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Exploring the role of proximity in SME knowledge-acquisition

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Abstract

Knowledge-acquisition activities of small- and medium-sized enterprises (SMEs) are assumed to benefit from geographic proximity to similar firms and centres of research excellence. This paper will explore the knowledge-acquisition processes and critical interfaces of innovative SMEs and outline factors that contributed to an observed lack of geographic proximity-based knowledge search activity. A growth path based upon innovation driven, rapid internationalisation and subsequent customisation strategies fostered organisational proximity-based knowledge-acquisition from international sources. It is argued that local contextual factors will determine if organisational or geographic proximity (or both) are the key to knowledge-acquisition. The recognition of a diversity of potential growth trajectories is recommended for SME policies.

Keywords: Geographic proximity; Organisational proximity; Knowledge-acquisition; SME growth; Regional policy

1. Introduction

Small- and medium-sized enterprises (SMEs) traditionally have been thought to benefit from collaborative knowledge-based activities in geographic regions based on the presumption that it is easier to mobilise the complementary resources and capabilities embedded in localised networks. Cluster research, for example, was developed following the observation of extraordinary productivity in certain industries in specific regions, such as in Northern Italy and Silicon Valley, where knowledge sharing between organisations in close geographic proximity appeared to have been a key source of advantage. Exploiting the inter-organisational benefits of geographic proximity now underpins a huge variety of policy initiatives as governments attempt to develop the regional advantages for national economic growth.

There is little doubt that geographic clustering has been a major contributing factor historically in the growth of many regions. In addition, there is evidence that firstly, the clustering of innovative activities correlates with productivity (Paci and Usai, 2000) and, secondly, that firms in clusters do innovate more (Baptista and Swann, 1998). However, like McKelvey et al. (2003) this paper addresses the validity of co-location arguments related to knowledge generation and innovation. In particular, the question is asked as to whether it necessarily follows that close geographic proximity to

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complementary knowledge and capabilities plays a part in SME innovation in all situations. If geographic proximity is not always fundamental to SME innovation, what factors might indicate the suitability of, or drive the development of, alternative knowledge-acquisition strategies?

The objective of the paper is to explore the way in which a sample of innovative manufacturing and service SMEs based in New Zealand accessed the knowledge that was key (as described by the SME managers) to continued innovation. All the firms studied grew on the back of a significant innovation and most are now 'international' in character in that they export virtually all of their production. Although most of the firms worked with local New Zealand suppliers, very few of these were described as key knowledge sources.

In order to understand better the role of proximity, the knowledge-acquisition processes will be described according to the critical interfaces employed to access and develop crucial knowledge bases. Whether these interfaces were reliant on geographic or organisational proximity provides the basis for a discussion of the impact of proximity and potential factors that might explain the observed lack of geographic proximity-based knowledge-acquisition activity.

Whilst the size of the sample used in this research can only result in the development of exploratory insights into this apparently non-localised knowledge-acquisition behaviour, particularly with respect to small-firms in small countries, the paper will attempt to develop some propositions regarding SME growth and innovation, which take into account factors that might trigger a growth trajectory that does not exploit geographic proximity to knowledge sources.

2. Knowledge-acquisition and proximity

Knowledge-acquisition is one part of knowledge management which, in turn, has been defined as "the process of critically managing knowledge to meet existing needs, to identify and exploit existing and acquired knowledge assets and to develop new opportunities" (Quinstas et al., 1997). There has been relatively little research reported on knowledge management and acquisition in SMEs (McAdam and Reid, 2001; Liao et al., 2003). Even from start-up, firms develop mechanisms for external learning (Almeida et al., 2003) but different national, institutional and firm factors (Mason et al., 2004; Hemmert, 2004) have significant influence on favoured knowledge-acquisition modes.

External knowledge-acquisition can occur in a variety of ways (Almeida et al., 2003), including the hiring of technical staff and through informal or formal collaboration and alliances. Geographic proximity to the knowledge sources with which the organisation is collaborating is generally assumed to assist knowledge-acquisition. Much of the advantage of such collaboration is thought to come from efficiencies in collective learning (Belussi, 1999), particularly for innovative firms. Whether understood as generating economic externalities or spillovers of R&D (Krugman, 1991; Audretsch and Feldman, 1994; Feldman, 1994) or facilitating inter-organisational transmission of tacit knowledge via social capital (for example, Powell et al., 1996), geographic proximity is thought to be important for innovative activity. "Since knowledge is generated and transmitted more efficiently via local proximity, economic activity based on new knowledge has a high propensity to cluster within a geographic region" (Audretsch, 1998).

Any exploration of geographic proximity leads directly to studies of successful knowledge sharing clusters. In 1998, Michael Porter stated, "today's economic map of the world is dominated by what are called clusters" (Porter, 1998). Localisation, regional innovation systems, industrial districts, learning regions, local production systems and agglomeration economies are other labels given to the phenomenon of geographically co-located firms in a value chain collaborating in some fashion in order to gain a measure of collective efficiency (Rabellotti and Schmitz, 1999). The observation of regional agglomeration economies is not new with most writers referring back to Marshall's work *Principles of Economics*, originally published in 1890 (Marshall, 1986; Keeble and Wilkinson, 1999). A rise in the number of studies of industrial districts and small-firm led economic growth in the 1980s combined with the increase in interest in 'networks' and social aspects of inter-organisational interaction (Granovetter, 1985; Burt, 1987, 1992; Gulati, 1999) is the result of renewed activity on the part of scholars in such disciplines as economics, planning, sociology, strategic management, organisational behaviour and business history (Harrison, 1991). The seeming paradox of the rise in "importance of local proximity and geographic

clusters precisely when globalization seems to dominate the economic activity" has been attributed to the fact that more innovative activity is associated with high-tech SME clusters than with "footloose multinational corporations" (Audretsch, 1998).

Definitions of clusters range from those that defer mainly to the geographic collectivity ("geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998)) to those that emphasise the knowledge sharing aspects of such groupings:

"Firms and organisations involved in clusters are able to achieve synergies and leverage economic advantage from shared access to information and knowledge networks, supplier and distribution chains, markets and marketing intelligence, competencies, and resources in a specific locality . . .. The modern concept of clusters involves integrated and often dissimilar firms and public agencies/institutions specialising and collaborating on R&D, innovation, commercialisation and marketing to produce a range of new or re-engineered products and services" (Enright and Roberts, 2001).

According to these theoretical approaches then, geographic proximity is a central factor in understanding firm-level knowledge-acquisition and innovation. However, geographic proximity is only one type of proximity. Lemarié et al. (2001) contrast geographic proximity, defined as "spatial separation and relations in terms of distance", with organisational proximity, which is based upon affiliation (actors belonging to the same relational area in which different kinds of interaction take place) and similitude (actors resemble one another). Both forms of proximity can enhance the sharing of tacit knowledge in the innovation process but much of the cluster debate seems to assume that geographic proximity alone should be sufficient. In fact, it is likely that the benefits of clusters often arise when the two types of proximity occur coincidentally. However, organisational proximity can also occur without co-location of firms.

The fact that co-located collaborative activity varies in different industries has been recognised for sometime, and is usually attributed to differences in the spatial location of production (for example, Audretsch and Feldman, 1994). Of the other studies that have found evidence of non-localised knowledge collaboration, many have been focused on the biotechnology industry (for example, McKelvey et al., 2003; Fontes, 2003; Lemarié et al., 2001). It might, therefore, be tempting to attribute the lack of co-location tendencies to specific characteristics of this 'new' industry, although the authors highlight other contributing environmental and contextual factors in the countries or regions in which their study firms were located, as also probably contributing to the phenomenon.

Variations in other organisational behaviours, such as approaches to innovation, may also be a factor. While co-location has been found to increase innovative activity in some studies (for example, Baptista and Swann, 1998) other researchers have questioned a universal correlation between geographic proximity and innovation. Hassink and Wood (1998), for example, found that, while geographic concentration of the opto-electronics industry was occurring in parts of Germany, this co-location did not necessarily lead to R&D collaboration and innovation. Beal and Gimeno (2001) found that "localised knowledge spillovers appear to reduce firm-level commitment to R&D", that is, that geographic proximity allows firms to displace their own knowledge generation activities with those of other local firms so that any increasing firm-level innovative output may be only transient.

The growth stage of the industry has also been suggested as a moderating influence in the relationship between geographic proximity and firm innovation. Tacit knowledge, it is argued, is more important to innovation in the early stages of an industry's life cycle and, as geographic proximity enhances the flow of tacit knowledge, agglomeration effects are also more likely in earlier stages of industry life cycles (Audretsch and Feldman, 1996). In their study of start-ups, Almeida et al. (2003) found that external learning through geographic co-location decreased with firm size. Hite and Hesterley (2001) argue that as a firm grows a shift occurs from 'identity-based' to more intentionally managed networks, which would mitigate against co-location occurring in more mature industries. Other factors that may work against geographically proximate knowledge-acquisition activities include the role of foreign firms and multi-nationals (Enright, 2000; Lemarié et al., 2001; Kearns and Görg, 2002) and the use of the ICT technologies (Howells, 1990; Zaheer and Manrakhan, 2001).

A significant amount of the co-location and cluster research reported revolves around identifying implications for, and policy suggestions for, regional policymakers with economic development intentions (for example, Belussi, 1999; Enright, 2000; Feser and Bergman, 2000; Morgan, 1997). However, there is a danger in the increasing pervasiveness of such policies in that the underpinning rationale has tended to be based upon the 'unquestioning acceptance' (Tallman et al., 2004) of these studies of successful, and often long-standing, clusters in certain regions (e.g. Northern Italy, Lazerson and Lorenzoni, 1999a,b) or nations (e.g. the USA). Wever and Stem (1999), for example, noted that technology intensive SMEs in The Netherlands had national rather than local networks and thus, they argue, "we should be careful about transferring research findings from one spatial context to another". Such research exposes the limits of a regional approach to high-technology SME growth even within Europe, let alone in other parts of the world (Rabellotti and Schmitz, 1999). Despite such examples, the transferability of such policies across all regions and nations is not often questioned, even though clustering policies are promoted in, and need to be sympathetic to the local characteristics of, developing regions such as Africa, Asia or Central America (Ceglie et al., 1999; Schmitz, 1990).

Perhaps before the implementation of these policies, questions should be raised about why localised agglomerations of collaborating firms have not developed, or have to been slow to develop, without government intervention. In this way, regionally based SME policies, if still deemed appropriate, might be tailored upon a firm understanding of the parameters of the specific locale (Marceau, 1999). This paper describes an exploratory analysis of the local factors and conditions in New Zealand that may have influenced the non-localised knowledge seeking practices of a sample of innovative SMEs, and proposes that an alternative growth path for such SMEs has mitigated against the knowledge-acquisition activities based on geographic proximity.

3. The research project

The exploratory research presented in this paper is part of a large-scale, longitudinal, multi-disciplinary, multi-investigator, research programme into the evolution of competitive capability in selected New Zealand firms (Campbell-Hunt et al., 2001). The objectives of the programme are to develop theory on the evolutionary processes that have influenced firm growth, based on a purposive sample of a few in depth case histories (Eisenhardt, 1989). A small number of firms were selected, with the advice of an advisory panel of business leaders, as exemplars of firms with a long history of sustained competitive success. A second group of firms was selected to include the examples of more recently established exemplar firms that had been recognised as such through local business awards. Given our interest in the long-term development of these firms, historiographic methods of investigation (Goodman and Kruger, 1988) were employed in order to assemble rich contextual material on the environmental conditions in which the development of the firms occurred (Pettigrew, 1990). Case study histories of the development of each firm were written, based on extended interviews with owners and managers. All of these interviewees had extensive experience of the firm in senior positions, stretching back several decades in many cases.

The limitations of data derived from participants' recollected accounts were discussed by Huber and Power (1985). We followed many of the procedures they recommended to minimise the motivational, perceptual and informational limitations they identify. For example, we sought factual information relating to past events, in addition to the managers' construction of them, in an attempt to improve our respondents' recall. Interviews were attended by a case writer and at least two of the research team, drawn from different disciplines. In this way, we acquired multiple-researcher, multi-disciplinary perspectives on each interview (Eisenhardt, 1989). Drafts of the histories were corrected and commented upon by our sources. By producing narrative histories of each firm prior to any attempt to undertake cross-case analysis and to develop propositions on the evolutionary processes, we sought to maintain the distinctive value of both forms of historical research (Dray, 1985), and to lessen the study's exposure to problems of self-selecting sources and interpretations (Fischer, 1970).

The catalyst for the line of enquiry reported in this paper was the observation that those firms in

Table 1
Characteristics of the sample firms

Firm	Industry/percentage of sales exported (where known)	Employees/location/year formed	Knowledge-acquisition activities
Atech	Electronic products 80	250 Hamilton 1938	R&D (internal)/merger or acquisition/customer—distributor (international)
ARtech	Computer simulation products (not known)	50 Dunedin 1989	R&D (internal)/merger or acquisition/customers (agents)/complementary NZ organisations (intra-sectoral)
Bprod	Beverages 40	600 Various 1934	R&D (internal)/customer-distributor/international consultants (intra-sectoral)
Ctech	Industrial chemicals 70 (of NZ production)	150 Auckland/Australia 1952	R&D (internal)/customer (and customer's customer)-distributor/international technology networks (intra-sectoral)
Etech	Electronic products 80	120 Marton 1939	R&D (internal)/customer-distributor (international)
Ftech	Industrial furniture 60	110 Wellington 1956	R&D (internal)/customer-distributor (international)/contractors (designers)
FStech	Orthotic products 80	14 Christchurch 1982	R&D (internal)/customer-distributor (local and international)
Itech	Equipment for chip industry 100	150 Auckland 1986	R&D (internal)/international consultants (also act as agents)
Jtech	Software systems 90	350 Christchurch 1996	R&D (internal)/customer-distributor
Ltech	Navigational lights 90	19 Wellington 1972	R&D (internal)/customer (international)
Ptech	Communication componentry 95	180 Wellington 1977	R&D (internal)/customer-distributor (international)
Rtech	Laboratory equipment 99	8 Auckland 1968	R&D (internal)/customer-distributor (international)
Ttech	Communication products 90	750 Christchurch 1969	R&D (internal)/customer-distributor/R&D (public)
Xtech	Wireless communications products 95	80 Wellington 1996	R&D (internal)/customer-distributor (international)/international networks (intra-sectoral)
Ytech	Navigational equipment 95	145 Auckland 1988	R&D (internal)/customer-distributor (international)/supplier

the study that had reputations for being highly innovative did not appear to focus their knowledge-acquisition activities neither in the local region nor in New Zealand. We interrogated the case studies and interview transcripts for descriptions of important or key knowledge-acquisition strategies and processes of these firms, according to the managers interviewed, and for evidence of any geographic proximity characteristics in this activity. Of the total sample in the overall project, 15 firms were selected for detailed study for this research because of their particular strengths in technology, innovation and design and, therefore, would be expected to have well-developed knowledge-acquisition processes aimed at continually improving the firms' products (Liao et al., 2003). With two exceptions, all are small-to-medium-sized enterprises, employing between less than 250 people. The two older (and consequently larger) firms were also selected in order to include their earlier and similar SME experiences. Company names are disguised in this paper, but a general description of each firm's knowledge-acquisition characteristics is given in Table 1.

4. The New Zealand innovation environment

The innovation environment in which these New Zealand firms operate is very different from other OECD nations and the following description will provide the context for the discussion of knowledge-acquisition behaviour. Of the approximately 300,000 enterprises in New Zealand, one-fifth are farms. Of the remaining enterprises, 96% employ 19 or fewer full-time equivalents (FTEs) and 84% employ five or fewer FTEs (Ministry of Commerce, 2000, includes sole operators). The average size of New Zealand firms, therefore, is six FTEs, which would be expected to constrain innovation by limiting the number of organisations that have the ability to resource or perform R&D, or have the technological literacy to be able to acquire the technological knowledge.

Although most New Zealand firms are apparently as innovative as their European Union counterparts (Statistics New Zealand, 2002[1]), with 68% of firms reporting that they had introduced a product and/or

[1] This study only surveyed firms with more than five employees.

process innovation within the last 3 years, very few of these firms would be considered to be 'high-tech' or would invest in R&D at international norms. About 1% of GDP is spent on R&D in New Zealand (Ministry of Research, Science & Technology, 2002), of which about two-thirds is public sector spending. Thus, about 34%, or about NZ$ 324 million[2], is spent by the private sector, which is very low in comparison with the OECD average of 60%. Although recent data was not available, in the mid 1990s seventy firms accounted for 65% of New Zealand's business spending on R&D.

Another local peculiarity is that the highest R&D spending firms are not necessarily New Zealand's largest enterprises. Firms under 100 and 500 FTE accounted for 42 and 82% of business R&D spending in 1999/2000, respectively, while firms over 1000 FTE accounted for only 7%. This very low figure for large firms reflects the lack of large-sized firms in New Zealand, particularly multi-nationals[3], in which much of the international R&D spend is concentrated (MoRST, 2002). Most R&D in firms employing less than 100 FTE is performed in service industries such as computer and communication activities (sectors which have also seen the highest growth rates in R&D spending in recent years) while that in larger firms is concentrated in more traditional sectors such as machinery and transport equipment and food related industries. The highest R&D intensity is seen in the radio, TV and communication equipment industries at 18.4% of value added. However, the overall manufacturing R&D intensity is 1.3%, in comparison with the OECD average of 6.7 %, reflecting the low-tech nature of most of the New Zealand's firms.

For this study, the regional nature of the innovation environment is also relevant. New Zealand's population density, a factor that alone may affect the propensity for co-location to occur, is around 14/km^2, which is fairly low in comparison with most OECD countries but similar to that of Norway, Finland and Sweden (Davenport and Bibby, 1999). Seventy percent of business expenditure on R&D is concentrated in three regions; Auckland (where more than a third of the population lives) with about 32% of business R&D, Canterbury with about 22% and Wellington with 17%. If significant concentrations of knowledge-based collaboration were to have evolved without intervention, then it might be expected that they would be found in these regions.

Despite this rather gloomy portrayal of a New Zealand innovation environment, consisting of predominantly low-tech industries populated by low R&D spending enterprises, there are individual companies that are world-leading. The low national figures are a consequence of the small proportion of firms investing in R&D but studies have shown that those firms that do engage in R&D often do so at close to international best practice levels (Davenport and Campbell-Hunt, 2001). In addition, these firms were more often focused on international rather than domestic markets and followed the strategies of market leadership or niche marketers (Johnston et al., 1994; Statistics New Zealand, 2002). It is to this group that most of our study firms belong.

5. Knowledge-acquisition activities of New Zealand SMEs

In this section, the firm's general approach to innovation, termed the 'knowledge-embedded solution', is described. In order to explore the role of proximity in knowledge-acquisition, attributes of this innovation approach are then discussed according to the type of interface (internal, external intra-sectoral, external inter-sectoral and public research) used to acquire knowledge and develop key knowledge bases. These interfaces are an expansion of Carrincazeaux et al.'s (2001) three critical interfaces – internal, external and public research, where the use of the term 'critical' emphasises how important it is for these interfaces to function effectively for innovation.

The New Zealand firms in this study are distinctive for many reasons, not only for being small or for being based in a country located far from major world markets. They have achieved remarkable levels of internationalisation with a very tightly focussed product portfolio and have offshore sales typically exceeding 90% of total (Table 1). Market participation is usually very broad, with sales in 50–60 countries around the world, and the firm often has the leading market share in their specific niche product area.

[2] At the time of writing, NZ$ 1 = 0.55€.

[3] New Zealand has only one such firm in the relatively low R&D intensity dairy sector. High R&D intensity sectors such as pharmaceuticals, communications equipment and aircraft are not represented in New Zealand by multinational firms.

The reason behind this high level of internationalisation, despite the small size of the firms and distance to markets, can be traced back to, in each case, the development of a world-leading or often world-beating proprietary product or service encompassing innovative technology, knowledge or design (Campbell-Hunt et al., 2001; Davenport et al., 2003). Many of these first vintages of innovations were the result of the creativity of the entrepreneur sometimes in conjunction with very small-scale rudimentary in-house R&D or engineering capabilities. Finding, often to their complete surprise, that they had such innovative products on their hands, the firms were then launched onto high growth trajectories, which put operating systems under great pressure and reshaped the existing capabilities of the firm (Corbett and Campbell-Hunt, 2002; Davenport et al., 2001).

Thus the first innovation, which launched the firms, was primarily the result of a knowledge base internal to the firms. For example, for Atech the innovation took the form of leading technology in mains-powered electric fencing systems; an innovative computer operating system launched Jtech internationally; and far exceeding the specifications demanded in a procurement tender by a major US Government Department established Ltech as a major competitor internationally in their product-line.

The world-leading innovation enabled the possibility of expanding the geographic scope of the firm well beyond the home market. Depending on the nature of the innovation, some firms chose to restrict geographic scope to certain regions, such as Australiasia, while others became global leaders (Campbell-Hunt and Chetty, 2002). Having survived the intense growth stage that rapid internationalisation catalysed, the challenge for many of the firms became the maintenance of innovation in order to fend off or outmanoeuvre the competition (Corbett and Campbell-Hunt, 2002), the latter being in the form of organisations that were often orders of magnitude larger in size and R&D resources.

Almost without exception, the firms developed an approach to product development that could be called ‘knowledge-embedded solutions’ to customers’ problems (Davenport, 2001). Rtech’s and Ftech’s approaches are typical:

“Customisation is one of [Rtech’s] main selling virtue’s. Rather than presenting customers with a product, the company works with customers to find a solution which suits them . . . it’s continual innovation” (Rtech).

“Obviously we offset price with the fact that we design and build solutions. We do not try to squeeze a customer into a product that we make if it is not quite right, we will move the product to fit the client. It is pretty important too that we are a design house as well as a manufacturing plant . . .. I do not think you win any big jobs without having some customisation: 80% of it might be standard, 90% of it might be standard but it is the person that can deliver up that 10–20% of non-standard quickly, efficiently and at the right price” (Ftech).

A knowledge-embedded solution encapsulates the development of a specific, usually unique, ‘complete’ or ‘whole’ product or service tailored exactly to a customer’s requirements, and often far exceeding those requirements. The knowledge base that underpins such a product development approach is a combination of internal capabilities, flexible production facilities (which are usually located in New Zealand in order to control small production runs to a very high quality level) and an intense understanding of the business of the customer. Because this knowledge is often garnered through agents local to the international customers, the companies have exceptionally strong, trusting relationships with these handpicked international distributors.

Flexible manufacturing usually enabled this ability and was also inextricably linked with clever design. The ‘ephemeralisation’[4] of the products, that is, vintages of solutions progressively accomplishing more and more functions with fewer and fewer materials and effort, can only occur with matching flexibility in manufacturing to provide such a level of customisation of solutions. Good design also involved encasing the solution in a high reliability, high quality product and packaging. While not all knowledge-embedded solution attributes are present in all of the study firms, the main components that make up this approach to developing new products or services are summarised in Table 2 in which

[4] A term coined by Buckminster Fuller to mean the principle of doing ever more with ever less weight, time and energy per each given level of functional performance. See Chapter 4 of Campbell-Hunt et al., 2001 for more details.

Table 2
Components of knowledge-based solutions (critical interface categories adapted from those of Carrincazeaux et al., 2001)

Knowledge base	Critical interface	Components
R&D and production	Internal—derived primarily from interaction within the firm between in-house skills, resources and facilities	Clever design Unconstrained creativity Breadth of specialist skills Unique combinations of technology Fast and efficient flexible manufacturing High quality product and packaging Deep understanding of 'doing business' from New Zealand
Supplier/contractor	External inter-sectoral A—derived primarily from close relationships with suppliers and contractors, located locally, nationally and internationally	Unique combinations of technology Fast and efficient flexible manufacturing High quality product and packaging Trust, honesty, loyalty, social capital in relationships
Customer/distributor	External inter-sectoral B—derived primarily from close relationships with distribution agents and demanding international customers	Clever design Exceptional service Exceeding customer expectations Trust, honesty, loyalty, social capital in relationships Deep understanding of 'doing business' from New Zealand
Industrial R&D	External intra-sectoral—derived from interaction between firm R&D activities	Reciprocal knowledge-sharing relationships with international firms or consultants in same industry *Very little evidence of any interaction between firms in same industry within New Zealand*
Public R&D	Public research—derived from interaction between firm and local academic research centres	Involvement of university or public research laboratory in development of original innovation in some cases *Very little evidence of any interaction between the current R&D activities of internationalised New Zealand firms and public R&D activities*

they are correlated with the contributing critical interfaces (von Hippel, 1994; Pavitt, 1998; Carrincazeaux et al., 2001) that support the development of the key knowledge bases.

5.1. The internal critical interface

The internal knowledge base or internal critical interface (Carrincazeaux et al., 2001) is based on the interplay between the skills, resources and facilities that reside within the firm. Most of the firms were very aware of the importance of R&D in building their firms' competitive advantage and many invested above average amounts in terms of percentage of revenue. Ytech was typical in this regard:

"Right now we are in our largest ever phase of R&D. We are just pouring engineers on and money in as fast as we can. We invest everything back into R&D. I would love another $10 million bucks and another 100 engineers if I could get them because the market's out there for slaughtering" (Ytech).

These skills were acquired in a number of ways including local and international recruitment of skilled individuals to build an R&D base but also by merger with, or acquisition of, other New Zealand firms, or firms in key markets (including taking majority stakes in distribution companies), that had complementary resources (Table 1). Atech has been particularly active with this mode of knowledge-acquisition, for example, acquiring a 50% shareholding in a South African marketing company in order to build up its intelligence in that market. Towards the end of the study, Atech bought Etech in order to acquire an unrelated but very innovative security product-line.

Several components of the knowledge-embedded solution are a result of this critical knowledge-acquisition interface. Many of the managers were very

proud of their firms' clever designs arising from convictions that there must be an 'easier way' to approach a problem. Often these designs were based upon combining technologies or reducing components in ways that the traditional industry might never have attempted. The ability to be creative and clever was almost always built upon a breadth of specialist capabilities embodied in human resources possessing particular skills of problem identification, problem solving and brokerage.

In comparison with their international competitors, New Zealand technologists (particularly engineers) and managers have often been trained in a wider array of technical areas and have had a broader range of developmental experiences.

"We travel overseas, or my staff do, and when we go to some of these big companies, about 10 different people have to come in to cover a range of things that we want to talk about and we are not experts yet we do know our business pretty well in all these 10 subjects. Yet over there, you ask them something [they answer], "Oh, I do not know, Joe Brown deals with that" so Joe Brown will have to come in and talk about that. So New Zealanders at a very early age get a very strong, almost general management overview of a business" (Ctech).

The creativity arises from this breath of experience combined with an almost naive openness to new possibilities unconstrained by educational and experience silos. One manager captured the epitome of this naive creativity when he proudly recalled that a competitor had told him:

"It is just as well you did not know what you were doing—anyone with any brains at all would never have tried that" (FStech)!

5.2. Inter-sectoral interfaces

With the exception of Ttech (which will be discussed later), the external inter-sectoral interface with supplies and contractors, either local or international, was not identified as a key knowledge-acquisition interface. From their case histories, it was apparent that the firms had relationships with both local and international suppliers and contractors, in some cases very close and long-standing relationships but, almost without exception, these were not highlighted by the managers as being important innovative knowledge sources for the firms.

In contrast, however, the most important critical interface for the majority of these firms was the external inter-sectoral interface derived from interaction with customers, sometimes via trusted distribution agents. Almost all of the key customers for this knowledge-acquisition interface were located overseas, as local demand accounted for less than 10% of most of the firms' sales.

One exception to this trend occurred in the case of FStech, which relied extensively on the feedback from local healthcare users of its product:

"A key New Zealand partner is the NZ society of [professionals] with whom [FStech] are currently engaged in a number of projects that will be of benefit to both parties. These projects range from research through to promotional activities. . . . [FStech] benefits from access to the latest research and in turn sponsors such research, which assists in maintaining high levels of current knowledge and predictive capability for future trends" (FStech).

The demands of the customers received via this key knowledge-acquisition interface for innovative solutions to their problems was a major driving factor for innovation. Not only were the solution designs a step change in cleverness but also they often far exceeded the specifications and expectations of even the most demanding customers. In fact, many of the firms openly said they often took on such projects for the challenge:

"Ptech got the idea when [a major telecommunications company] offered a tender with very specific requirements. They sought a product which would give them some adjustment in the field and that is where we started to develop our [innovative component], which we subsequently turned into a remotely adjustable product and it is only by us having recognised the benefits for the customer, the end user, the operator by doing that, that we have been able to establish our niche business. If you did it mechanically like [the competition] did . . .the capacity was compromised. . .. [The telecommunications company] came out with this spec, as there were not many people in the world doing this so it was a global tender. . .. So our product that we came up with, as far as [the telecommunications company] was concerned,

was a first and while it was simple technically – it was not too sophisticated – it was ingenious" (Ptech).

"[We] go for the stuff that is too complicated for the average engineer" (Itech).

However, equally important (if not more so) is the knowledge sharing that occurs during service to the customer that accompanies the knowledge-embedded solution. Many of these firms had a reputation for going 'beyond the call of duty' to provide follow-up service or to rectify a problem even when the fault was not caused by the firm's product. This knowledge sharing builds customer loyalty and is perceived to balance the risk of doing business with a small company from a far-off place in the South Pacific. Rtech, for example, provided full plans and specifications to accompany its product, despite the risk that they would fall into the hands of competitors. Atech, when it entered The Netherland's market with its electronic fencing products, ran a very well subscribed hotline on New Zealand's unique practices in low-cost controlled grazing. This knowledge is taken for granted in New Zealand, but the willingness to share it helps to differentiate the product in the marketplace and build loyalty with the customers.

Because of the regional and global nature of almost all of the firms' markets, the relationships that underpin the distribution network were key to many of the knowledge flows, to and from the customers. These knowledge flows, either directly from customers or through agents, were essential to gaining the intimate understanding of the customer that is necessary to build the internal knowledge base and to be able to deliver knowledge-embedded solutions. Ctech and Atech provide examples of both the modes:

"[Ctech's] small size means it is willing and able to tailor products to meet small-scale specific customer needs. . . .[Ctech] typically deals directly with its export customers rather than operating through agents as the product-lines are too specialised for an agency relationship to be effective . . .. Many of [Ctech's] staff have grown with and learned from their experience within the company, gaining intimate knowledge not only of the [Ctech] product but also the end use of the product in particular customers' processing plants. Many of these processes are unique and confidentiality and trust become common bonds between production staff and the [Ctech] representative or technical adviser. This breadth of understanding makes it easier to develop and implement innovations than in larger, more structured companies" (Ctech).

"[Atech's] R&D staff and distributors discuss how products can be changed or developed to better suit their individual markets. [We] wanted a system that would allow us to produce products that met the slightly different production requirements of the 100 plus countries and millions of customers [Atech] exported to while improving quality and decreasing inventory and costs. . . . A great deal of trust and training is essential [of local distributors], but the benefit is that markets are seen through the eyes of locals who can respond more appropriately to opportunities" (Atech).

5.3. Intra-sectoral interfaces

As was the case for inter-sectoral interfaces, strong relationships in international collaborative networks of complementary consultants and peer companies were also a feature of the firms' knowledge-acquisition processes. Where there were gaps in know how, the firms actively sought specialist collaborators from individual expert consultants to peer organisations, even those that might appear to be competitors. Thus the main external intra-sectoral critical interface was with international organisations in the same industry as, in general, local peer organisations did not exist or were not seen as potential knowledge sources.

"We are quite prepared to admit that we do not have all the answers, and we are even more prepared to go out and ask the questions of those that do have the answers. . . .With one [international collaborator] we were looking to widen our base of [product A] manufacturing and with the other [international collaborator] we were hoping to increase our knowledge of [product B] manufacture. We have technical discussion and it is not all the information flowing into New Zealand but a lot flowing out . . .. They are as much people relationships as they are technology relationships" (Bprod).

"We have always worked on the premise that you do not want to be constrained in design and, therefore, the more technical knowledge you have the better and some of that knowledge can be built internally and other

development is dependent on working with expert contractors" (Ftech).

"Most people are only as good as the peer group that they work with . . .. To be successful you really need good peers. And in New Zealand [Bprod] is more advanced than any of the other local companies . . .. So it really needed to look for peers who are more international to approach" [Bprod].

Itech's design consultants are highly respected professionals and academics based in the US who also act as an knowledge-acquisition interface between Itech and their potential customer base by recommending that the customer deal with Itech as well as by feeding knowledge of customers' needs back to Itech.

"Mainly I use these [US] consultants to do the design work in conjunction with us. They come down here and they work with us, do tests and we work out how to develop [solutions for the customer]. By the time we get the contract to make something, we have not got a design for it. We design and build it as we go along so when we have got it worked out [the consultants], can take the design somewhere else to get the [whole package] built but we have already got the inside worked out of how to do it and the technology to do it" (Itech).

The technology networks Ctech built up over the years enabled it to keep abreast of world trends in the industry. As an example of the level that a technology network can reach, Ctech's relationships were now viewed as a substitute for internationalisation for this regionally based firm.

"Our technology relationships are now really a networking set-up where we exchange ideas; we might even agree to work on a joint project together with somebody overseas. It is fairly broad reaching, because there are a lot of medium-sized [product] manufacturers around the world like us who feel a little exposed in today's economy, and they are appreciating the opportunity to be able to globalise without the investment" (Ctech).

Evidence for a critical knowledge-acquisition interface involving intra-sectoral interaction between the R&D activities of firms in New Zealand, however, was scarce. Where it did occur, close proximity did not appear to be a factor. For example, ARtech collaborated with another company, which could be called a complementor in that it is product range complemented rather than directly competed with ARtech's products. Together the companies delivered complex computer animation products for specific applications but the two organisations were based at opposite ends of the country[5], a fact that appeared to help not hinder collaboration:

"Combining the intellectual property of the two companies created the potential for disagreements, but because ARtech and [firm B] had such defined areas of expertise, mutual respect and were geographically distanced, it seemed to work" (ARtech).

5.4. The public research interface

The last critical interface described by Carrincazeaux et al. (2001), the public research interface, involves interaction between firms and local, publicly funded research institutes and universities. In several cases, the firms in this study did access expertise located in New Zealand universities or research institutes, particularly in the early stages of the development of the key innovation that launched the firms. ARtech was formed with a group of computer science experts from the local university, and the university originally owned a share of the company. However, this share was sold just 2 days before ARtech secured its first major international contract. The technology platform underpinning Atech's first products came from a local public research institute. In some case, the public researchers had subsequently joined the firm so the knowledge base was internalised, particularly once the firms became successful internationally with their innovation. Etech, for example, recruited a visionary technologist from the local university who had been key to their early product successes. However, almost all the firms, once established in their international markets, did not appear to use, or continue to regularly use, the local public research resources.

[5] A driving distance of 1362 km/844 miles (but includes a ferry passage) or at least 2 h of flight time.

6. Knowledge-acquisition—what is the role of proximity?

From this description of the modes employed by exemplar New Zealand SMEs to develop knowledge bases crucial to these firms' innovative abilities, it is clear that the main critical knowledge-acquisition interfaces were the internal interface; the external inter-sectoral interfaces with international distributors and customers; and the external intra-sectoral interface with international consultants and peer organisations. The inter-sectoral interface with suppliers and contractors was present but was not attributed by the managers as a key knowledge-acquisition interface. The knowledge-acquisition interfaces that were lacking, in the majority of cases, were the local (whether regional or even New Zealand-based) intra-sectoral interfaces with firms in the same industry and the interface with New Zealand public research establishments.

The absence of these interfaces for these exemplar firms poses some interesting questions, both theoretically and for those that are interested in supporting co-location-based economic development policies or encouraging public–private R&D interaction. Localised activities are certainly present in the supply chain, and some of this interaction probably does contribute to the product development. However, the majority of the key knowledge bases, at least from the managers' perspectives, were derived from interfaces with international individuals or organisations. The question arises then as to why geographic proximity is not a major factor in driving access to key knowledge sources for these innovative New Zealand SMEs?

6.1. The role of existing co-located intra-sectoral firms

In their study of biotech SMEs in France, Lemarié et al. (2001) argued that geographic proximity matters more at the entry stage at which time new firms are very dependent on localised firms and networks, but that this changes when the firms reach a mature stage at which time their networks become more national or international in focus. They reason that "the analysis is very different at the time of the start-up, when the survival and development of the firms depend on the founder's close network of relations, and later when the firm is established and builds sound relations in the same scientific, productive and commercial network" (Lemarié et al., 2001).

In the New Zealand case, there was more evidence for localised knowledge-acquisition activities at the stage of start-up, particularly with public research sources. However, the key interface with similar organisations in the same sector was very rare probably because the 'depth' and 'density' of New Zealand sectors is, in general, very thin. That is, in most sectors there may not be no more than one or two firms operating, and where there are several firms, they are rarely co-located in one region. Sternberg (1999) noted that, in one of his German study regions, the benefit of proximity was counter balanced by other regional disadvantages resulting in a lack of localised collaborative activity. Thus, in regions where local characteristics work against activity in the geographic region, it is likely that other strategies for knowledge-acquisition must be employed. In the New Zealand case, the lack of local intra-sectoral firms at the early start-up stage meant that these firms were not able to rely on the support mechanisms of an existing sector in close proximity and had to be far more self-sufficient in generating their internal knowledge bases.

P1a. *A lack of existing co-located organisations in the same sector will work against geographic proximity as a factor in knowledge-acquisition.*

P1b. *Knowledge generation within the firm, the internal critical interface, will be a much stronger innovation mode when geographic proximity to intra-sectoral organisations is not possible.*

6.2. The role of early and rapid internationalisation

It could be surmised that because many of these New Zealand firms experienced rapid internationalisation early in their existence, their entry stage was highly curtailed. Thus, if they survived this intense period, the firms were far more global in their outlook at an earlier stage in their development than might be the case for SMEs in other regions. Thus, even at an early stage, the key knowledge interactions for these firms became their international customer or peer organisation contacts as the firms improved their product or service in response to new customer demands—a

form of organisational proximity. This scenario is similar to that identified for a minority group of French biotechnology start-ups by Lemarié et al. (2001). Fourteen percent of their sample firms grew extraordinarily quickly because of their involvement with national and international venture capital companies. Lemarié et al. (2001) state that "geographic proximity is clearly of little importance for this type of firm, which is situated in an international market for the diffusion of its products and maintains relations with laboratories elsewhere" (Lemarié et al., 2001).

The trend for effective SME internationalisation to include an extension of their resource base through alliances with offshore partners has been recognised (for example, Lu and Beamish, 2001). However, the fact that these international interactions may supplant local activities is less apparent. In the New Zealand case, it was not international investors that were the catalyst for early and rapid internationalisation, but international customers, and the attractor for these international customers was the world-leading innovation (Campbell-Hunt and Chetty, 2002). Keeble et al. (1999) also observed the importance of national and global networks in the innovative activity of R&D intensive SMEs in Cambridge. Knowledge intensive Finnish new ventures were observed to internationalise more rapidly (Autio et al., 2000), although this was attributed to their greater ability to learn rather than to their ownership of world-leading intellectual property, which appears to be the logic behind New Zealand SME internationalisation (Campbell-Hunt and Chetty, 2002). The following propositions summarise the possible influence of innovation and rapid internationalisation on the strength of organisational proximity as a factor in knowledge-acquisition:

P2a. *World-leading innovation is the strategy that drives rapid internationalisation of New Zealand SMEs.*

P2b. *Rapid internationalisation* (*based on innovation*) *results in organisational proximity with international knowledge sources.*

Coordinating sectors with a view to increasing exports underpins many SME support policies and growth activities. However, proposition P2b suggests a paradox in such an approach. Successful internationalisation apparently reduces the need for local knowledge sharing linkages. Thus, while intra-sectoral linkages may be useful for initiating exporting activities, such localised collaboration perhaps should not be expected to continue to be paramount for firms, once they are established in international markets. Marceau et al. (1997) also noticed an apparent negative correlation between export intensity and local linkages: "Over the period under examination, Australia's export intensity increased substantially, yet we see a decline in average linkage density. This suggests that the drive to exports through increasing overall trade intensity has not resulted in a net positive effect on domestic linkages. It also suggests that many of Australia's exporters may not have strong domestic inter- or intra-industry linkages." Given the similarity with the New Zealand case, Marceau et al. (1997) may also have been observing the displacement of geographic proximity by international organisational proximity.

The New Zealand firms in this study, therefore, did not have the apparent advantage of existing local intra-sectoral support, when they were first formed. It would be an interesting question to ask what might have been the outcome, should co-located intra-sectoral firms exist. Perhaps internationalisation might have been even more rapid if other internationalised firms already existed in the geographic region from which the new firms were able to learn. Alternatively, the early stage firms may have been more risk averse, in terms of which international markets they might enter, perhaps preferring to follow in the footsteps of other local firms, accessing their existing customer base, rather than the new firms establishing their own. Of course, this presupposes that no (substantial) domestic or regional market existed, as is generally the case for most innovative New Zealand firms. It is also probable that the small size of the local market and a lack of co-located intra-sectoral firms are also correlated.

6.3. The role of customisation

The lack of availability of economies of scale for these New Zealand firms has led most of them to enter niche international markets and offer knowledge-embedded solutions to customers. Thus, one of the most important knowledge-acquisition interfaces is with the firm's international customers and distributors. An innovation strategy based upon an extreme level of customisation meant that an intricate

understanding of the customer's business and environment was needed in order to deliver on, or excel beyond, customer expectations. High levels of customisation, therefore, may also be another key factor which turns the attention of the firms internationally and away from local knowledge sources and it would be expected that, conversely, low levels of customisation, might favour geographic proximity.

Hendry et al. (2000) found that, for their sample of firms in the opto-electronics industry, national and international relationships were much stronger than local relationships. They argued that this was a function of customer and supplier markets, which derived from the technological characteristics of the particular industry and the way its markets had been created. The opto-electronics firms formed close working relationships with customers then tailored their products to suit. Whilst the firms in this New Zealand study belong to a range of industries, the way in which markets were created was similar across most of the firms and parallels the customisation approach of the opto-electronics firms. Thus, the role of market formation by customisation appears to have an impact on the relative importance of geographic proximity.

P3a. *A high level of product or service customisation will enhance the importance of customer interaction as a key knowledge-acquisition interface.*

P3b. *For firms specialising in high levels of customisation, the dominance of international customers will increase the importance to a firm of organisational proximity, over geographic proximity to local knowledge sources.*

6.4. The role of exceptions

Even within this small sample of New Zealand innovative SMEs, there were exceptions to these propositions. For example, a few of the firms do maintain links with key public research sources, although they may not be continuously active. However, the fact that public research sources were more commonly an interface early in the firms' growth (and even a source for building the internal knowledge base through acquisition of the key public sector researchers) suggests that, like SME collaboration policies, the role of local public research resources may be to support the early stages of a growth path based on innovation, but that sustaining such an interface may become less critical (but still occasionally useful) as international resources become accessible to the firms through their international network of customers and consultants.

Potentially, the international research networks of the public research providers could also play a key role in supporting internationalisation by providing the firms with access to international research resources that could augment the domestic resources (Davenport, 2001). While this strategy would be commensurate with the knowledge needs of these firms, it may also result in the local research resource no longer being quite so critical to a firm as it matures. Such an outcome would appear counter to espoused government desires for locally based public–private partnerships, yet may be inevitable given the typical growth trajectories identified in this study of innovative New Zealand SMEs.

Agglomerations of intra-sectoral firms (or clusters) do exist in New Zealand (Akoorie, 2001) but they tend to be in industries that are based upon New Zealand's long history of commodity production, particularly primary production (e.g. dairy, forestry) or are in sectors in which New Zealand's natural attributes and strong local demand have played a major part in the industry development (for example, wine, yachting, creative media and film). Yet this sample of exemplar firms, recommended by industry leaders, contains only one firm, Ttech that belongs to a recognisable cluster of intra-sectoral firms and public research sources. In fact, the cluster grew around this firm, which is one of the older organisations in the study, having been founded in its current form in 1969, because of the purposive efforts of the firm's founder who is still the current Ttech Board Chair. Despite having a similar recent growth story to the other study firms, which resulted in an extensive network of international contacts, this entrepreneur placed particular emphasis on growing local capability, especially focussing on the abilities of local suppliers and educational interactions with the local university.

"We do not build anything mechanically, it's all done outside. But when we first went out to the local tinsmith, he was not accustomed to building things to the type of tolerances that we were wanting. We had to grow his ability. We did not have to persuade him but

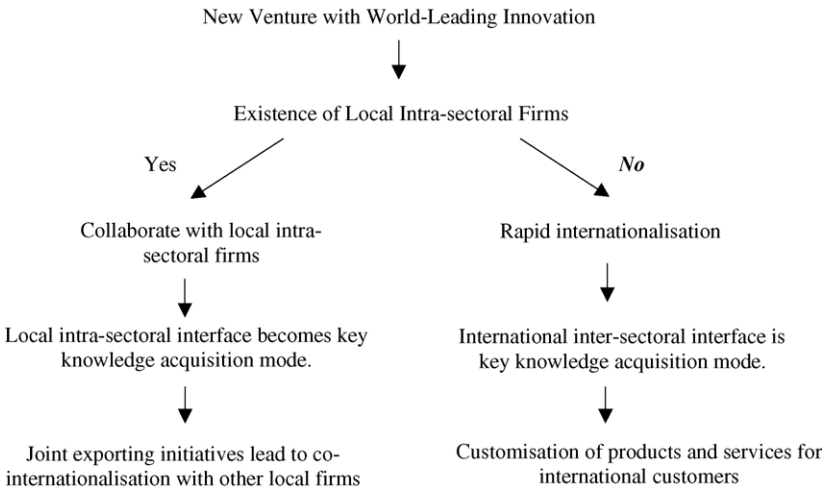

Fig. 1. Potential growth trajectories for New Zealand SMEs.

he bought the better machinery because he saw industry growing around it. . .. The growing of support services is something that you do both consciously and it happens subconsciously because other people are seeing the company grow and you are placing increasing demands, tighter and tighter demands, in terms of quality, time, availability, back up and resources. We have got enough now to say, that is good, this guy is great, we will buy another bit of plant to support them" (Ttech).

"In terms of developing a technology we tend to work more with the educational institutions. We have had for many years a great association with [B] University in the UK and we work very closely with [C] University here. That is mostly where the technology comes from" (Ttech).

On the back of this intense nationalism, Ttech is now one of the largest manufacturing firms, with the most extensive R&D skill base, in the country, as it has become a very attractive employer both for local and international scientists and engineers. In addition, because of the increased capabilities of the local component and human resource supply infrastructure, the region became very attractive to other fledgling firms in this and related sectors, which has resulted in an identifiable cluster growing in Ttech's home city. Thus, one of the most intensive knowledge-based clusters in New Zealand developed because of the intentional local focus of one entrepreneur and his firm.

In addition, this exception provides an example to reinforce proposition P1a that once there is a certain density of requisite suppliers and similar intra-sectoral firms, a cluster may emerge, but that without it, the more common rapid internationalisation trajectory appears to takeover, working against geographic proximity for knowledge-acquisition. It is possible that a similar clustering of intra-sectoral firms may happen around some of the other innovative SMEs in this study, as they grow towards the size Ttech. If so, it will be interesting to see of equally purposive efforts are required by the central innovative firm, to grow the local sectoral scale and capabilities.

By combining the propositions given above with these few rule exceptions, two potential growth and internationalisation paths can be identified (Fig. 1). If a certain threshold (yet to be determined but indicated by the Ttech case) of a co-located intra-sectoral grouping exists, then new ventures are likely to be attracted to it and an agglomeration of firms based on knowledge-acquisition and development via geographic proximity may grow. Coupled with the lack of a substantial domestic market (the usual situation in the New Zealand) internationalisation would also be likely to occur through the cluster. However, if this emergent local intra-sectoral infrastructure threshold does not exist, as is the case for most innovative New Zealand new ventures, then a different growth path may come into play. With concomitant lack of a local market and a world-leading innovation, the rapid and early inter-

nationalisation trajectory may takeover for innovative SMEs, resulting in international organisational proximity underpinning the critical knowledge-acquisition interfaces.

Variation in innovation strategies and performance are to be expected in different economies with different institutional and market environments, with some environments supporting particular kinds of innovation strategy at the same time as discouraging others (Whitley, 2000). Whilst these growth paths (Fig. 1) over-simplify the situation in New Zealand, such a line of reasoning may provide for more understanding of the complexities of the role of proximity in SME knowledge-acquisition. For example, it may be that very specific local conditions peculiar to particular regions and/or particular countries may mean that geographic proximity to knowledge sources is irrelevant to SME growth, particularly if another more favoured growth trajectory is available. In addition, the fact that co-located collaborating sectoral firm groupings do, or do not, exist may not be central to economic growth, particularly if alternative growth trajectories are sustainable. Thus, while collaboration between co-located firms is obviously important to economic development or growth in some regions or nations, it need not be the sole target of policy approaches to SME growth. In conjunction with a number of studies calling generic clustering approaches into question, this study indicates that locally targeted collaborative policies would be more appropriate as a part of a suite of economic development tools, based upon the particular needs and characteristics of the inhabiting firms and the regional context.

7. Conclusion

The impact of geographic proximity to knowledge sources on the innovative activity of firms and regions will no doubt continue to be of great interest to scholars and policy makers alike. The contribution of this study is to provide further evidence that a ‘one size fits all’ regional policy approach to supporting SME growth is not necessarily appropriate in all contexts. In this New Zealand case study, firms from a variety of industrial sectors were able to grow and be successful internationally without reliance on localised knowledge sources. Several of the critical interfaces (Carrincazeaux et al., 2001) that underpin knowledge-acquisition, particularly those with local intra-sectoral firms and with local public research establishments, appeared to be absent as important sources in the firms’ recent knowledge-acquisition strategies. In addition, the ability of a selection of New Zealand knowledge intensive SMEs to succeed internationally by offering what could be called ‘knowledge-embedded solutions’, despite the lack of local critical knowledge-acquisition interface options, indicates that alternative paths for SME growth may be as viable as the path that progresses through geographic proximity to other intra-sectoral firms.

The lack of localised knowledge-acquisition activity and the observation of an alternative growth path based on rapid internationalisation, are attributed to various characteristics of the local innovation environment in conjunction with the SMEs’ own innovation strategies and market bases. Firstly, the lack of other local intra-sectoral firms at the time the new venture began worked against the likelihood of knowledge-acquisition activities based on geographic proximity. It is proposed that this results in a much stronger reliance on the internal critical interface, so that a greater emphasis on building the internal R&D knowledge base, through processes such as recruitment but also merger and acquisition, will result.

The absence of a substantial domestic market combined with a world-leading innovation propelled many of these firms into a growth path of rapid internationalisation, such that they were very quickly exposed to sophisticated and demanding international customers. Thus the key critical knowledge-acquisition interfaces very quickly became the international, rather than local, inter-sectoral and intra-sectoral interactions. This can be framed as displacement of the opportunity for gaining benefit from geographic proximity by the increasing importance to the firms’ innovative activities of organisational proximity (Lemarié et al., 2001) to distant customers and collaborators.

The third set of factors centre upon the innovation strategy followed by these firms once established in the international markets. The SMEs, in general, differentiated themselves by offering ‘knowledge-embedded solutions’ to their customers, which depended heavily on both the internal, and international intra-sectoral and inter-sectoral interfaces as key knowledge sources. Thus, high levels of customisation for key customers drove further innovation, a factor that

also works against localisation of activities in favour of knowledge-acquisition from demanding but distant (at least geographically) customers, consultants and distribution agents.

In summary, it appears that the growth path that is peculiar to this specific set of innovative SMEs may be a significant factor in the observed lack of geographic proximity attributes in their knowledge-acquisition activities. Thus, the fact that sectors with co-located knowledge sharing firms have not emerged does not reflect a lack of innovative firms. What it does reflect is the particular combination of circumstances, including the lack of other local intra-sectoral firms at new venture start-up (which, in turn, reflects the lack of depth and density of firm numbers in most sectors), coupled with a world-leading innovation, which drive the firms on a rapid internationalisation path instead of a growth path based on geographic proximity to, and collaboration with, local firms. When this is coupled with the subsequent 'knowledge-embedded solution' customisation strategy, the interface with intra-sectoral international firms and inter-sectoral international customers and agents, cements the non-localised approach as the preferred mode for firm knowledge-acquisition activities. Thus, because the key knowledge interfaces are with entities that are neither resident in the region, nor in New Zealand, organisational proximity dominates knowledge-acquisition activity over geographic proximity.

Having said this, the counter-factual situation is not present to check this proposition, that is, it cannot be determined what would have happened if local intra-sectoral firms had been accessible to the SME early on in its life. Would the firm indeed have focused their knowledge-acquisition practices locally or would rapid internationalisation have driven them on the alternative path regardless of any collaborative opportunities with local intra-sectoral firms? In which case the key driver may be the world-leading innovation that launches the firm on this path rather than the lack of intra-sectoral collaboration. Whatever the outcome might have been, the fact that local intra-sectoral knowledge sources did not exist did not preclude the success of these firms.

Such an outcome is, therefore, further evidence that there are a number of factors that foster knowledge-acquisition by SMEs. Geographic proximity may be the key to SME knowledge-acquisition and growth in certain contexts and at certain times in the life cycle of a firm. In other environments, however, organisational proximity may be as important as geographic proximity or, as has been described for these New Zealand firms, organisation proximity is the sole proximity attribute of knowledge-acquisition. In a similar vein, Tallman et al. (2004) argues that as the construct of closeness for information exchange changes, "the relevant concept of space may move away from physical geography".

Regional development policies could, therefore, be more appreciative and inclusive of relevant contextual factors could drive a diversity of potential SME growth paths. In France, for example, Mangematin et al. (2003) found that two different growth trajectories were observed for biotechnology SMEs, and argued that this explained the variable effects of certain public policies. In this New Zealand case, initiatives supporting geographic proximity might be important for innovative start-ups but other policies supporting rapid internationalisation strategies would be more appropriate as the firms mature. In this way, a flexible suite of policies would be tailored to the local context of available growth paths, and their associated knowledge-acquisition proximity attributes, as some or all of these trajectories may be as viable in the longer term as growth based solely on geographic proximity to knowledge sources.

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