophisticated example of clustering created out of the visionary ideals of the owners of a leading glass company. As a large firm led cluster, some of its interesting features include its “large family” style make up, its particular focus on high technology, and the manifestation of the convergence factor through two technologies and medium small firm interaction. As in all successful clusters, St Asaph attracts highly trained, highly paid quality of staff who help to boost the skills base of the region. Again, in common with well-known clusters, St Asaph Optronics enjoys a high level of networking which is institutionally supported by the Optronics Forum and the Welsh Development Agency (WDA). Through its recognition of opto-electronics as a key enabling technology, the WDA does more than support networking – it has linked strategic economic development policy to the interest of the cluster.

Since Pilkington opened up in St Asaph in 1957, as a single industrial base, the region has seen both the evolution of the company at the cutting edge and the emergence of a brood of small, high technology companies around the mother hen – Special Glass. The new firm formation alongside advances in productivity and convergent technologies, is
similar to the evolution of the wool cluster in Prato, albeit at a smaller scale. This also allows for economies of scale (groups of firms co-operating for international markets) and scope (variety of products and services through networks) to be realised, and reflects the convergent factors of combined technologies, growth processes and supportive infrastructure referred to by Porter (1998).

The evolution of the St Asaph cluster is closely defined in the sense that specialisation in optics and electronics defines the competency base of the firms and, synergistically, the region. The spin-off process enables the transition from competency building to competency leveraging more easily than a linear process of development because specific expertise is retained within the nexus of firms and within the region. Specific firms find it easier to deploy firm addressable assets from the larger network of kindred people and firms. The spatial dimension does not reflect natural resource advantage but the competitive advantage of highly specialised knowledge base. The regular spin-off process and the inter-firm linkages through technology, people and focused resources, also allow for collective efficiency, development of techniques for customer orientation and cumulative capacity. Innovation therefore is more likely to take place in such an environment with its enhanced skills and knowledge base, its infrastructure, and technology spillovers. Managing the innovation process for firms is to a great extent tied up with the externalities of networking, reliance and use of complementary technologies, skills and expertise, and operating in similar global markets.

The Optronics cluster also demonstrates the innovation paradox of growth not being confined to firms growing in size but rather through the spin-off process allowing many small firms to emerge in a fairly short period of time. The close cluster, regional phenomenon also has a global dimension in that most firms operate in international markets while having a regional network base.

**Some general observations**

In considering the St Asaph case study of clustering and the related learning process, some observations are worth noting:

- Different factors and incentives encourage clustering. The St Asaph model highlights “visionary leadership”
on Pilkington’s part. This can be compared to the “regional high technology excellence” model of Cambridge (Longhi and Keeble, 1998) or the “demand factor, large-firm-small firm mix” model of West London (Mitra et al., 1999). The way firms in such clusters learn and grow is to some extent dependent on the type of cluster in question.

- The organisational form is dynamic in nature and scope (allowing for different types of firms to emerge and evolve at different points in time, as for example the spin-offs in St Asaph. Thus the learning process is concerned with changes in the nature and scope of different organisations, which in turn is dependent on how these organisations interact.
- Technological, organisational, and skills convergence are essential to learning and the clustering process, as evinced in the focus on optronics in St Asaph.
- Convergence factors lead to the management of paradox, as in local networking for international markets, the development of internal competencies together with the management of external interfaces, increasing returns and economies of scope from upstream activities, especially with small firms as in the multiple portfolio of firms in St Asaph. The learning process is supported by convergence factors, and the emerging set of competencies helps to manage paradox and complexity.
- The management of externalities, convergence, paradox, coupled with the mix of skills base, infrastructure support, new firm formation and technological development, offer the best opportunities for learning, innovation and the realisation of competitive advantage, both at the level of the firm and at the level of macro-level policy making.

Conclusions and policy considerations

The objective of this paper was to explore the link between collective learning and innovation through clustering as an innovation management process for both firms and regions keen to build on the advantages of new technology and innovation. By studying the examples of clustering through an adoption of the “learning system” model of analysis, both the policy maker for the region and the manager of the individual firm can make decisions which are aimed at improving competitiveness capabilities.

In forming effective policies both at the level of the firm and the region, decision makers need to consider carefully the learning process inherent in the management of externalities, convergence issues, paradox, uncertainty and complexity. This is especially useful in the current economic climate. Through such a management process due care can be taken of the global-regional dichotomy, co-operation and competition issues, core competencies and divergent product base, increasing and diminishing returns, all of which appear to be taking place at the same time, often within the same industry. This helps to avoid hard line approaches that would claim, for example, that only those industries demonstrating increasing returns are likely to survive the competitive race. Managing paradox also helps to accommodate different agendas of stakeholders, especially within a cluster environment.

Ensuring transversal technological connectivity coupled with appropriate management know-how is perhaps adequately afforded through the adoption of a learning system which connects firms, their knowledge base, their learning processes and their competencies with the environment.

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