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Innovation and Clustering among Information Technology Firms in Melbourne[1]

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ABSTRACT *This paper investigates innovative activities, clustering and regional interaction of a group of Information and Communication Technology (ICT) firms in the metropolitan area of Melbourne. In order to make an evaluation of the regional innovation potential among the firms, a written questionnaire was sent to the selected firms. The focal point of the analysis lay in determining innovative activities within individual firms and degree of linkages between different firms. The results indicate that innovative relationships with customers and suppliers are stronger within the region and they tend to co-operate more on a vertical basis. However, the findings suggest that firms rely only partly on innovation partners within the region and to a considerable extent they are integrated in national and international networks.*

Keywords: innovative linkages, clustering, information and communication technologies (ICT), regional innovation, Melbourne.

Introduction

In recent years, increasing local and international competitive pressures, together with rapid progress in information technologies, have stimulated 'innovation-intensive' production in industrial countries. Information technologies have been among the fastest growing innovations in both production and use during the past four decades. The prospect for continued growth is also strong. These technologies embody innovation in materials and devices, in design and manufacturing techniques, and in the uses to which the technologies are put.

In information technology, like other industries, enterprises need to gather information on both the specialist needs of customers and the technical possibilities of meeting such needs. The performance of such high-tech enterprises is determined by creating value for the consumer through innovation. Innovation is fundamentally a learning process. Such learning by 'doing', by 'using', by observing from, and sharing with, others depends upon the accumulation and development of a wide variety of relevant knowledge. The strategic behaviour and alliances of firms, as well as the interaction and knowledge exchange between

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firms, research institutes, universities and other institutions, are at the heart of the analysis of innovation processes. In this context, degree of linkage and interaction between enterprises, universities, research institutions and other actors involved in the whole process become more important than ever.

Although much attention has been paid to the concept of national innovation systems, it is clear that many innovations take place at the regional or local level. There is extensive literature on the workings of sub-national innovation systems which emphasises the advantages of close proximity between producers, suppliers and support services in diverse industries concentrated in particular geographical areas.[2] In this way, small and medium sized enterprises have overcome the problem of limited resources by becoming a part of a larger social community such as Third Italy or Silicon Valley, and use localised knowledge networks to be innovative. They obtain size advantages through new forms of economic associations such as formal and/or informal networks, clusters, or joint ventures and strategic alliances. It is observed that small enterprises, being a part of a larger social community, have been very competitive and innovative.

This research contributes to empirical investigation of the innovative activities and linkages among ICT enterprises in the metropolitan area of Melbourne. The focus is on evaluating the interaction and degree of linkage between ICT companies with nationally based companies, and institutions such as customers, suppliers, universities and public research institutions. The methodology also permits some evaluation of the innovative activities of the firms and their assessment of the suitability of the local environment for innovation. The paper presents the results obtained from a survey carried out in Melbourne. It is the objective of this study to discover any clustering effect among the ICT companies located in the metropolitan area of Melbourne. Before presenting the empirical results, a brief introduction to the Victorian Government's ICT policy is necessary.

Victorian ICT Policy Framework

In recent years, there have been signs of a very positive attitude of the Australian federal government to the key importance of ICT. Nearly all state governments have recognised the importance of ICT to the future of their economies. Victoria has moved furthest in providing infrastructure to support exploitation of R&D. It has appointed a minister for multimedia to coordinate a strategy and project implementation framework. This has involved such investment in R&D exploitation as the establishment at RMIT of the Interactive Information Institute to create sustainable ICT products in collaboration with government, industry and the community. In this section, a brief introduction of these polices is given.

Vic21

As the information economy rapidly takes shape at the regional, national and international level, many countries have responded to future challenges by developing and implementing information industry strategies. In 1995, the Victorian state government responded to the challenges of the emerging global information economy by developing the Victoria 21 policy (Vic21).[3] The Victorian government was quick to identify the opportunities offered by the new information age. With traditional manufacturing industries in decline, the high technology and service sectors have rapidly become the growth poles for the future.

The government of Victoria's commitment to the information age was evident in its encouragement of an information industry base and multimedia in Victoria. The government believed that the Victorian economy has the opportunity to flourish not only as a major centre of value-adding and manufacturing industry, but as the leader in multimedia, communications and information technologies.[4]

The Victorian government has developed the Vic21 strategy to reflect its commitment to economic development for Victoria, and to build a coherent response to the challenges faced. The government's objectives have been to:

- transform the way in which government services are provided;
- establish a significant and growing information industry base in Victoria in terms of both hardware and multimedia content development; and
- ensure that all Victorians have access to quality on-line information technology and the necessary training and education to enable them to use it.

In general, Vic 21 provided a policy framework for the converging areas of information technology and telecommunications. This policy also developed in response to the high level of competition in the region, and for this purpose the Victorian government provided $A200 million to support the policy and project activity of Vic21. It also appointed the region's only minister for multimedia.

By 1996, more than $A380 million had been invested by the private sector in a variety of ICT industries. Also, major investment had been ploughed into the establishment of domestic service centres for the rapidly growing telecommunications and pay TV industries. There were also other major investments across the industry spectrum from such companies as Fujitsu, Ericsson, Foxtel, IBM, Hewlett-Packard, Martin Dawes, Olivetti, Logica and Nokia.[5]

To establish a clear direction and the appropriate targets for growth across Victoria's information economy, the government developed a strategic vision: 'Victorian firms will carve out a major role in the global provision of multimedia products and services, and the Government will use the power of communications technology and multimedia to transform the way it provides services to and communicates with the public'.[6] Underpinning the implementation of this vision have been the three objectives already mentioned. In addition to these objectives, there have been four inter-linking strategies. Project priority has been given to those actions that will promote development of the information industry in Victoria, particularly initiatives that offer opportunity for the private sector to link with government to develop content and services.[7] These strategies include:

- developing a growing cluster of firms and activities to position Victoria as a centre of excellence in the information industries;
- leading Victoria's transition to an information economy;
- taking government on-line by 2001; and
- making the government a best-practice user of information, communications and multimedia applications.

To support and implement its agenda, a public sector agency, Multimedia Victoria, was formed by joining units from the Department of Premier and Cabinet, Arts Victoria and Business Victoria. The agency has been established within the Department of State Development and has focused on strategy and project implementation. As mentioned, the government appointed the region's first

minister for multimedia and from 1996 established a major multimedia expo—Interact—to be held every year to showcase Victoria's multimedia content industry. In sum, the Vic21 strategy was a comprehensive policy supported by a strong commitment at the political, bureaucratic and industry level.

Connecting Victoria

After its victory in the state election of 1999, the Labour government put forward a new policy agenda for information and communication technology. Connecting Victoria is the government's strategy for growing the information and communications technology industry. The main aims of the policy are to position Victoria as the nation's ICT leader and to build Victoria as a knowledge economy. However, this strategy focuses more on small and medium-sized businesses and on regional and rural Victoria than Vic21. The government outlined six elements to its strategy to grow the ICT industry:[8]

- building a learning society;
- growing the industries of the future;
- boosting e-commerce;
- connecting communities;
- improving infrastructure and access; and
- promoting a new politics.

Through Connecting Victoria, the Labour government wants to create a social, as well as an educational and economic agenda for universal access to information and communications technologies.

One main focus of the new state government is on regional initiatives. The Department of State and Regional Development (DSRD) has responsibility for shaping policy for regional development and delivers programs to enhance economic and infrastructure development, investment attraction, job creation and community development in regional Victoria. Multimedia Victoria works with other groups in DSRD to achieve this. Some programs with a strong regional focus include:

- the Regional Infrastructure Development Fund;
- the Regional Connectivity Project;
- Connecting Communities; and
- VicOne.

These programs are designed to ensure that new technologies are helping regional Victorians overcome the tyranny of distance. They are to help regional businesses reduce the cost of servicing their customers, making it easier for them to find markets that were once too expensive or remote to reach.

In November 2001, the government of Victoria released a new ICT industry plan, *Growing Tomorrow's Industries Today*.[9] This document outlines how the Victorian government will work with industry to grow a globally significant ICT sector in the state. It claims that Victorian industry has internationally competitive expertise and products, and that Victoria produces world-class ICT graduates. The plan identifies Victoria as a global hub for research and development with several ICT clusters of excellence. In short, the four objectives of the plan are:

- the Victorian ICT industry generates substantial exports, jobs and wealth for the state;
- Victoria is home to internationally recognised and globally competitive ICT companies that are integrated into global industry supply chains;
- Victoria is an internationally recognised centre for ICT research, development and commercialisation; and
- Victorian industry fully leverages the competitive advantages provided by ICT.

The plan emphasises the importance of clusters of firms and the need to identify and promote these clusters.[10]

Research Context

In recent years, a great deal of research has been done on regional networks and regional clusters of SMEs.[11] These clusters are varied and created by different mechanisms. In general, they are a concentration of firms in particular sectors and localities. These are normally small geographical areas that have several firms (often SMEs) in the dominant industry or industries. 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.

In this context, connections, linkages and partnerships are key factors in distinguishing clusters.[12] The nature of the linkages between firms, customers, suppliers, distributors, agencies, and across sectoral boundaries influences the scope and purpose of various business activities and the innovation process, and often helps to determine the effectiveness of those connections at local, national and international levels.

The definition of clusters as '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'.[13] The geographic concentration of interconnected firms is supported by interconnected suppliers, downstream channels, customers, manufacturers of complementary products, and also extends to companies with complementary skills.[14] 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.[15]

As the literature abounds with theories dealing with clusters of high technology firms and/or innovative milieux, this paper does not deal with them at length.[16] The central idea is that the cluster of local firms can be defined as a geographically bounded concentration of interdependent firms, which means that the firms form a local production or social system. In this relation, Rosenfeld suggests a working definition for clusters as 'a geographically bounded concentration of interdependent businesses with active channels for business transactions, dialogue, and communications, and that collectively share common opportunities and treats'.[17] This definition emphasises that 'active channels' are as important as 'concentration', and that industry does not form a cluster if there are no active channels among firms.

Rosenfeld has identified a number of characteristics for a successful regional cluster.[18] These factors range from degree of R&D capacity, knowledge and skills to proximity of suppliers and capital availability. To summarise his points about the

key factors in the economic efficiency of a cluster, the following characteristics can be identified: specialisation, local networks, R&D and educational institutions, existence of a qualified workforce, access to local financial institutions, cooperation between firms, networks for acquiring other competencies, and local innovativeness. Based on the empirical survey and subsequent interviews of the firms in the metropolitan area of Melbourne, this paper looks at each of these in order to evaluate the characteristics of the regional cluster of ICT firms.

Methodology and Data

The ICT sector in Melbourne is heavily dominated by high technology business services, especially activities in the field of information, multimedia and communication technology. Despite the presence of some very large firms, the ICT industry is characterised by small firms of fewer than 20 employees. These firms face severe challenges in introducing new products and services.

In an attempt to identify any clustering effect and innovative behaviour of these small firms, a mail survey, supplemented by 10 interviews, was carried out in 2000. A total of 171 firms, mainly small and medium sized high-technology ICT firms, was selected in the CBD and surrounds of Melbourne. These firms belonged to the sectors of multimedia, software development and programming services, telecommunications, network and Internet services; the so-called ICT service firms. From the 171 firms, 48 useable questionnaires were received (a 28% response rate).

All the firms were asked whether they had introduced product and process innovations during the previous three years and how they rated various factors in the development of their new services, products and/or processes. Firms were also asked about their linkages with external partners, such as customers, suppliers, universities, and public research organisations. As growing numbers of authors allege that co-operating companies are more successful in innovation than those that do not maintain external co-operation, this paper concentrates on the innovative links of ICT firms with customers, suppliers and knowledge centres. In what follows, the results of this survey are presented.

Specialisation

It has been widely argued that regional industry clusters refer to geographical concentrations of firms in the same or related industries. In most of the cases, these clusters are specialised within one or more industries within the local region. Benefits that have been observed to flow from such clustering include: the creation of localised pools of specialised workers; the provision of inputs at lower cost and with greater variety; environments conducive to the formation of intermediate goods industries; and tacit knowledge that can be shared because it is concentrated 'external to the firm but internal to the locality'.[19]

While the Victorian ICT industry is not as big as the state's agri-food or automotive industries, it is still substantial in national terms. Victoria also has a strong position as one of Australia's key ICT exporting centres. Indeed, the Allen Consulting Group found that 14 of the top 50 exporters in the information industries were based in Melbourne.[20] Similarly, in many other key areas, Victoria has a large proportion of economic activity in the information industries.

In 1995, according to the government, the ICT sector produced $A534 million in new investments and $A200 million in new net exports for Victoria. Growth in

this sector, and the opportunities presented by multimedia, made it a priority for attracting new investment and facilitating exports and joint ventures. The Victorian government invested heavily in the sector; for example, the government provided $A32 million over the period 1996–98 for ICT development.[21]

In Victoria in general, and in Melbourne in particular, there are groups of firms with emerging specialisations in different sub-fields of ICT. Most of the firms in the present sample were focused in software engineering, multimedia, telecommunications or Internet services. Few firms were engaged in activities across more than one or two of these areas.

Local Networks

Innovation can be stimulated through interactive learning processes, both within firms and between firms in the supply chain (suppliers and customers). Local networks can link firms into regional clusters in order to take advantage of collective knowledge and access to a range of resources. These resources include knowledge embedded in institutions such as research institutes or universities, but also tacit knowledge that can be shared across firms through the movement of ideas and people. Local networks refer to firms that cooperate in a number of different ways, including through 'learning networks'.

In Melbourne, our survey and interview data suggest that while most ICT firms considered in-house R&D and sources within the firm as 'crucial' for their new product and/or process development, interaction with customers and suppliers was also a very important source of information and learning. Firms in the sample were asked to include only those close collaborative links that had been, or still were, of considerable importance to the development of the company. Data on the frequency of links, and interaction with the external partners, are presented in Table 1. The most important external links for competence development were those established with customers.

Table 1. Links and interaction with external partners ($N = 48$)

	Never	Seldom	Frequently	Always	Mean	Rank
Customers		3	20	25	3.46	1
Suppliers		12	28	8	2.92	2
Consultants	2	18	20	8	2.71	3
Foreign partners	7	8	25	8	2.71	3
Government	4	20	13	11	2.64	4
Other firms in same industry	6	16	19	7	2.56	5
Other firms in different industries	9	15	17	7	2.46	6
Trade associations	10	20	14	4	2.25	7
Research organisations	12	19	12	5	2.21	8
Universities	13	19	10	6	2.19	9
Informal contact with research organisations and universities	13	23	10	2	2.02	10
Training institutions	13	29	4	2	1.89	11
Venture capital firms	20	22	4	2	1.75	12

Note: 1 = Never, 2 = Seldom, 3 = Frequently, 4 = Always.
Shaded box: share of firms > 30%.

Clearly, the supply chain network extends beyond the local region. Nearly 34% of the firms reported suppliers located in other areas of Australia and 40% of the firms reported global suppliers. Data also suggest limited interaction with other firms in the same industry or other firms in related or different industries. When there was evidence of such interactions, it was usually at the national rather than the local level. This evidence suggests that local 'networking' was not a particularly important factor in the general business activities of these firms. This finding was underscored in interviews carried out with two firms located in the same city premises. The firms were engaged in a similar specialisation, yet there was no joint learning, no informal meetings, no exchange of ideas or discussion of common problems.

R&D and Educational Institutions

Another characteristic of a regional cluster is that it is likely to incorporate institutions engaged with R&D and training in areas relevant to the business activities of the firms in the cluster. Such institutions include local technology development centres, research centres and universities. This characteristic is particularly important when the cluster is a high-tech or a science-based cluster. Here both public and private sectors play an important role in setting up such centres to ensure growth of the local firms. These institutions are important in the cluster because they provide a range of human resource and technology development capabilities not otherwise available within individual firms.

There are several world class R&D and educational institutions in the area of ICT in Victoria. For example, Melbourne is home to Australia's largest public spender on communications R&D—Telstra—and private spender on R&D—Ericsson. In fact, eight of Australia's top 10 spenders on R&D are located in Victoria. Six universities in the city offer degree and other courses on various specialised aspects of ICT. One would expect local firms to take advantage of these pools of local resources.

Interestingly, of 48 firms surveyed, 12 indicated that they never had any direct interaction with a local research organisation (Table 1); and 13 firms reported that they had never had any interaction with the universities. Of the remaining firms, a majority (19 firms) reported that they had 'some' interaction with a research institution or a university. Only a few indicated that they had regular ('always') interaction with research organisations or universities (five firms with research organisations and six with universities).

The data also suggest that when such interaction exists with research organisations, the distinction between local and national links is comparatively weak. Interaction with research institutions was reported equally strongly at local and national levels, while for universities, surprisingly, it was stronger at the national level. This suggests that local firms look for expertise not only from local institutions, but also from national institutions. It seems that firms increasingly rely on computer-based information networks as sources of information and rely less on local scientific and technological capability. Firms do, however, take advantage of the local institutions' knowledge in the sense that the majority hired skilled employees who had trained at local universities. Firms considered these skilled employees to be 'crucial' for their innovative activities in developing new services and/or products.

Existence of a Qualified Workforce

The existence of a qualified and skilled workforce is another characteristic one would expect to find in a successful regional cluster. For a sector such as ICT, a range of skills is required. It is not only scientific and technical skills that are important, but also commercial, administrative, marketing and general business skills. It is also important to have access to both codified, formal knowledge skills as well as less formal skills and tacit knowledge. In particular, a high level of creativity is required if firms in the cluster are to build an entrepreneurial culture.

Most firms rated the existence of skilled employees as crucial. However, most also rated Melbourne as 'average' in terms of the availability of technically qualified labour in ICT as well as the availability of skills for business (see Figure 1). Given the apparent high quality of the educational institutions in Melbourne, it is surprising that these firms did not rate Melbourne more highly as a place for sourcing qualified ICT personnel. Their responses may reflect the general shortage of such skills and the way the workforce is quickly absorbed by larger, well-known

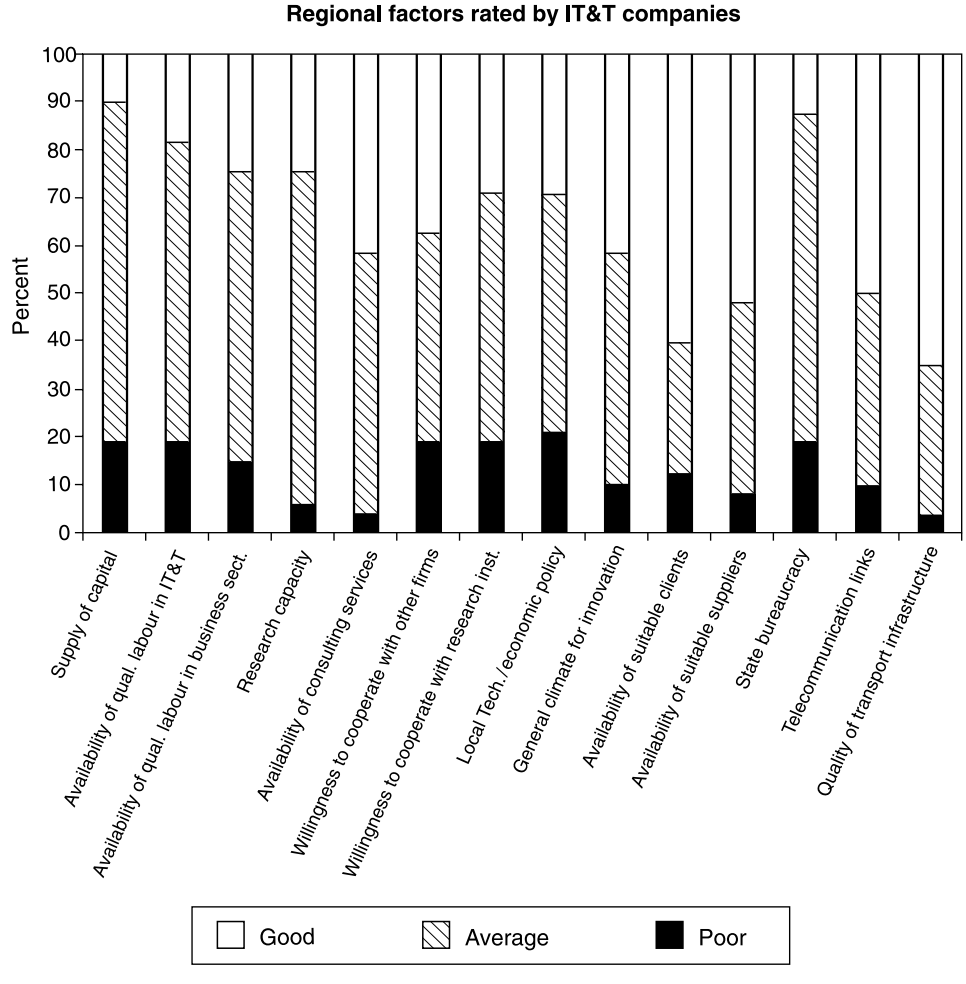

Figure 1. Assessment of general locational factors.

Table 2. Values in innovative activity ($N = 48$)

	Not valuable	Valuable	Crucial	Mean	Rank
Skilled employees	0	5	43	2.89	1
In-house R&D	0	10	38	2.79	2
Customers	2	18	28	2.54	3
Management	0	23	25	2.52	4
Sales and marketing	7	14	27	2.42	5
Suppliers	16	20	12	1.92	6
Trade shows	14	25	9	1.89	7
Outsourced R&D	18	23	7	1.77	8
Competitors	20	22	6	1.71	9

Note: 1 = Not valuable, 2 = Valuable, 3 = Crucial.
Shaded box: share of firms > 30%.

companies, able to provide better work and pay conditions. Smaller firms, in contrast, while offering interesting and creative opportunities, provide more of a risk for longer-term career prospects.

Although firms indicated that technically skilled employees and in-house R&D were the main factors in their innovative capacity, they also drew attention to the need for complementary management, sales and marketing skills (see Table 2). Of the 48 firms, almost half indicated management as 'valuable', while the other half indicated it to be 'crucial'. In the case of marketing, 27 firms reported it was 'crucial' while 14 firms reported it as 'valuable'. This illustrates the demand for a band of skills that include, on the one hand, a supply of technical and specialised skills (including research), and, on the other hand, a supply of high-level commercial skills.

Access to Local Financial Institutions

Another characteristic of a successful cluster is the easy access of firms to financial institutions. Being locally based ensures that financial institutions are familiar with the sector, with local management and marketing issues and with the range of constraints and opportunities available to firms in the region. This means that financial institutions can help to bring competency to firms.

In gaining access to capital, it is not only venture capital firms and private financial institutions that are important but also public authorities, public financial support mechanisms, and effective and reliable administration. Among the sample ICT firms in the present study, almost half indicated that they had used some form of public assistance. This assistance mainly comprised state and federal government assistance schemes and support for ICT and the use of the federal R&D tax concession scheme.

In terms of private financial institutions, the evidence suggests that more than half of the firms (27) had used funding from private financial institutions, mainly banks. In most cases these institutions were local. Far less use was made of venture capital firms. While half of the firms indicated that they had 'minimal' contact with venture capital firms, only six reported 'frequent' interaction with these firms. Although interaction with venture capital firms was low, it appears

that firms in the ICT sector are now working more closely with them. This is reflected in the growing number of venture capital firms operating in the locality during the last few years.

In summary, the availability of capital was rated by the majority of the firms (34) as 'average' in their local area. Nine firms responded that the supply of capital was poor, while five firms indicated that the supply was good. There is room apparently for providing more funds and assistance for these firms to help them to grow. As noted, the Victorian government recognises the role of innovation in science, technology, and ICT. In fact, innovation has been a catalyst for the continued growth of the telecommunications industry in Victoria. As a result, the government has allocated $A310 million over five years to boost science, technology and innovation in Victoria.

Cooperation among Firms

One of the important and ideal characteristics of any regional cluster is close co-operation between local firms and a variety of other institutions. This allows firms to form a localised system that demands and establishes mutual trust between firms and institutions, as well as within firms. In some regional clusters, certain 'meeting points' exist that make the informal exchange of experiences and ideas possible. This has been emphasised as an important feature in the success of Silicon Valley.[22] However, it also suggests, and this is discussed further below, the importance of lifestyle characteristics in emergent 'knowledge-hubs'.

When the Melbourne firms were asked if they exchanged ideas or experiences with other firms, a majority of them (32 firms) responded only 'occasionally' and only nine firms indicated 'often'. Seven firms responded that they never exchanged ideas or experiences with other firms. It also emerged that in many cases these informal relations came about through meetings organised by professional bodies or associations. It was interesting to find that proximity did not seem to play an important role in encouraging informal relations. Only five firms responded that their informal interaction was a product of geographical proximity (see Figure 2). However, professional associations did appear to provide both a forum and a catalyst for informal interaction.

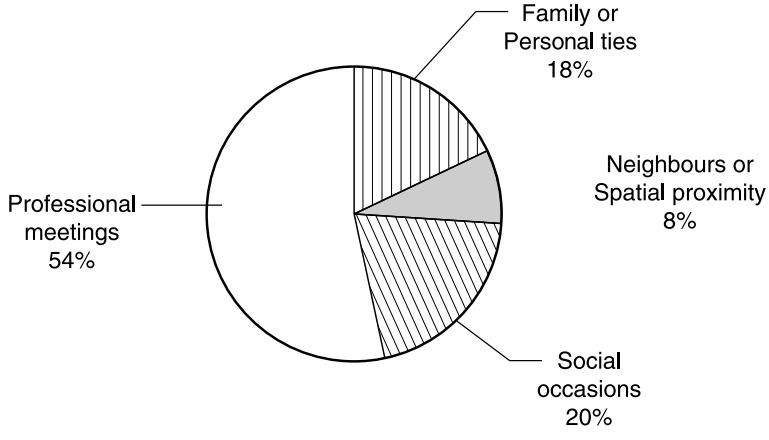

Figure 2. How do informal relations occur?

Nearly half of the sample firms reported that they had some form of formal agreements for collaboration with other firms. However, these 'other firms' were not necessarily local. Such agreements were distributed evenly across local areas, other parts of Australia and abroad. In short, while these firms had made a decision to locate their business in the Melbourne region, it was not in order to be close to other firms related to their business activities. However, the majority of the firms noted that having 'friendly contact and interactions' with local ICT firms could potentially be an important asset for their firm.

Networks for Acquiring Other Competencies

International evidence suggests that firms in a successful regional cluster will have contact with 'knowledge milieus' beyond their local region. In this way, firms can gain access to competencies (technological capability, know-how) not available in their local region. With established external connections, firms are more able to gain assistance with technology development and innovation when need arises. This enables a regional cluster to become even further specialised.

In the case of the ICT firms in Melbourne, the evidence indicates that firms rely primarily on their own internal capability for developing new products or services. Most firms reported that the main source of information for innovation support was 'within the firm'. This priority was followed by 'information from clients' (see Table 3). Other favoured sources of information included technology suppliers (purchasing equipment), hiring skilled employees and attending conferences. Most firms (35) had used consultants as a method for acquiring knowledge at some time over the past three years (Table 4). However, few firms reported contact with other national or local technology support agencies as a means of supporting their technology development. Only half of the firms in the sample reported contact with any technology support agency. While most firms reported relatively frequent contact with other firms in a different industry or in their own industry, these were mainly located in other parts of Australia.

Links with universities or government research institutes were also relatively weak. The majority of firms considered these institutions of minor importance as

Table 3. Sources of information ($N = 48$)

	Mean value	Rank
Sources within firm or parent company	3.6	1
Clients or customers	3.4	2
Computer-based information networks	3.12	3
Conferences, meeting, journals	2.69	5
Foreign partners	2.67	6
Competitors	2.6	7
Suppliers	2.6	7
Fairs, exhibitions	2.58	9
Consultancy firms	2.15	10
Universities/higher education institutions	2.12	11
Government/non-profit research institutions	2.08	12
Patent disclosures	1.75	13

sources of information. Half of the firms indicated that they had only minimal contact with any training institutions whether located in the local area or at the national level. In this context it is important to bear in mind that the present sample was comprised entirely of SMEs. As noted earlier, there is a small number of quite large firms operating in the IT sector in Melbourne and it has been reported elsewhere that there are several formal collaborative arrangements between Melbourne universities and these firms.[23] The location of these larger firms in the region and their contribution to clustering of professional expertise through teaching, research and business activities provide an innovative milieu that can have positive indirect benefit for the smaller firms in the region. Similarly, there is also the indirect contribution that universities or research institutes can make toward a regional cluster. For example, these institutions contribute to the local employment of highly skilled professionals. Given that the firms in our sample had only minimal direct contact with universities, it is the universities' indirect contribution to human resources and the formation of a professional milieu that is likely to benefit these smaller firms.

Local Innovativeness

The last typical feature of a cluster that we explored concerned the level of firm innovativeness. We expected to find innovativeness not only in the development and production of new products and services, but also in the creation of new firms and organisational changes in existing firms. Such innovativeness underpins competitiveness in global markets in ICT and contributes to creative business cultures.

Among the ICT firms in Melbourne, almost all reported that they had developed new products or services during the past three years. This suggests that these firms are innovative in their field. It may be relevant that a quarter of these firms took over another business over the same period (see Table 4). Over a third of the firms had obtained rights and/or licences from other organisations. The sample as a whole was therefore both innovative in terms of developing products, but also relatively innovative in terms of organisational change. However, the evidence does not necessarily confirm any collective reliance of these firms on locally based institutions for achieving these levels of innovation.

While the data do suggest that there is considerable interaction along the supply chain within the local region, it is at national and global levels where customers, suppliers, universities and research institutes are most likely to

Table 4. Methods of acquiring knowledge ($N = 48$)

Methods used	Number of firms
Hired skilled employees	47
Purchased equipment	41
Conferences, fairs, exhibitions, publications, journals	40
Used consultants	35
Obtaining rights/licences from other organisations	18
Contracted out R&D	16
Take-over of another business	12

influence their level of innovativeness. In other words, they appear to act both locally and globally.

Discussion and Conclusion

This paper sought to investigate the clustering behaviour of small and medium sized firms in the ICT sector in Melbourne. The objective was to see if we could find evidence of what might be described as a local innovation system. The study also examined the innovative behaviour of these firms, and particularly the innovative linkages in terms of the frequency and location of the partners. In terms of the existence of a local innovation system, the evidence was rather ambiguous. For example, co-location did not, in any straightforward way, appear to translate into collaboration. This suggests that these firms do not appear to operate in the typical innovation cluster suggested by the literature.

Localisation effects that are most closely related to possible levels of interaction within clusters were not rated as particularly important. These findings seem to suggest only low or intermittent levels of networking and collaboration within local concentrations of innovative firms. Taken together, the data tend to support the proposition that innovative firms in metropolitan areas, such as Melbourne, are gathered together not so much because they need to use strong intra-industry networks or linkages, but rather because they are making use of the multiple opportunities provided by urbanisation. These results further indicate that in metropolitan regions the levels of local networking and regular interactions are lower than might be expected from the theoretical literature in this area. Most of these innovative firms are not heavily dependent on local networking or linkages to support their innovative outputs. Instead, most of them are taking advantage of locality on an *ad hoc* basis.

These findings may also be contrasted with the reports coming from the policy community. As explained earlier, the idea of industrial clusters forming the basis of regional economic growth is strong in Victoria. Spatial concentration of firms in the same, or closely related, industries is seen by the Victorian government as key to international competitiveness in Australian's high-tech industries, such as information technology. Although there are concentrations of specialised industries in the Melbourne region, as this research suggests, it seems that the internal resources of the firms located there are key elements in enabling them to be innovative. These include financial, labour, and technological resources. The location of many such firms in the same area, even if only to satisfy simple logistic requirements, creates effective demands and larger markets for more of these important local factors of production.

Thus, despite the government's emphasis on clustering policy, it seems that for innovation and product development the existence of skilled employees, in-house R&D and finance are more crucial. As firms indicated, the existence of a localised human resource with strong technological capability is of great importance for their innovative activities. However, firms also indicated that for sales, marketing and management, the existence of demanding customers, together with complementary commercial skills, was also critical. These were reported as valuable factors in developing new services and products. In sourcing commercial skills and information, local, national and global boundaries were generally unimportant. Information gained directly from customers or potential customers was reported as 'very important for access to new or specialised information'. Such information was often sourced through the Internet, which also rendered location less critical.

Similarly, information from competitors concerning new products or processes was gained from fairs and exhibitions. But while these sources were primarily local, information was also gained through similar events elsewhere. Firms reported little use of support services provided by universities, research organisations or government-sponsored technology support agencies, whether local or further afield. Use of government technology agencies was rated very low and the majority of the firms indicated that they had never used support services provided by such agencies.

For the development or acquisition of new technology, distance was even less relevant. Public research institutions, and to some extent universities, do not appear to play any direct or important role in firms' innovative activities. Customers were reported as the most significant 'drivers' of their innovative activities and these were geographically dispersed. But while customers were considered very important, interaction with other local firms operating in ICT was limited. In other words, their interaction with other firms was business-based rather than locally based. Locality did appear important but in more indirect ways. A majority of firms indicated that they had some informal relationships with other firms. Many of these arose from personal contact or meetings organised by local professional bodies rather than directly through commercial or technical activities.

To what extent do these findings and observations throw light on the question of local innovation clusters? The evidence from the behaviour of ICT-based SMEs in Melbourne suggests it might be helpful to consider different innovation activities occurring across different geographically based domains. For example, location appears important for acquiring tacit knowledge and keeping up to date with professional developments and practices. A pool of locally based technical personnel and local professional forums were both important for technological and business capability development. In both cases, it was the flow of tacit knowledge rather than codified knowledge that was gained by location. A professional environment attractive to people with similar interests appeared as an additional lifestyle factor providing a clustering advantage. But at the more formal level of providing direct technical training or R&D assistance, it was the national system of higher education rather than local institutions that appeared more significant. In gaining access to new technologies, whether through licensing or other mechanisms, the significance of local, national or global boundaries appears even less material.

This does not mean that geographical location was unimportant. It was important for the Melbourne firms because it provided a hub for the dissemination and application of technologies produced there to firms located elsewhere in the state. Government policy and the co-location of some large firms and educational institutions in the locality combined to create a local professional environment conducive to innovation. This suggests that the boundaries around innovation activity for these firms were rather fluid. For some innovation activities, locality was a salient feature; for others, the national boundary was more significant. For some activities, there were no boundaries; they took place within the global domain.

Notes and References

1. An earlier version of this paper was published in T. Turpin *et al.* (eds), *Innovation, Technology Policy and Regional Development*, Edward Elgar, Cheltenham, 2002.
2. See, for example, P. Cooke *et al.*, 'Regional innovation systems: institutional and organisational dimensions', *Research Policy*, 26, 1997, pp. 475–91; A. Amin and N. Thrift

(eds), *Globalization, Institutions, and Regional Development in Europe*, Oxford University Press, Oxford, 1994; A. Isaksen, 'Regional clusters and competitiveness: the Norwegian case', *STEP Report R–16*, STEP, Oslo, 1996.

3. Liberal Party, *Victoria 21: Into the Information Age, The Connected Community*, Victorian Liberal Party Policy Document, Melbourne, 1996.
4. S. Braim, 'Policy evolution in the information economy: an assessment of the Victoria 21 strategy', *Telecommunications Policy*, 22, 4/5, 1998, pp. 443–52.
5. *Industry: Growth and Jobs in Victoria*, Victorian Liberal Party Policy Document, Melbourne, 1996.
6. Braim, *op. cit.*
7. *Ibid.*
8. J. Brumby, *Connecting Victoria: The Victorian Government's Strategy for Information and Communications Technologies*, Ministerial Statement, Department of State and Regional Development, 1999.
9. Government of Victoria, 'Growing tomorrow's industries today', *Information and Communications Technologies Plan 2001*, Department of State and Regional Development, Melbourne, 2001.
10. *Ibid.*
11. See, for example, OECD, *Boosting Innovation: The Cluster Approach*, OECD, Paris, 1999; M. Storper, *The Regional World: Territorial Development in a Global Economy*, Guildford Press, New York, 1997; J. Simmie and J. Sennett, 'Innovative clusters: global or local linkages?', *National Institute Economic Review*, 170, 1999, pp. 87–98.
12. R. Camagni (ed.), *Innovation Networks: Spatial Perspectives*, Belhaven Press, London, 1991; M. Porter, 'Clusters and competitiveness', *Harvard Business Review*, 76, 1998; M. Enright, 'Regional clusters and firm strategy', in A. D. Chandler, P. Hagstrom and O. Solvell (eds), *The Dynamic Firm: The Role of Technology, Organisation and Regions*, Oxford University Press, Oxford, 1998; P. Cooke and K. Morgan, *The Associational Economy: Firms, Regions, and Innovation*, Oxford University Press, Oxford, 1998; J. Mitra, 'Making connections: innovation and collective learning in small businesses', *Education and Training*, 42, 4/5, 2000, pp. 228–36.
13. Enright, *op. cit.*, p. 337.
14. Porter, *op. cit.*
15. *Ibid.*
16. See, for example, Camagni, *op. cit.*; Cooke and Morgan, *op. cit.*; A. Markusen, 'Sticky places in slippery space: a typology of industrial districts', *Economic Geography*, 72, 3, 1996, pp. 293–313; T. Padmore and H. Gibson, 'Modelling systems of innovation: II. A framework for industrial cluster analysis in regions', *Research Policy*, 26, 1998, pp. 625–41; R. Rabellotti, 'Is there an industrial district model? Footwear districts in Italy and Mexico compared', *World Development*, 23, 1995, pp. 29–41.
17. S. T. Rosenfeld, 'Bringing business clusters into the mainstream of economic development', *European Planning Studies*, 5, 1, 1997, pp. 3–23.
18. *Ibid.*
19. E. Ehrnberg and S. Jacobsson, 'Technological discontinuities and incumbents' performance: an analytical framework', in Charles Edquist (ed.), *Systems of Innovation: Technologies, Institutions and Organisations*, Cassel, London, 1997, pp. 318–41.
20. G. Bougias, *Better Understanding the Information and Communications Technologies and their Role in Victorian Society*, Information Economy Statistics Research Project Report, Multimedia Victoria, Melbourne, 2000.
21. Liberal Party, *op. cit.*
22. A. Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA, 1994.
23. T. Turpin *et al., University and Industry Research Partnerships in Australia: An Evaluation of ARC/DEETYA Industry Linked Research Schemes*, Higher Education Division, Department of Education, Training and Youth Affairs, Canberra, 1999.