Innovation and the city: Review of the Auckland regional innovation system

EeMun Chen

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Author: EeMun Chen

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Contact: occasionalpapers@med.govt.nz

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Abstract

Place matters in innovation. New ideas – and the capability to translate them into innovative goods, services, processes or markets – rely on the sharing of knowledge and resources by a diverse range of players, including firms, suppliers, employees, universities and government research institutes. For this paper, a review was undertaken to examine the extent to which Auckland has all the actors, linkages, inputs and framework conditions required for innovation. A regional innovation system approach was used. The review found that innovation in Auckland is constrained by business and management capability; a general lack of collaboration between business, and between industry and education/research organisations; and a lack of coordinated planning and investment to address the growth needs in areas of competitive strength. A number of recommendations for action are made for central, regional and local government to improve Auckland's innovation performance, and thus New Zealand's innovation performance.

JEL Classification: O1, O3, R11
Keywords: regional innovation, innovation system, Auckland

Executive summary

Business innovation is the application of new ideas in a commercial environment. It is a key determinant of productivity growth. However, innovation is essentially a social process which is stimulated and influenced by many different factors and actors that are internal and external to a firm. Taking a localised and systems approach to understanding the relationships between these factors and actors is essential to understanding innovation performance. The relationships, resources and information flows that underpin innovation take place in, and are shaped by, an institutional and environmental context that differs from region to region.

The findings of this review are based on research, indicator analysis and interviews with firms, government organisations, universities, business and industry associations, Crown research institutes and working groups. The paper assesses:

- the strengths in the innovation system that should be maintained or further developed
- the weaknesses in the system that need to be addressed
- the linkages between organisations and institutions that influence innovation.

These three elements identify the actions that will make a significant impact on innovation and the economic performance of Auckland.

While Auckland essentially has all the raw ingredients of a well-functioning regional innovation system, they often work in isolation of one another. Knowledge could be much more effectively commercialised in the region.

The collaboration and linkages expected within a regional innovation system are largely absent, and are thus constraining business innovation.

Within most businesses interviewed, innovation was hidden and informal and relied largely on internal resources. While suppliers, customers and competitors can be good sources of information and innovation, on the whole most firms did not work with them in any coordinated way.

High competitiveness between firms at a regional and national level did spur some innovation. However, this was often a barrier to collaboration to enable more innovation.

Further, there are real research and development strengths in the work of the universities, Crown research institutes and other education and research organisations in the Auckland region which are relevant for business innovation.

Interviews conducted as part of this review highlighted the lack of connectedness between firms and these organisations as the greatest weakness in the regional innovation system. A few companies did have reasonably strong relationships with individuals in research organisations, but these were exceptions. The concerns expressed by both parties included different timeframes, public funding requirements, intellectual property protection and financial costs.

What was particularly stark in reviewing various sectors within the Auckland region was the lack of articulate, clear strategies for growth and innovation. Many businesses lacked these as well. Without these strategies, industries did not have a vision of where they are heading or what is required to achieve growth. They therefore lacked coordination in organising their resources.

Overall, little thought is given to identifying the collective growth needs of industries at a regional level and the region's relationship to the rest of New Zealand – such as in infrastructure, skills and R&D, which often require coordinated investment from multiple government (central, regional and local) agencies and businesses.

Strong leadership and management skills were consistently found to be critical to successful innovation and developing a culture of innovation in the firm. However, this review revealed a general lack of strong management capability in Auckland. Firms found it difficult to, or in some cases were not interested in, growing the business, developing new or better products, or reaching new customers or markets. Clearly such an approach to strategy and leadership will constrain innovation. Further, while Auckland and New Zealand are considered to be solid training grounds for adaptable managers with generalist skills, this experience does not provide exposure to the dynamics of foreign countries and international markets. Strong

commercial skills – preferably gained by working in large or multinational organisations – were desired by firms and considered to be scarce.

This paper offers a number of policy responses in relation to these weaknesses – for example, innovation vouchers to improve firm access to research; intermediaries or "translators" to foster relationships between the education and research sector and industry; the development of sector strategies; and more tailored and on-the-job approaches to business and management capability support. Other weaknesses (for example, infrastructure) and strengths (for example, the openness of customers to new products/services/processes and Auckland's ethnic diversity) across the region are also discussed, and suggestions for improvement are made.

It should be noted that ensuring all parts of a regional innovation system are operating to their potential is a long-term and difficult task which requires all the actors in the system (industry, capital providers, education/research, regional and central government) to come together to bring the actions proposed to fruition. This paper is part of Auckland's regional innovation journey.

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1. Why innovation, and why Auckland?

1.1. Introduction

The world's markets provide almost unlimited opportunities for New Zealand firms. However, capturing a share of these opportunities is not easy. Firms need to be better producers, better marketers and better managers, and have better goods or services than their competitors.

Innovation is therefore essential for success. Innovative firms are more likely to record an increase in market share, profitability and total sales than non-innovative firms (Statistics New Zealand, 2008). Indeed, "the ability to create, distribute and exploit knowledge and information…is often regarded as the single most important factor underlying economic growth and improvements in the quality of life" (OECD, 1999, p. 7).

International evidence highlights the key role that outward-facing, global city-regions play in leading their nation's economic development (see, for example, Parkinson, Hutchins, Simmie, Clark & Verdonk, 2004; OECD, 2006). The importance of face-to-face contact for innovation and knowledge-intensive activities has increased (McCann, 2009[1]). Face-to-face contact and knowledge flows tend to occur more freely in cities or regions – rather than between nations – where the firms, agencies and institutions are located (see for example Hendy, 2010, for the relationship between city size and scientific collaboration). New products and services are

[1] See McCann (2009) for a discussion of globalisation and its associated impacts on increased spatial transaction costs for face-to-face contact and high value goods, and the complexity of knowledge that is generated and manipulated which requires even more face-to-face contact.

typically developed and commercialised in cities due to the proximity of talented individuals to production facilities, the availability of research services, and access to a range of hard and soft infrastructure.

Auckland – being New Zealand's most populous and productive city-region with an international gateway role – has an important part to play in contributing to New Zealand's innovation performance and capacity. This review aims to uncover Auckland's strengths and weaknesses in making this contribution.

To inform the review, a framework for assessment was developed to outline the components a strong regional innovation system should have, based on international literature. The framework was then populated using a combination of primary and secondary data, including a wide-ranging literature review, innovation indicator development and data collection, and in-depth studies of a number of critical sectors in Auckland.

A sectoral lens at the regional level is useful as innovation characteristics – as well as the role policy and programmes play – can vary considerably from one industry sector to another.

The sectors studied in depth were advanced materials, marine, digital content, food and beverage processing, and finance and insurance services. Tourism and health technologies were also given some attention. The method for the review is detailed in *Appendix 1*: *Method*.

Overall, this paper presents a picture of how innovation occurs in Auckland and whether, and how, the environment for regional innovation can be improved.

1.2. Governance of the regional innovation system

Innovation has been recognised as important to Auckland. *Auckland Unleashed – The Auckland Plan Discussion Document* (Auckland Council, 2011) prioritises the development of "an internationally connected innovation system" (p. 84) as key to progressing a productive and high-value economy. Previous strategies have also highlighted innovation – for example, the *Auckland Regional Economic Development Strategy*, launched in 2002; and the subsequent *Metro Project Action Plan*, released in 2006, which set out the implementation of the strategy. The *Metro Project Action Plan* had five themes, including innovation. The Auckland Regional Council and its

business unit and regional economic development agency, AucklandPlus, led the delivery of the innovation theme with oversight from the Metro Innovation Leadership Group (a group of public and private sector innovation leaders). The new Auckland Council and the regional economic development council-controlled organisation, Auckland Tourism, Events and Economic Development Ltd (ATEED), will now have responsibility for fostering innovation in the region.

Nationally, attention has also turned to innovation systems assessments to inform policy. In 2007, the OECD completed a review of the New Zealand innovation system. A number of its findings have been reflected in government policy at a national level. This review takes account of the national implications of the findings at a regional level. It also includes a more in-depth assessment of the regional innovation system in Auckland to support the development of the Auckland Council and ATEED's work programme.

This review intends to provide guidance to central, regional and local government agencies about how innovation occurs in the Auckland region and what can be done to accelerate it.

The *Metro Project Action Plan* and AucklandPlus identified that there was a system of support in Auckland. However, at the same time it recognised that firms often did not know how to enter or move around the system and that innovative activity could be increased and firms could improve their internationalisation. The challenge is to identify the fine-tuning points and the system modifications that will not disrupt the good work that is already occurring.

The assessment of a regional innovation system is not necessarily an end in itself. The process of reviewing the regional innovation system or the regional innovation journey (Benneworth, 2007) can be just as important as the actions that result from it. Through assessing the strengths and weaknesses of the innovation system, the Auckland region is more aware of its current limitations and opportunities and is developing the capability to cooperate, make decisions, prioritise and commit to an agreed view of its innovation future.

2. What is innovation and what is a regional innovation system?

2.1. Innovation

The Organisation for Economic Co-operation and Development (OECD) defines innovation, in the third edition of the Oslo Manual (2005), as:

> The implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations. (p. 46)

This review focuses on innovation as the application of new ideas in a commercial environment. It acknowledges that innovation can also be defined more broadly. For example, it can include public sector, non-profit and societal innovation, which importantly complements and reinforces private sector innovation. However, the review is most interested in business innovation which leads to high-value outcomes for firms, for Auckland and for New Zealand. It can result in a new or better product or service coming to market, or involve a new or improved process. While product or process innovations are usually the first examples that spring to mind, innovation can also be applied to improvements to the organisation (such as design, structure or strategy) and developing new markets and channels to market. See *Table 1* for examples of international and New Zealand innovation. Innovation is broader than formal investment in research and development, although the latter is often central to the innovation process.

Table 1: Examples of innovation

Product innovation	Apple's iPod is widely recognised. It set a new standard for MP3 players globally. Locally, Navman's GPS systems, Fisher and Paykel Appliance's Dishdrawer, Icebreaker and the Hamilton Jet are examples of firms which have developed new products for the market.
Process innovation	Process innovation is where firms change the way they operate internally with the intention of creating a competitive advantage. Internationally, low-cost airlines have changed their processes and systems to reduce the cost of travel. Locally, Peter Jackson turned film production norms on their head by shooting all three *Lord of the Rings* movies at the same time.
Market innovation	A market innovation is where a firm changes a market environment or opens up new opportunities. For example, Xerox changed its offering by leasing copiers to its customers as an alternative to purchasing and significantly changed the market for copiers. Locally, The Warehouse changed the market for consumer goods by opening destination "big box" stores with a wide range of low-cost products.
Organisational innovation	Organisational innovation is where a firm changes its organisational structure to create an advantage. Many local companies are setting up parts of their operations closer to offshore customers, markets and suppliers. When Icebreaker designed its organisation, it focused on ensuring a close relationship with suppliers to guarantee the right micro-fibre was available for its Merino wool products.

Some key features of innovation are[2]:

- Innovation is essentially interactive and relies on *collaboration*. Firms do not innovate in isolation but instead interact with other local, national and international institutions.

- Innovation involves *creativity* and is *non-linear*. Whilst there is a generally-understood, sequential innovation process of translating an idea into a commercial application, there are various feedback loops (for example, market testing which results in a refinement to a product) and innovations can also arise unexpectedly.

[2] See Collaborative Economics (1999); Nauwelaers and Wintjes (2000); Edquist and McKelvey (2000); Edquist (2001); and Smith (2006).

- Innovation relies on *tacit as well as codified and embodied knowledge*. Personal experience and informal, uncodified knowledge can be as valuable for innovation as explicit knowledge. Transferring such knowledge often requires face-to-face contact.

- *Demand matters.* Customers and consumers play an important role in stimulating innovation.

Overall, innovation is essentially a social process which is stimulated and influenced by many different factors and actors that are internal and external to a firm. The set of interconnected organisations and elements that influence the development, diffusion and use of new and improved products, services, processes and market developments is referred to as an *innovation system* (e.g. Acs, 2002; Freeman, 1987; Lundvall, 1992; Nelson, 1993; Edquist & McKelvey, 2000). Taking a systems approach to understanding the relationships between these factors and actors is essential to understanding innovation performance.[3]

It is also important to note that an innovation system is evolutionary and that a long-term perspective (years, even decades) is needed (Edquist & McKelvey, 2000). Linkages between institutions and the availability of inputs and framework conditions are often dependent (path dependent) on investments made previously.

2.2. Why focus on an innovation system at the regional level?

Because innovation is a social process of learning and knowledge transfer, significant elements of this process are localised. *Proximity* helps knowledge spillovers and interactions between firms and other organisations. Cities, in particular, provide proximity, density and variety, making it easier for people to meet and get together. Geographic clustering and critical mass in industrial segments are especially important (see, for example, Audretsch and Feldman, 1996; Lemarie, Mangematin & Torre, 2001; and Brocklesby, Campbell-Hunt, Chetty, Corbett, Davenport, Gawith & Mattear, 2004). Regions with large cities and towns also offer agglomerations of consumption.

The relationships, resources and information flows that underpin innovation also take place in, and are shaped by, an institutional and environmental context that differs

[3] On innovation and innovation systems in general, see Edquist (2001; 2002); Nauwelaers and Wintjes (2002); Innovation Working Group (2003); Navarro (2003); and Smith (2006).

from region to region. For example, the availability of skills and research expertise differs markedly between Auckland and Wellington. Grimes, Le Vaillant and McCann (2011) describe the different proportions of knowledge-intensive employment and industry concentration in Australasian and European cities and find that Auckland has greater proportions of employment in high-tech manufacturing than Wellington (although not as much as Hamilton, Christchurch and Dunedin). Further, the types of businesses, customers, traditions and routines for social interaction are also likely to differ between regions.

2.3. The key elements of a regional innovation system

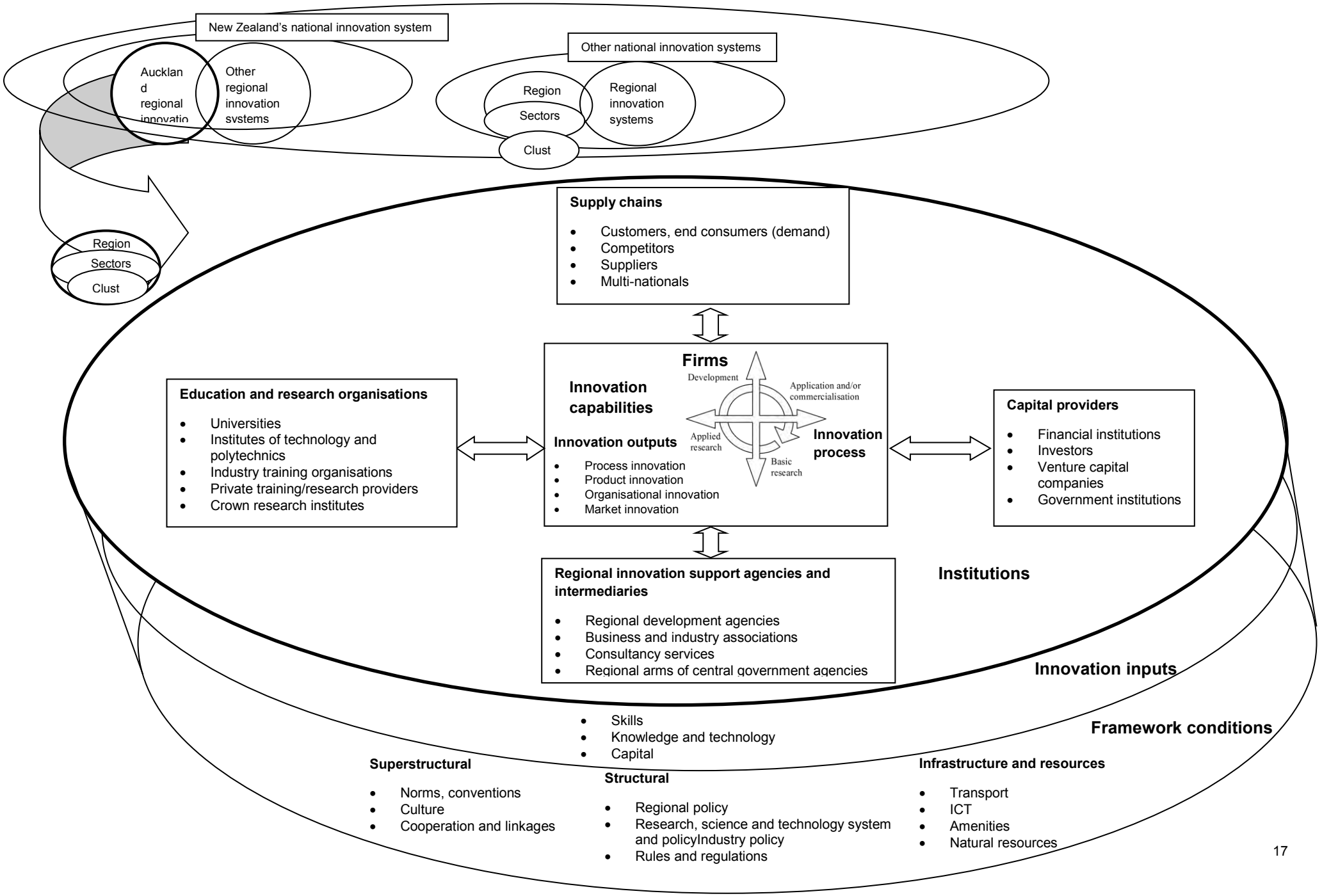
Based on a wide-ranging literature review, the main components of a regional innovation system are institutions, innovation inputs, framework conditions (see *Figure 1: A Regional Innovation System Framework*) and, most importantly, the linkages between all these different components:

- Firms are central to the regional innovation system. They adopt or develop innovations in products and processes for commercial gain.
- Firms interact and link with their supply chains, education and research organisations, capital providers and regional innovation support agencies as part of the innovation process.
- Successful innovation requires a number of inputs, including capabilities, skills, capital and investment flows, and technology.
- Firms operate as part of a broader system – including the financial system, labour markets, the education system and the science system – which is governed by the national and international legislative and regulatory framework. Further, culture and norms, and collaboration and linkages all influence innovation.
- Sectoral innovation systems and clusters of firms can be seen within the regional innovation system.
- Auckland's regional innovation system exists within New Zealand's national innovation system and, through global linkages, the international innovation system.

A number of indicators were selected to benchmark the Auckland region's performance on the framework. These indicators track Auckland's innovation performance with other regions in the world. The indicators chosen are informative, comparable in terms of time and place, reliable and complete. Suitable indicators could not be found for all areas of interest. For example, broad, objective and consistent indicators of the quality of regional infrastructure and capital for innovation have proven difficult to attain. The quality of data for New Zealand at a regional level has been particularly weak.

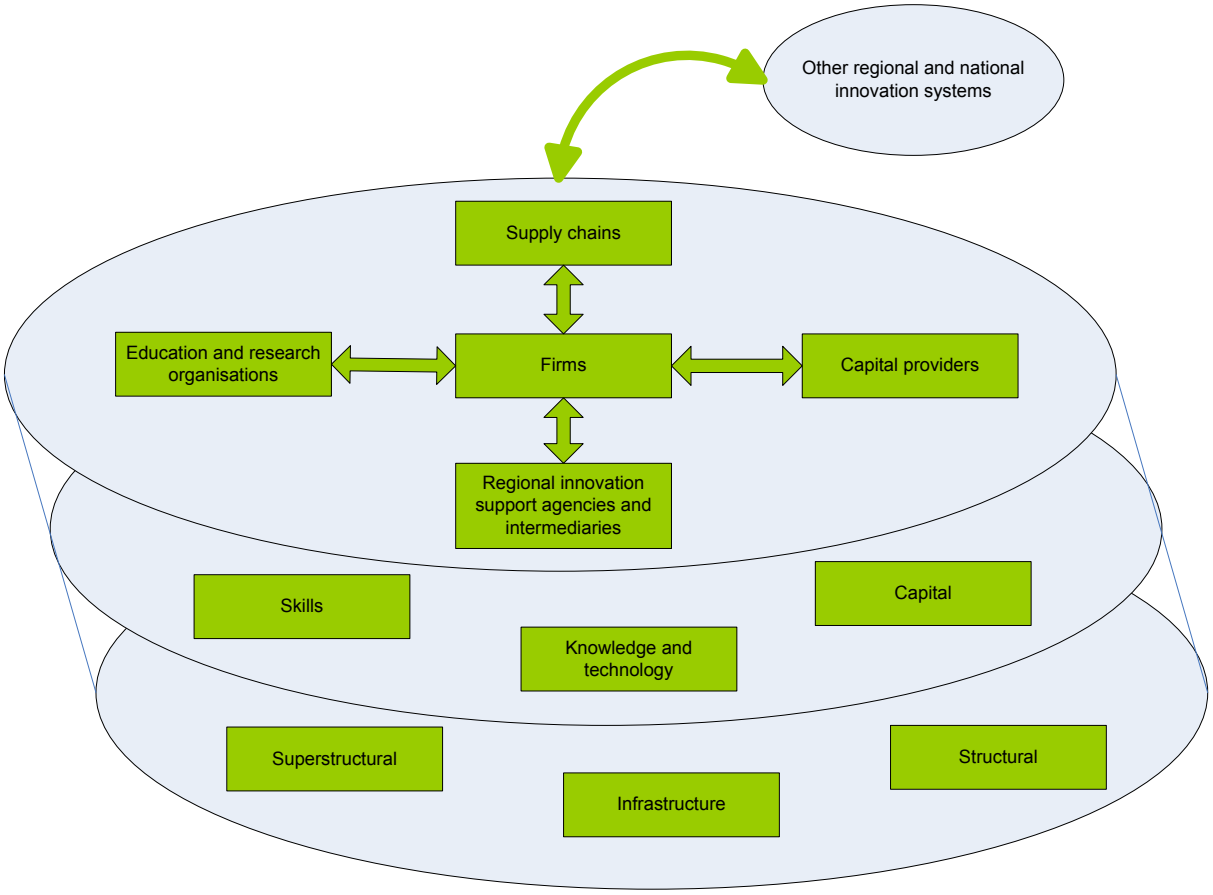
Throughout this paper, additional indicators and data are also presented to provide a more complete picture. While the comparisons will not be with a consistent set of regions or nations (for example, in some instances New Zealand is referred to, Auckland is compared to other New Zealand regions only, or Auckland is compared with a small set of international regions) they supplement the smaller set of benchmarking indicators.

Figure 1: A regional innovation system framework



As a summary, the high-level findings of the review are presented using the framework illustration and they adopt a traffic light system. Green indicates relatively strong performance, orange signals an average performance or some cause for concern, while red means that Auckland has performed poorly on this indicator. If Auckland's regional innovation system was considered to be strong across all components, it would be depicted by the diagram below (*Figure 2*).

Figure 2: Illustration of a strong regional innovation system in Auckland



3. A short economic and innovation history of Auckland

Auckland is a young city. The town was established in 1840 and was originally the capital of New Zealand. The capital moved to Wellington in 1865 but, during its brief tenure in Auckland, it impacted the shape of Auckland's future economy. It brought a new focus on business, and the scope and specialisms of Auckland's economy were carved out.

Auckland's early specialisation in food and beverage manufacture, finance and insurance services, ship-building and materials manufacture can still be seen today, while services such as tourism and export education have recently grown in importance (Singleton, 2006). These industries grew from Auckland's natural advantages – such as its spring water, harbour, forests and minerals. This review examines a number of these sectors in-depth. The sectors selected were: advanced materials, digital content, marine, food and beverage manufacturing, financial and insurance services, health technologies and tourism.

While the agricultural sector dominated other regions around New Zealand, it grew slowly in Auckland due to soil and drainage difficulties and few sheep and cattle. Auckland instead focused on manufacturing and, by the early twentieth century, saw-milling, flax-milling and the processing of grain, meat and dairy products accounted for approximately 40 percent of manufacturing employment in Auckland (Winder, 2006). Since these early years, Auckland has continued to develop small-scale manufacturing based on the assembly and processing of imported components and materials aimed at the domestic market. Manufacturing has been primarily domestically oriented, due in part to transport cost barriers and moderate tariffs.[4]

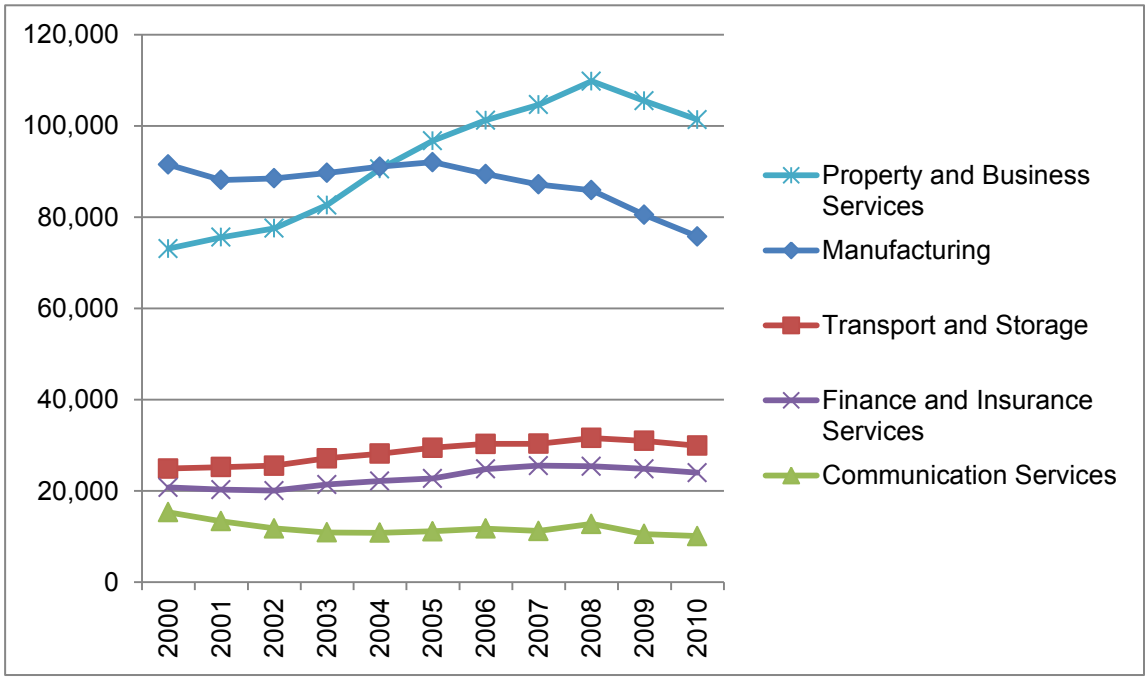
Auckland also became New Zealand's major seaport as well as a centre for shipbuilding and ship repairing. Its location provides a natural gateway to the Pacific Islands as well as major trading partners, Australia and Britain (McLean, 2006). While its exports were eclipsed by Lyttelton in 1892, Auckland was the main port for imports. The busy port had waterways that made it easy for people to travel to their homes near the coastline. The boatbuilding industry consequently flourished. In

[4] Either because manufacturing was based on domestic resources, or there were lower international transport costs for materials than finished goods. See Hawke, G. (1985). *The Making of New Zealand: an economic history*. London: Cambridge University Press, p. 51. Tariffs were largely a source of government revenue.

1906, Auckland had almost the same number of employees in the shipbuilding industry as the whole of New Zealand.

Extractive industries contributed to the early economy of Auckland – timber in particular but also flax, Kauri gum, gold, manganese and copper. By 1870, 90 percent of New Zealand's timber exports came from the Auckland region and 80 percent of it was destined for Australia. Auckland's manufacturing capability also came to the fore around this time as timber was also turned into fittings for buildings (mainly door and window joinery) (McLauchlan, 2008). As the years went by, Auckland, like other regional economies, has shifted from manufacturing production to knowledge-intensive services (OECD, 2007a). As *Figure 3* shows manufacturing employment in Auckland has fallen in absolute terms since 2000, although it has shrunk proportionately. Jobs in property and business services have grown strongly, with the biggest increases in business administration, employment placement, computer consultancy, contract staff and accounting. Nevertheless, manufacturing is still vital to today's economy. Auckland is the main centre of manufacturing activity in New Zealand (by GDP and employment) and is a relatively strong performer (Auckland Regional Council, 2009).

Figure 3: Employee count, selected industries in the Auckland region, 2000-2010



Source: Statistics New Zealand Business Demography

Although Auckland is nationally dominant in manufacturing and its economy has moved towards the services sectors, it has always had a strong services orientation due to its trading town origins. In the nineteenth century, Auckland provided services while the rest of New Zealand relied on the pastoral export industries of wool, meat and dairy products. These included port facilities, transport, distribution, banking, and finance. Auckland's first company was New Zealand Fire and Marine Insurance, which was established in 1859. With the addition of the Bank of New Zealand and the New Zealand Loan and Mercantile Agency, Auckland became New Zealand's financial centre in the last third of the nineteenth century.

Auckland continues to have head office functions today, and has strengths in finance and insurance, wholesaling, transportation, R&D, design, marketing, software and support services. This paper later comments on how well some of these service strengths are integrated into the innovation system, including innovation in the financial services industry.

Around the late 1880s and early 1900s, Auckland's early industries focused on the domestic market as it had a growing population. Industry moved its attention from resource processing to production of building materials, furniture, clothing and footwear (Winder, 2006). Because retailing, wholesaling and infrastructure (reclaimed waterfront land, gas, sewerage, water and rail) developed within the inner city, there appeared to be no investment in larger-scale, suburban, export-focused plants.

Auckland businesses are able to serve a large domestic market and this has led researchers and commentators to suggest that Auckland firms are, as a result, less export-focused (e.g. Jordon, 2006). This is consistent with what history tells us. Today, around 22 percent of Auckland businesses are thought to be exporters (NZIER, 2008) and 18 percent of businesses in New Zealand reported export sales in 2009 (Statistics New Zealand, 2010).

However, there are difficulties in estimating export activity at a regional level.[5] Recent analysis suggests that while some types of goods and services exported from

[5] Auckland's industry composition is also likely to skew results as it has a strong service sector that does not generally lend itself to exporting. There are also difficulties with measuring services that may contribute to goods which are eventually exported. Firms based in Auckland may be more outward facing than firms based outside of Auckland, due to agglomeration

the Auckland region have grown significantly over time, on the whole Auckland does not have a comparative advantage in exports. In fact, the relative importance of export sales to the Auckland region has declined over the 2001-2008 period (McDonald, Zhang & Smith, 2010). There is no comprehensive statistical information to identify the shares of export and import trade that originates in, or is destined for, the Auckland market – especially for the services that Auckland firms provide to exported goods.

Despite this, Auckland is important for exporters from other parts of New Zealand. Auckland's port and airport now account for 34 percent of cargoes being exported, significantly more than the 6.3 percent of exports in 1867.

Auckland's export-orientation and international linkages have important ramifications for innovation. The region's modest export performance, informal approach to collaborating internationally (as discussed later) and, perhaps, the fact that it does not capitalise on existing international linkages are likely to be barriers to innovation performance.

When the capital city moved to Wellington in 1865, Auckland's inhabitants were able to concentrate on the business of business, rather than the business of government. The mix of individuals who settled in Auckland was pivotal in cementing the entrepreneurial and commerce-driven nature of Auckland business. Settlers appeared more transient, more individualistic and more driven by money. The leaders of early Auckland were businessmen. They referred to themselves as gentlemen of fortune, although those outside Auckland considered them to be landsharks and speculators (Stone, 2006). Auckland is now the base of about a third of New Zealand's enterprises and 38 percent of New Zealand's gross domestic product (Infometrics, 2009). Auckland has made, and continues to make, an important contribution to New Zealand's economy.

As a city with a high concentration of business and employment, Auckland has also reaped agglomeration advantages. Recent research indicates that the Auckland region has approximately 45 percent greater average labour productivity than the rest

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effects and better international connections. In contrast, it has also been concluded that demand for goods and services produced in Auckland tend to be more localised than other New Zealand regions, reflecting Auckland's relatively large market. This may result in relatively low exports to other regions of New Zealand, and low exports to the rest of the world (see inter alia Jordon, 2006*)*.

of New Zealand (Maré, 2008). Further, in the Auckland central business district, this productivity is 120 to 158 percent higher. Auckland's higher productivity is due in part to the composition of its industries, with the remainder coming from other factors.[6] Agglomeration benefits are pronounced for the industries in wholesaling, transport and storage, and financial services in Auckland. Firms appear to have benefited from being surrounded by others in the same industry. Other cities around the world exhibit similar "productivity premia". For example, London is 41 percent more productive than the national UK average, while inner London has a productivity premium of 152 percent (ONS, 2007).

The "flashiness of Auckland life and business, and the brashness of conspicuous consumption" (McLauchlan, 2006, p. 10) were treated with hostility and derision by people south of Auckland and in the South Island at the beginning of Auckland's existence. These sentiments have continued until the present. In 2008, when Auckland residents were asked to identify the city's brand and personality from 48 attributes, over 99 percent considered Auckland to be unique, dynamic, restrained, progressive and arrogant. This compared to 99 percent of New Zealand residents who viewed Auckland as arrogant, unapproachable and different. Further, while New Zealanders had knowledge of the city and viewed it as relevant, they had a considerably lower opinion of it (Brand Capital, 2008). It should be acknowledged that these differences plus city rivalry are not uncommon around the world (see Stone, 2006). However, while Auckland's "arrogance" and "progressiveness" may lead to increased innovation and entrepreneurialism in general, compared to other parts of New Zealand there may be challenges in developing inter-regional linkages to improve innovation performance.

From its early beginnings, Aucklanders have been more diverse and less homogenous than, for example, the organised migrant movements that landed in Canterbury and Otago. There were more Irish and Scottish migrants than English migrants and Auckland also had closer ties with Australia as most migrants were from there or entered via Australia. A large proportion of the population were also

[6] Auckland's productivity premium is due to its industry composition (accounting for about half of its higher labour productivity) and a combination of technical efficiency (more outputs with the same inputs), allocative efficiency (higher output prices or lower input prices) and other unmeasured inputs (such as capital intensity and labour quality). The same study cautions that the link between employment density and productivity may not necessarily be causal. That is, adding more firms and people into the region does not necessarily give rise to improved productivity.

Māori. In 1853, Māori represented two thirds of Auckland's population and played a significant role in agricultural production.

This diversity and business orientation has continued throughout Auckland's history. Subsequent relaxing of immigration policy and waves of migration from other parts of Europe, the Pacific Islands and Asia, in particular, has meant that the Auckland region continues to be more ethnically diverse than the rest of New Zealand. In 2006, 35 percent of people in the Auckland region were born overseas (compared with a national average of 22 percent). In Auckland, 56.5 percent of its population identifies as European (Pakeha). Of the balance, 18.9 percent identify as Asian and 14.4 percent with the Pacific peoples ethnic group (both more than the national average), but only 11.1 percent identify as Māori (less than the national average). This ethnic diversity is increasingly thought to be advantageous for innovation, entrepreneurship and economic development, although socio-economic factors (such as employment, housing, participation and settlement) are considerably more important in relation to wealth creation and quality of life than ethnicity.

By international standards, Auckland's population makes it a relatively small city-region. While Greater London had a population of 1.9 million in 1830, Greater Auckland's population reached only 20,000 in 1871 but then grew to 68,000 by 1901 (McLauchlan, 2006). In 2006, census figures showed Auckland was home to a third of New Zealand's population with just over 1.3 million people, an increase of 12.4 percent in the previous five years. Auckland's population has grown rapidly in recent years compared with regions in New Zealand as well as internationally (MED, the Treasury and Statistics New Zealand, 2007). This has been driven by high levels of inward international migration as well as natural increase. It is projected to continue to grow faster than the national average.[7]

Auckland also has a relatively young population. The median age in the Auckland region in the 2006 Census was 33.9 years, two years younger than the median age for New Zealand as a whole (35.9 years).

[7] Statistics New Zealand predicts, according to the medium projection series, that the resident population of the Auckland Region will increase by around 561,300, from 1,371,000 in 2006 to 1,932,300 in 2031. This is an average annual percentage increase of 1.4 and compares with a projected national percentage increase of 0.8 per year during the same period. See Statistics New Zealand. (2008). *Auckland region quarterly review: March 2008.* Wellington: Statistics New Zealand.

Innovation was also apparent in Auckland's early years. Auckland and New Zealand's pioneering beginnings often meant that innovation was incremental – practical solutions were found for the problems arising from various constraints. But some firms have been more disruptive in their innovations – for example, the rise of the Farmers Trading Company as the first mail-order company in 1909 in Auckland to its current business model of multiple department stores across New Zealand. This was the result of market and organisational innovation which was developed internally but made use of international advances in management practices (Hunter, 2006).

If models of business innovation (*Table 2*

: Generations of business innovation models) are applied to Auckland firms, it is not entirely clear whether the various generations have been passed through or that the sixth generation (the open innovation model) is now widely in operation, as this paper will later highlight. Open innovation occurs when firms do not rely entirely on their own R&D but buy or license processes from others. In addition, open innovation also means that inventions not being used are taken outside the firm through joint ventures or licensing, for example. This paper will later describe how many of Auckland's firms are highly competitive with each other and as a result have become insular in their innovation approaches.

There are, of course, exceptions to this general observation. Brancott Estate's (previously Montana Wine) innovation approaches over the years shows that some firms have used a variety of different models. Brancott Estate's strong relationships with its distribution channels through wine education courses and wine colleges for the general public demonstrate a fourth-generation approach. Its technological partnerships with Champagne Deutz and Cordier and 40-year supply relationship with Panprint (now part of the Blue Star Group) show a fifth-generation sophistication (Campbell-Hunt et al., 2001). Other innovative and successful Auckland firms, like Rakon and Nuplex Industries, have emerged from strong R&D, physical sciences and engineering capability that were the result of open innovation approaches – for example, products produced under license, copies of products available overseas and adapted to the New Zealand conditions, or simply just more effective and efficient organisational processes.

Table 2: Generations of business innovation models

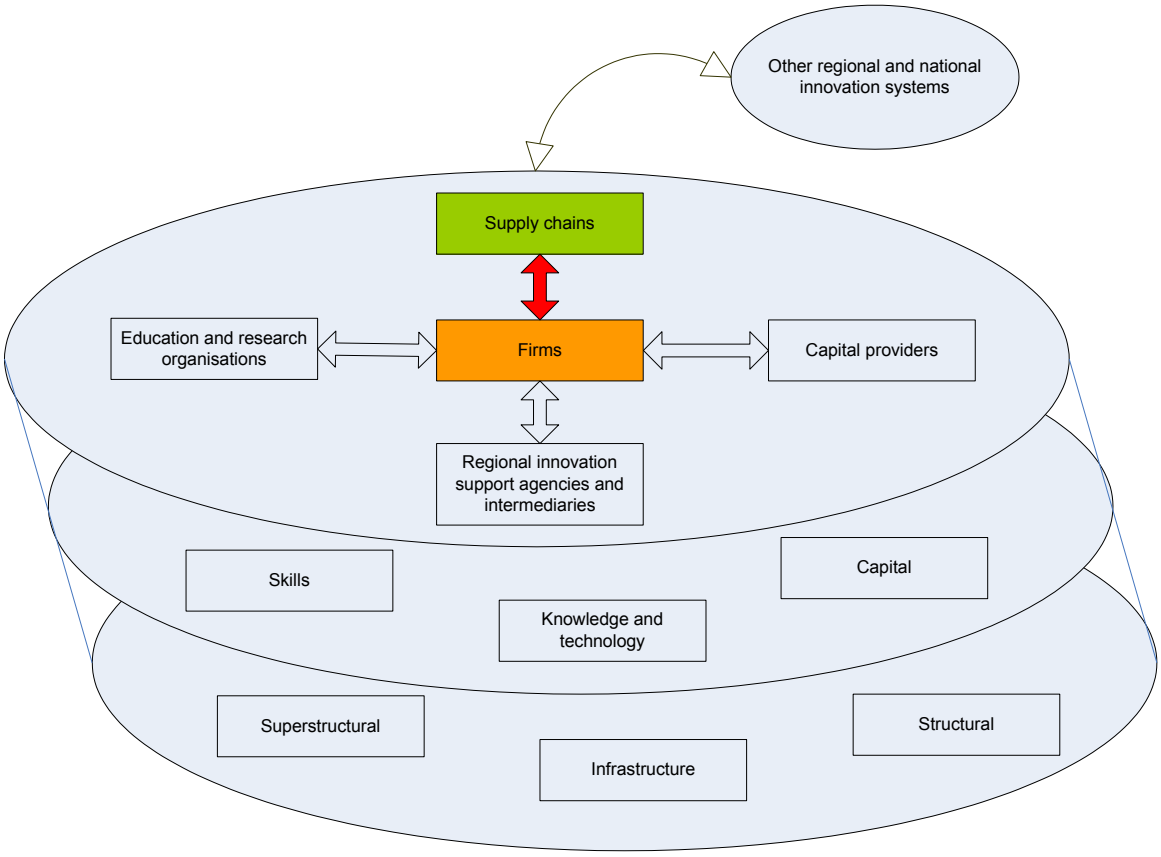
1st Generation: Technology push	1950s – mid-1960s	• Traditional linear sequential process • Emphasis on R&D push • Consumers/customers receive the R&D results
2nd Generation: Market pull	Mid 1960s – 1970s	• Traditional linear sequential process • Market/need pull • Emphasis on marketing • Market provides ideas and direction to R&D
3rd Generation: Coupling models	Mid 1970s – 1980s	• Sequential model with feedback loops • Integration of R&D and marketing
4th Generation: Integrated model	Early 1980s – 1990	• Parallel development with integrated development teams • Strong upstream supplier linkages and partnerships • Close relationships with customers • Integration between R&D and manufacturing • Horizontal collaboration including joint ventures and strategic partnerships
5th Generation: Integration and networking model	Post 1990	• Fully integrated parallel development supported by advanced IT • Use of expert systems and simulation modelling in R&D • Strong linkages with customers • Strategic integration with primary suppliers including co-development of new products and linked systems • Horizontal linkages including joint ventures, collaborative research groupings, collaborative marketing arrangements, etc. • Corporate flexibility and speed of development • Increased focus on quality and other non-price factors

Source: Rothwell, 1993 as cited in Hobday, 2005.

The influence of Auckland's early economic development is evident in the city we see today. It is still New Zealand's trading town, providing services to the rest of New Zealand, but it is also a strong manufacturing centre that makes a large contribution to productivity.

Innovation is also apparent in Auckland's history. The rest of this paper uses the regional innovation system framework to uncover Auckland's innovation strengths and weaknesses today. While Auckland has reaped the advantages of business innovation in its past and its firms have continued to innovate, firms may not be utilising all that the region and the rest of New Zealand has to offer – particularly the knowledge and expertise of other firms and organisations.

4. Innovation in firms and supply chains



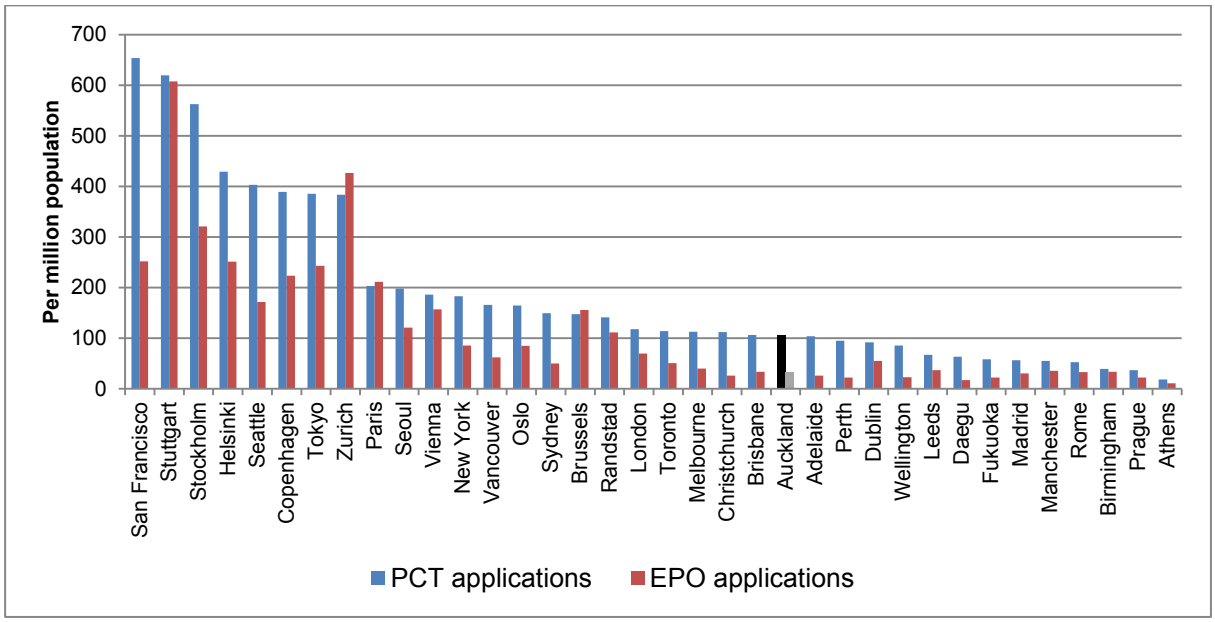
4.1. Levels and types of innovation

In 2009, 46 percent of New Zealand businesses reported innovation activity. This is broadly similar to other OECD countries (Statistics New Zealand, 2010a). While official statistics are unavailable at a regional level for firm innovation activity, patenting data, interviews with firms and advantages that cities bring to innovation suggest that Auckland firms undertake more innovation activity than those in other New Zealand regions. Auckland's size confers agglomeration benefits and higher productivity, and the region has a considerable infrastructure to support innovation compared with other parts of New Zealand (for example, financial institutions, universities, industry clusters and so on).

The number of applications for patents provides a measure of the output of a region's R&D through its inventions. While filing and granting of a patent is no guarantee that an invention will be commercially exploited, patenting activity is regarded as a useful innovation indicator which gives strong signals about the effectiveness of R&D

spending in generating commercial applications.[8,9] Auckland's patenting rate sits between Christchurch and Wellington; however, it sits at the lower end of an international comparison of metropolitan regions, similar to the Australian and UK city-regions (*Figure 4*).

Figure 4: Patent applications to the European Patent Office (EPO) and under the Patent Cooperation Treaty (PCT), per million population, 2007



Source: OECD. Stat, Science, Technology and Patents series, Patents by region, 2007.

Turning to the different types of innovation, New Zealand firms are more likely than the average EU firm to report market innovation, but less likely to report managerial or organisational innovations (Statistics New Zealand, 2010a). Firms interviewed for the sector studies generally confirmed these inclinations. While market innovation tended not to be described in the interviews, this may be due to product innovation being in the forefront of interviewees' minds, rather than other types of innovation. The focus on market innovation by New Zealand firms is likely to be driven by the country's size and distance from major markets. This distance becomes a push for firms to be more innovative in the way they approach their markets and the marketing

[8] For some industries, patenting may not be the most effective way to protect intellectual property rights. This is evident particularly in industries where the rapid commercialisation of innovations and being the first to market matter more than the long-term protection of securing a patent.

[9] A number of different indicators can be used for patenting activity, including applications filed to the national patent office, triadic patent families (where patent protection is sought in the US, Japan and Europe), Patent Cooperation Treaty (PCT) filings and European Patent Office (EPO) filings. The triadic patent families indicator is considered better, as the cost of filing in three different jurisdictions suggests that inventions are more economically valuable than simple patent counts and this may be less discriminating of minor inventions and highly important inventions. Due to data availability, PCT and EPO are used in this review.

function. However, firms appeared to struggle with international market engagement, particularly in understanding how to enter new markets (for example, logistics, labelling, channel management), and the full cost of doing so. Despite this, there were some examples of offshore servicing and testing being introduced.

Forms of organisational innovation were not particularly apparent, other than the outcomes of merger and acquisition activity, although there were some exceptions in the financial and insurance sector, including Vero's introduction of business excellence throughout the organisation. The relative paucity of organisational innovations is likely to be due to the tendency for smaller firm owners to work "in the business" rather than "on the business" as well as weaknesses in management capability.

In general, most product innovation across the sectors interviewed was incremental and involved improvisation rather than more radical forms. This, as well as not employing other forms of innovation, is likely to lead to firms losing competitive advantage and market share. Respondents in a follow-up study for this review, believed that less successful firms in their respective sectors had failed because they simply stopped investing in product development and improvement, and hence stopped innovating (Ascari Partners, Strateg.Ease & PricewaterhouseCoopers, 2011).

4.2. Firm size and innovation

New Zealand's national innovation rate increases with business size. Sixty-four percent of businesses with 100 or more employees are innovators, compared with 43 percent of businesses with 6-19 employees (Statistics New Zealand, 2010a). A survey of micro (0-5 fulltime equivalent employees or FTEs), small (6-49 FTEs) and medium (50-99 FTEs) in New Zealand in 2008 found that micro firms had an innovation rate of 34 percent, while small firms' rate was 54 percent (New Zealand Centre for SME Research, 2009).

The size of firms in Auckland presents a significant challenge when it comes to improving innovation performance. As at February 2009, there were 161,104 firms

located in the Auckland region, constituting 31 percent of New Zealand businesses.[10] They employed 621,430 people or 32 percent of the national workforce. But, like the rest of New Zealand, Auckland's economy is dominated by small to medium-sized businesses (SMEs).[11] Globally-significant firms are important for capturing value from innovations and economies of scale in distribution and marketing. New Zealand has few globally-significant firms on a population basis compared with other OECD countries.[12] Australia has 45 such companies. New Zealand potentially has one, which is headquartered in Auckland: Fonterra.

Auckland interviews found that small firms were focused on their current projects or customer orders and did not have the time or resources to think beyond their immediate concerns. Large firms tended to be more formal in their approach to innovation, with dedicated staff and allocated budgets – although this tended to be directed towards new products, and the budget was often referred to as "design and marketing". However, the factors mediating firm size and innovation are unclear. Approaches to managing and measuring innovation, and investment in R&D all appear to matter but often the relationships are not found in ways one would expect.

4.2.1. Managing innovation

Rather than spending large amounts on R&D, the most successful firms build international capability along the innovation pathway, integrate activity between the different stages, and align innovation management with their corporate strategy (Juruzelski, Dehoff & Bordia, 2006). Worryingly, firms in New Zealand appear to have less of a focus on innovation at the strategic level. When asked to rate the importance of various business strategies, only 37 percent considered innovation to be very important, while more than 70 percent of businesses said that the quality, delivery or pricing of goods and services was very important (Statistics New Zealand, 2006a). Given this, it is not surprising that the sector interviews for this review uncovered little in the way of a systematic approach to managing innovation in

[10] Statistics NZ. (2010). *Business demography statistics*. "Firms" are defined as "economically significant enterprises". They must meet at least one of the following criteria: annual GST expenses or sales of more than $30,000; rolling mean employee count of greater than three; part of a group of enterprises; a new GST registration that is compulsory, special or forced; registered for GST and involved in agriculture or forestry; over $40,000 of income recorded in the IR10 annual tax return (this does include some units in residential property leasing and rental).

[11] SMEs in New Zealand are defined as enterprises with 19 or fewer employees. The ratio of "small units" (0-49 employees) to "medium-large units" (50+ employees) in Auckland is 65:1, whereas for the rest of New Zealand it is 68:1.

[12] In the 2010 Forbes Global 2000 list, Switzerland had 48 companies, Australia 45, Sweden 27, Singapore 18, Ireland 16, Denmark 13, Finland 11, Norway 10, Portugal 9, Chile 8 and New Zealand had none. Fonterra does not appear on the Forbes 2000 list because it is owned by a co-operative.

Auckland. Most firms interviewed managed the innovation process informally and generated ideas through informal brainstorming, relying on their internal resources to supply staffing and funds for innovation.

However, there was also considerable variation from sector to sector, with innovation processes being more formally managed within the financial sector or by food and beverage firms. On the other hand, the fledgling digital content sector – which is dominated by small, undercapitalised firms – primarily used informal innovation processes, such as brainstorming.

Lack of information and poor access to information in relation to innovation and innovation management appears to be a particular barrier for small firms. This may occur at different points in the innovation process. Digital content firms said they did not know where to go for advice on matters such as licensing, or even how to access sector-specific skills or expertise. Further, there were few cases of exemplar firms for them to learn from.

Greater support is needed for firms to "do" innovation. This could be in the form of innovation management tools and clear channels for accessing information and support (both from the private and public sectors). The findings suggest that it is likely to be useful to develop initiatives that assist small firms in making innovation management more systematic through workplace initiatives that enable them to learn while still allowing them to focus on their current projects. Given that the challenge appears to be related to firm size, policy responses may be targeted at improving the capacity of firms to manage innovation through increasing scale using collaborative mechanisms.

4.2.2. Measuring innovation

The concept of "hidden innovation" and what is considered "innovation" may also play a part in the relationship between firm size and innovation performance. "Hidden innovation" [13] refers to innovation that may not be captured by traditional measures – for example, investment in R&D, measures of patents and definitions of innovation. Smaller firms may be underrepresented in patenting statistics, preferring to rely on other strategies of intellectual property protection. The firms interviewed

[13] See NESTA (2007) and NESTA (2008) for a more in-depth discussion of "hidden innovation".

usually did not use the term “innovation” to describe new or significantly-improved activities, considering them to be part of their everyday business. While it does not necessarily matter whether firms refer to innovation by name, having a shared understanding of what constitutes innovation does matter when it comes to designing interventions intended to stimulate innovation.

R&D can also be misunderstood by firms. It is important that firms know what R&D is and how it contributes to firm performance, as there are linkages between a firm’s understanding of R&D and their subsequent implementation of R&D activities (New Zealand Centre for SME Research, 2009). In a baseline study as part of pre-intervention data gathering for the now repealed R&D tax credit, most SMEs indicated they “go with their gut feeling” in answer to the question: “How do you know whether your firm engages in R&D or not?” (New Zealand Centre for SME Research, 2009). Also, most firms did not formally document their R&D projects and expenditure, which presents a challenge to any R&D policy that relies on firm accounting (Ministry of Research, Science and Technology, 2009).

Given that “innovation” and other innovation-related terms like R&D are considered as too vague and intangible by firms, the language used to promote and improve innovation needs to be better considered. This could be achieved through better championing of innovation and R&D – for example, through elevating the public profile of private sector innovation leaders, profiling success stories so that innovation actors can see and understand its effects, and better coordination of innovation messages. Another option that could be considered for some sectors (e.g. digital content, marine) is whether R&D scale can be created through a collaborative approach to managing projects across many small firms.

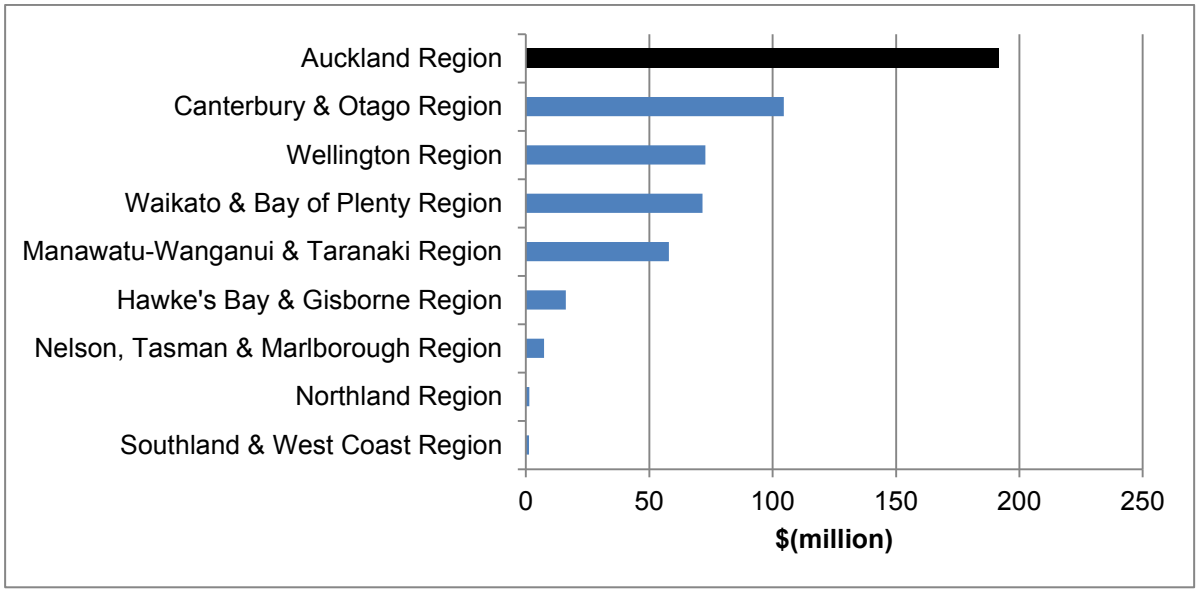
4.2.3. Investment in research and development

R&D is positively associated with profitability and export activity in New Zealand (Ministry of Research, Science and Technology, 2009).

Figure 5 shows that the Auckland region accounted for 37 percent (191.6 million) of the New Zealand business R&D spend ($524.3 million) (Tuya, 2007). Whilst absolute expenditure is greater in the Auckland region, once comparisons with

regional GDP are taken into account business R&D is not particularly concentrated in Auckland.

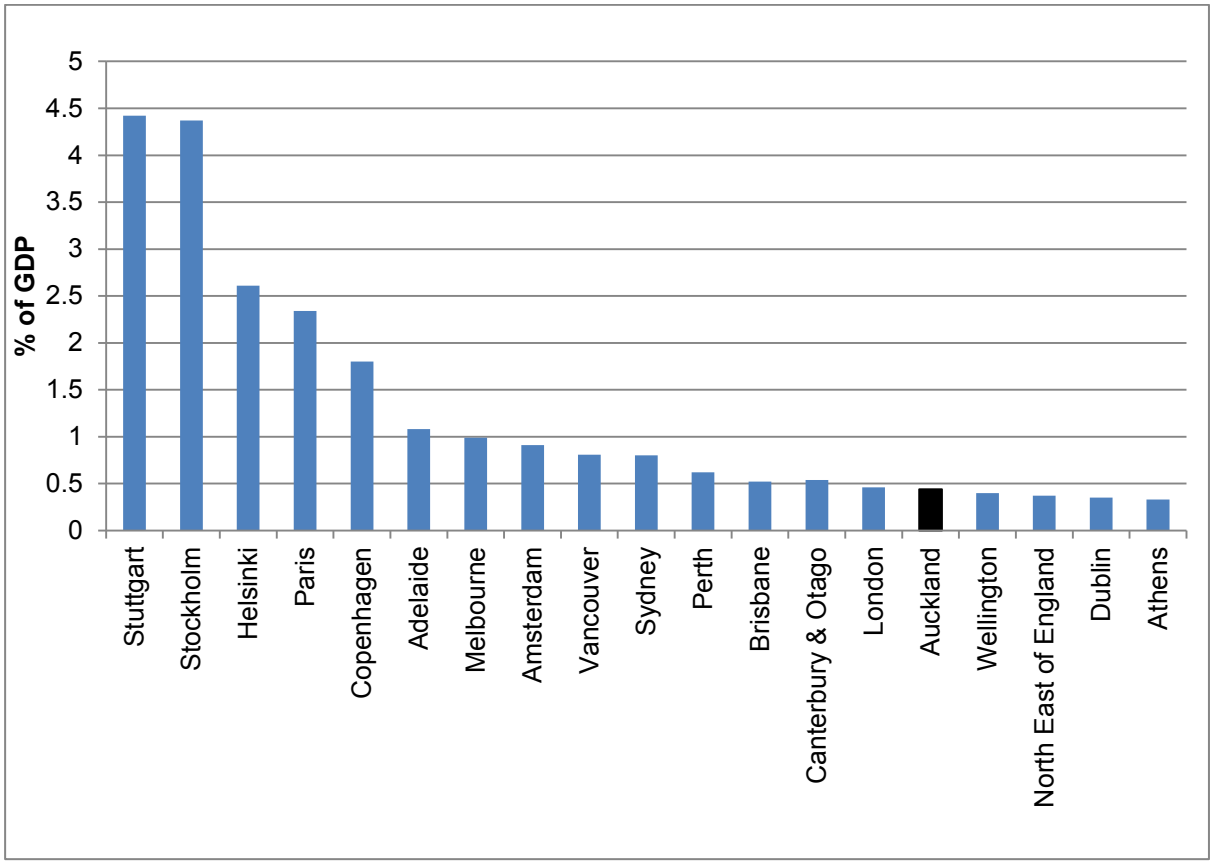
Figure 5: Business expenditure on research and development, 2002



Source: Statistics New Zealand. (2007). *Regional assessment of research and development feasibility project*.

When New Zealand's business R&D expenditure is compared with that of other OECD countries, it becomes apparent that New Zealand firms under-spend on R&D. Business R&D expenditure in Auckland is 0.44 percent of regional GDP, slightly higher than the national figure of 0.42 percent of GDP. Yet business R&D expenditure in the average OECD country is about 1.5 percent of GDP (*Figure 6*) and some regions spend much more. Comparable Australian states (Victoria, New South Wales and South Australia) spend more than twice as much on business R&D than the Auckland region.

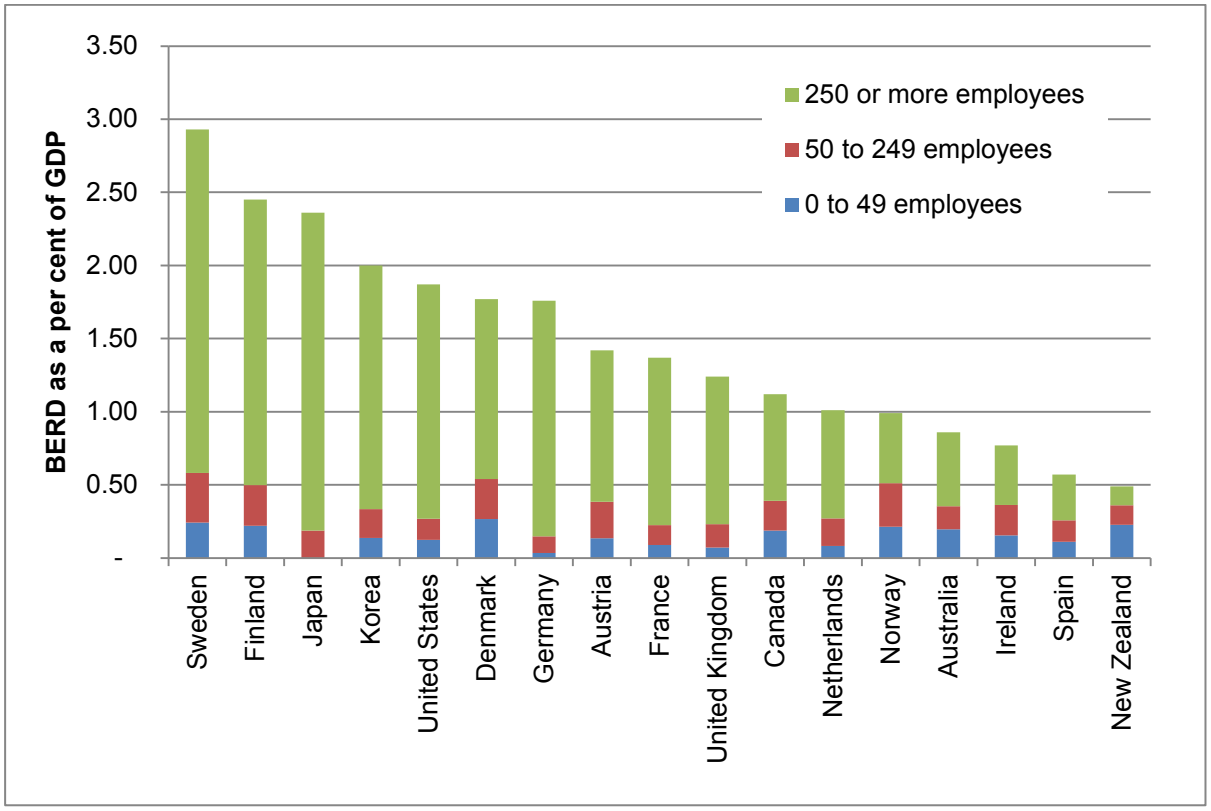
Figure 6: Business R&D expenditure as a percentage of GDP, 2002



Sources: Technolopolis. (2006). *Strategic evaluation on innovation and the knowledge based economy in relation to the structural and cohesion funds, for the programming period 2007-2013.*
Department of Education, Science and Training. *Australian science and technology at a glance 2004*.
Statistics New Zealand, regional GDP estimates.
Statistics New Zealand. (2007). *Regional assessment of research and development feasibility project.*
Statistics Canada. *Science Statistics*. November 2007 edition.

New Zealand's business R&D expenditure profile differs from other OECD nations due to firm size and difference in R&D intensity of different sectors. New Zealand's smaller firms invest at a similar rate to those in other countries (*Figure 7*). New Zealand and Auckland appear to be lacking the larger, internationally-scaled, high-tech or knowledge-intensive firms that drive private sector R&D investment in other economies. Or, given that the larger Auckland firms tend to be owned offshore, perhaps it is the larger base of smaller firms who should be investing even more.

Figure 7: Business expenditure on R&D (BERD) by firm size, 2005



Source: Ministry of Research, Science and Technology performance and evaluation.

Auckland and New Zealand's low rate of business investment in R&D is of particular concern. To improve national performance in this area, the government announced increased support for business R&D in the 2010 Budget. New initiatives include technology development grants for firms with strong R&D capabilities and technology transfer vouchers for firms with little R&D capability to commission research from accredited research organisations. At the regional and local level, the most effective public interventions will likely involve aligning and supporting networks and groupings which encourage collaboration between firms, and between firms and education/research organisations (both public and private sector), so that there is easier access to resources for R&D and innovation.

While firms state that R&D investment is critical to competitiveness, both small and large firms appear to struggle to invest in R&D in Auckland (Ascari Partners et al., 2011). For small firms, focusing already-scarce resources on R&D was considered to be risky for ideas that may fail technically or commercially. In 2008, 54 percent of SMEs in New Zealand spent less than $10,000 on R&D, 24 percent between $11,000 and $50,000, and expenditure above $50,000 was relatively uncommon

(New Zealand Centre for SME Research, 2009). Some larger firms interviewed did not appear to have an organisational culture that valued R&D and they focused on improving existing products rather than developing anything new. R&D activities also tended to be based at headquarters of larger multinational companies. Firms with foreign ownership stated that R&D activity was undertaken by their offshore parent company.

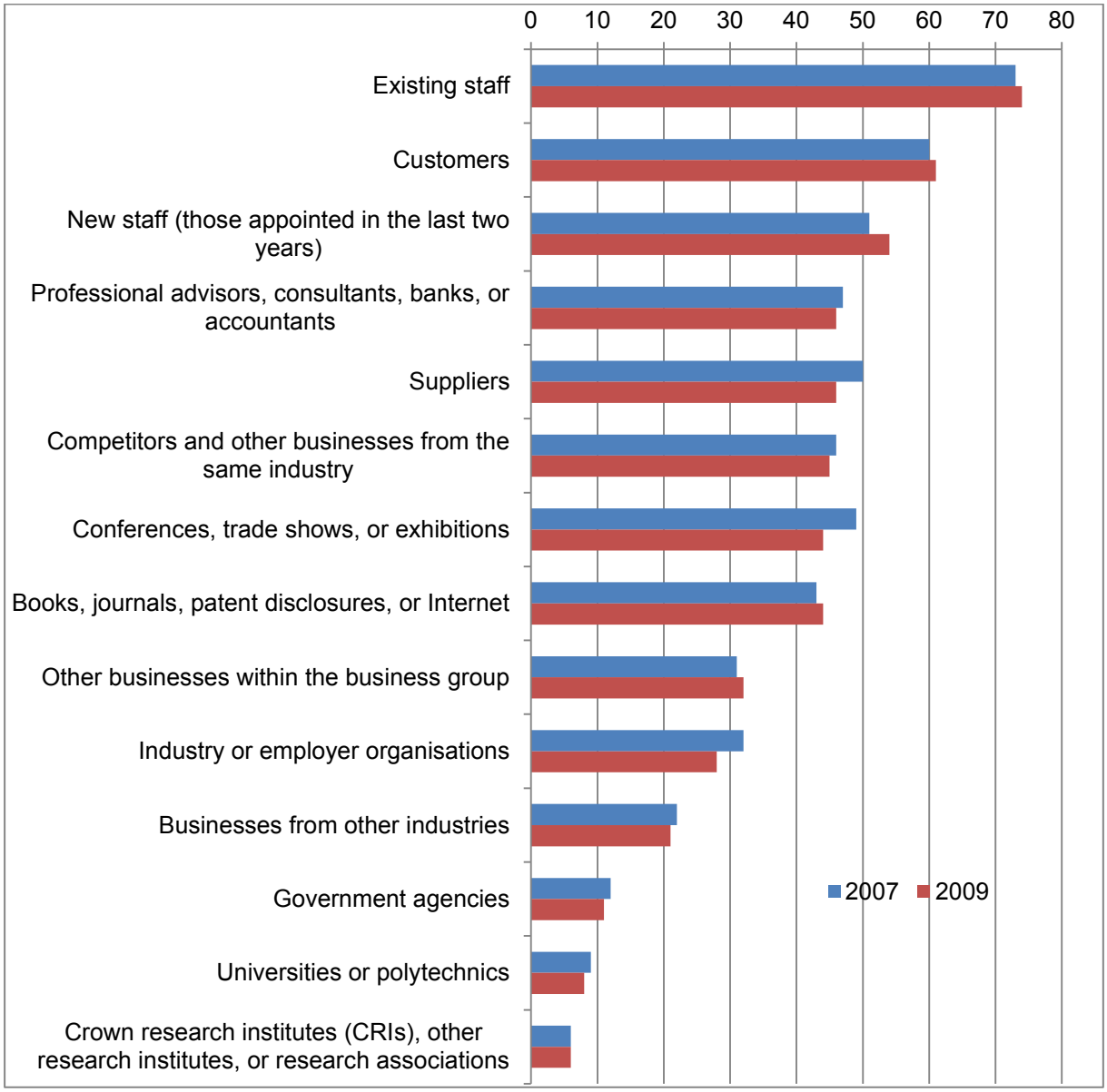
4.3. Innovation and the value chain

Demand conditions are crucial. Innovation often takes place when firms are stimulated by, and work with, their customers, competitors, suppliers and international businesses. The review examined the extent to which firms interacted with their value chain for innovation.

4.3.1. Working with customers

Internationally, the largest R&D spenders that engaged directly with their customer base had twice the return on assets and three times the growth in operating income in comparison to other firms (Juruzelski et al., 2006). New Zealand firms rely primarily on their own staff, but many (61 percent) regard their customers as the most important *external* source of information (*Figure 8*) (Statistics New Zealand, 2010a). The sector studies confirmed these findings, showing that innovation was typically initiated within the firm, although customers had an influence on the process. While customers appear to have been used even more over time, it is concerning that firms are relying less and less on other external networks and continue to become more inwardly focused. This has consequences for the ability of firms in Auckland to improve their innovation performance.

Figure 8: Sources of ideas or information for innovating businesses, last two financial years at August 2007 and 2009



Source: Statistics New Zealand. (2010a). *Innovation in New Zealand: 2009*.

Some segments of Auckland's industries had strong linkages with their customers. Auckland's luxury vessel customisation industry demonstrated the importance of maintaining close connections with customers and of customers driving innovation. The luxury boats sub-sector is the most export focused of the marine industry, and firms attended to the customer's complete business needs including communications, travel arrangements and other services. Vessels are built to customer specifications and buyers take an active part in all stages of the construction and fit-out of their vessel. Flexibility and a firm's focus on the quality of the customer's experience is thought to generate customer loyalty and offer a point of

difference, which was confirmed by international customers in a workshop for this review.

Consumer demand for larger boats also drives innovation. The term “superyacht” originally referred to craft of 30 metres in length; however, average displacement has increased five-fold in the last twenty years. This creates design and production challenges, increasing the use of advanced materials for construction, rigging, and sails, and requiring innovative solutions to meet engineering requirements. One such advancement is Cervina Group’s vessel control and monitoring system (VCAM), a fully-automated, touch-screen system that interfaces with the navigation, security and audio systems on the vessel. It is also scalable.

For food and beverage processing firms, the customer is typically the buyer for a supermarket chain. Local supermarket chains are not thought to drive innovation; however, supermarket chains overseas have had a significant impact on product innovation. They demand products to meet consumer trends, source sustainability and ethics-aligned products, and have increased the development of their own product ranges (Partos, 2008). In Auckland, large food and beverage processing firms rely on market research to understand consumer trends and fast-moving consumer goods firms make extensive use of focus groups to test new products. Access to international market knowledge and the ability to translate this information into new product development are particular weaknesses that have been strongly and consistently noted by Auckland’s food and beverage processing sector. This appears to be a barrier to innovation by firms, especially aspiring exporters.

The financial and insurance products sector also uses customer focus groups to assist in product and process development. Market research agencies play a key role in this sector by providing firms with customer insights. Advanced materials companies had strong technical relationships with customers and some companies made use of customer focus groups to provide fresh insights into what customers were seeking in terms of the functionality and performance of products.

A point of difference that was noted about Auckland and New Zealand’s customer base was the openness of end-consumers to trying new things like innovative products and services. Firms in the food and beverage sector, finance and insurance

services sector as well as the health technologies sector all commented on this uniqueness. While this may be the case, firms and sectors did not appear to be capitalising on this in any coordinated fashion.

It is clear that the quantity and quality of customer demand for innovation is variable across sectors in Auckland, and that firms should make more use of their customers, both locally and internationally. While Auckland provides the biggest domestic market for local products and services, firms do not appear to be taking full advantage of it. For example, the workshop with the food and beverage sector found that Plant and Food Research capitalises on Auckland's diverse ethnic mix and recent migrant arrivals to conduct tasting panels for products bound for export markets. However, none of the firms and industry representatives were aware of this service. The approach appears to be relatively passive with few firms bringing their customers into the innovation process. There are exceptions (for example, ASB's use of customers in strategic innovation); however, as a region or sector this approach does not seem to be a strength. Auckland – which has stronger global linkages through its ports, foreign direct investment and extent of personal relationships – should be more attuned to international patterns of demand. Given Auckland and New Zealand's remote location and distance from major routes of commerce, these are linkages that cannot be dismissed.

Auckland firms must be able to deliver what their trading partners are demanding in order to be successful. This will require more investment in, and greater access to, in-depth market and customer information. More could be achieved at the local, regional and national level to improve these types of linkages. These could involve collective approaches to gathering market intelligence, regional forums for strengthening international linkages or using public procurement to stimulate innovation.

4.3.2. Working with suppliers

The organisations within a firm's supply chain can provide a source of ideas and technology for innovation, and be collaborators in the innovation process. However, suppliers are used as a source of innovative ideas to a much lesser extent than customers, although suppliers are more likely to be involved in collaborative arrangements for innovation than customers, competitors and universities (Statistics

New Zealand, 2010a). In the finance and insurance sector, there is evidence of collaboration between technology payment segment firms – for example, banks collaborating with SMS providers and content providers to introduce mobile banking. In the food and beverage sector, there is considerable outsourcing of manufacturing, packaging and distribution in the region.

As part of Winstone Wallboard's review of traditional gypsum-based plaster wallboards and the introduction of new wallboards to residential markets, integrated services were offered to intermediaries in their distribution chain. For example, builders could order and receive a house-lot of wallboard, along with windows, flooring, doors and other components from partner companies. These services provided the basis for developing strategic partnerships with specifiers and manufacturers of other building products as well as with process partners such as builders, distributors and installers. Those partners became tightly linked to Winstone Wallboard's internal processes. These relationships led to ready and mutually-profitable opportunities for Winstone and their partners. For example, Pilkington's Hush Glass got access to a valuable route to market by partnering with Winstone in their search for a noise solution.

Larger firms tended to have greater engagement with supply chain partners. The marine sector was an exception to this. Because boatbuilding is characterised by SMEs specialising in discrete areas, supply chain partners tend to work together with the shared purpose of building a better, bigger, smarter or faster boat. The customer may deal with a single boatbuilding firm that has many sub-contracts to deliver the end product.

Generally, suppliers were impacting on innovation through introducing new products and inputs into firms, rather than through a deliberate or considered collaborative approach from the firms themselves. For example, in the digital content sector, hardware and software suppliers introduce and educate firms on the use of new technology to improve workflow practices and to ensure the latest equipment is adopted in production. In the advanced materials sector, the role of technically-savvy importers was highlighted as an important component in introducing new materials and technologies.

4.3.3. Working with competitors

National and international competitors can stimulate innovation by providing knowledge and creating inter-firm competition. Maintaining a competitive edge is a primary concern for Auckland firms yet, unsurprisingly, they are often reluctant to collaborate with rivals out of a concern that their competitors will gain advantages by accessing company knowledge. This sensitivity made it hard to set up focus groups and workshops for this review. Competing for a limited range of domestic business and local opportunities was a particular barrier for firms collaborating in the digital content sector.

Overall, there was little evidence of inter-firm collaboration on innovation projects beyond firms' own value chains. Respondents to a follow-up study also commented that they were too competitive to collaborate with other firms within the same sector on R&D projects, particularly with direct competitors. They did not think it was in the firm's best interest to collaborate with others within the same industry because of the importance placed on protecting their intellectual property – the source of their competitive advantage (Ascari Partners et al, 2011).

Firms in the wine sector have tackled some of these perceived barriers by focusing their collaborative efforts at different points along the innovation pathway. For instance, they tend to work together on production rather than on marketing. Babich Wines, Shingle Peak Wines, Nautilus Estate and Wairau River Wines are equal partners in the Marlborough joint venture, Rapaura Vintners. Rapaura is a winemaking and bottling plant that processes up to 5,000 tonnes of grapes a year, allowing the partners to share the capital costs of wine production.

There also appeared to be an increasing awareness that it is worth pursuing collaboration to secure major offshore market opportunities and collectively address resource bottlenecks. A number of industry development initiatives in Auckland over the last few years reflect this, including Film Auckland and the "Family of 12" winemakers, who jointly market their wines internationally.

In general, Auckland firms do not innovate by applying all the different types of innovation, and they tend to rely on their own resources rather than partnering with others. Innovation is typically incremental, as firms focus on small improvements and

changes to their core products and services with little investment in radical innovation. There are a number of issues here. The use of networks and collaborative relationships within industries and across sectors is likely to improve innovation performance in Auckland as firms will learn from each other and collaborate to compete. These networks, relationships and/or collaborative mechanisms are likely to differ depending on the sector. For example, in the food and beverage processing sector, New Zealand Food Innovation Manukau and the New Zealand Food Innovation Network have both physical as well as virtual collaborative structures. For other sectors, regular information exchange forums would be an appropriate first step. Additionally, it is important to include key players across the supply chain when designing any initiatives as they play an important part in strengthening innovation.

4.3.4. Capabilities

Capabilities refer to processes and routines that provide firms with a competitive edge. Not surprisingly, capabilities differed considerably across the firms or sectors interviewed. However, some common themes emerged. First, New Zealand's size and distance promotes an agile approach to manufacturing, design and commercialisation. Many successful firms have been able to adapt their business model or reduce cost structures to respond to competitive threats, such as shifting parts of the innovation chain offshore, and diversifying products and service lines. Domestic consumers are also regarded as relatively open to new products and this makes it easier to introduce and test product developments.

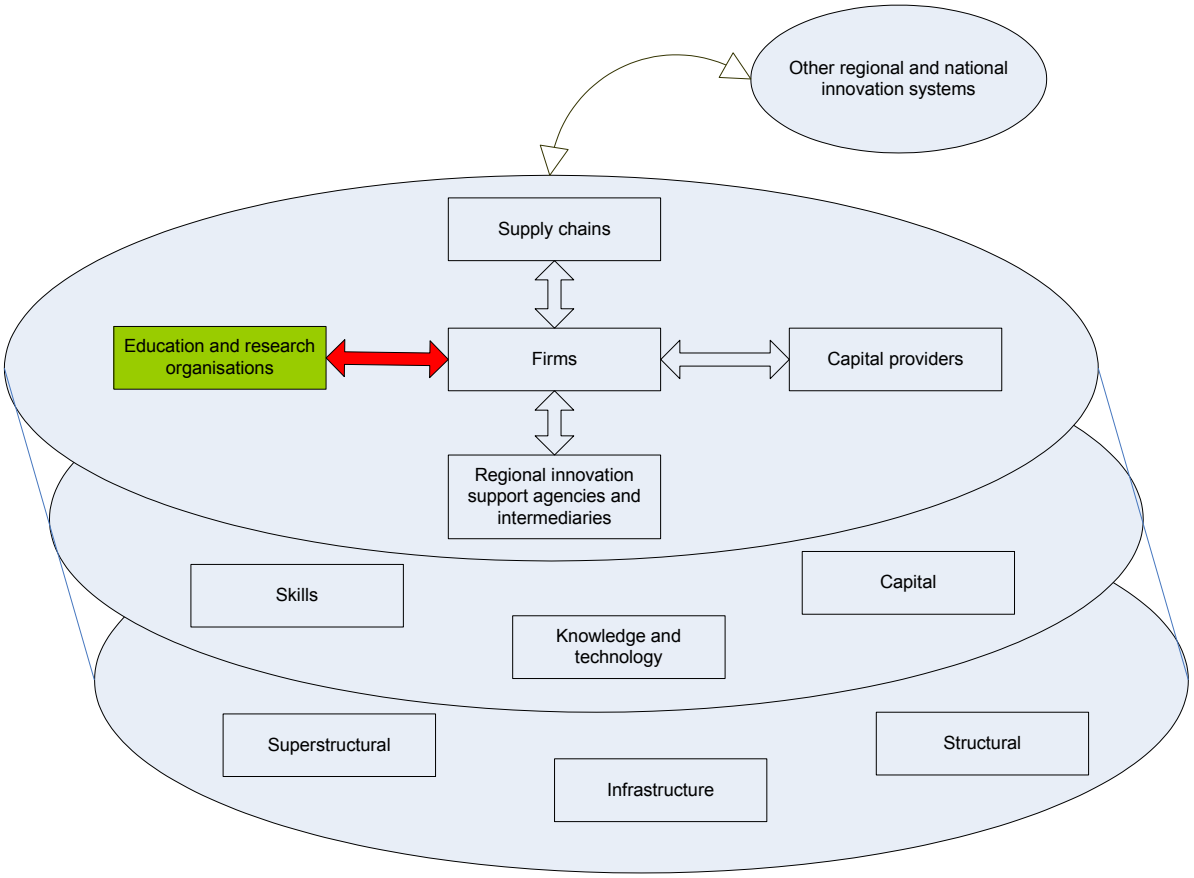
The research and industry expertise in the region provides an embryonic but largely untapped capability that can be drawn on, although it is not yet well connected. For example, in the advanced materials industry, Auckland has a good concentration of applied companies (e.g. in marine, construction, transport and packaging) and a significant repository of applied research – spanning plastics, composites, polymers and light metals – that is unusual in its breadth.

The strength and potential of the Auckland economy relies on its connections to rural, provincial and agricultural economies. In many ways, the core business of the Auckland economy is to add value to exports through professional and financial services, business management and marketing. In this review, the financial and

insurance services sector was studied. However, innovation within the services industries has largely been ignored, both at the policy level and at the firm level, although this is not unique to the Auckland region. With a growing professional services industry, as well as a need to focus on a "weightless economy" due to Auckland's distance from the rest of the world, further work needs to be completed on how innovation within this sector can be identified and fostered.

The New Zealand marine, food and beverage and digital content sectors, in particular, have successfully built solid reputations internationally and there is now an opportunity to build on this advantage. In addition, New Zealand's clean and green and "creative" image benefits marketing efforts. This reputation can be further strengthened by the New Zealand brand, which was developed through the collaborative marketing efforts of New Zealand firms, NZTE and Tourism New Zealand and through high-profile events for international markets (branding is discussed further in section 10, *National, local and international linkages*). Auckland as a region, however, generally does not collaborate in its efforts to market its industries, and this needs to be improved. In addition, a key point of discussion at the workshops was that Auckland's reputation did not necessarily reflect the reality – for example, digital content is riding on the international reputation of Weta Digital, and Auckland's marine sector is facing real capacity constraints. Unless fundamental issues are dealt with, workshop participants believed that Auckland (and New Zealand) firms would be overtaken by leading regions in other countries.

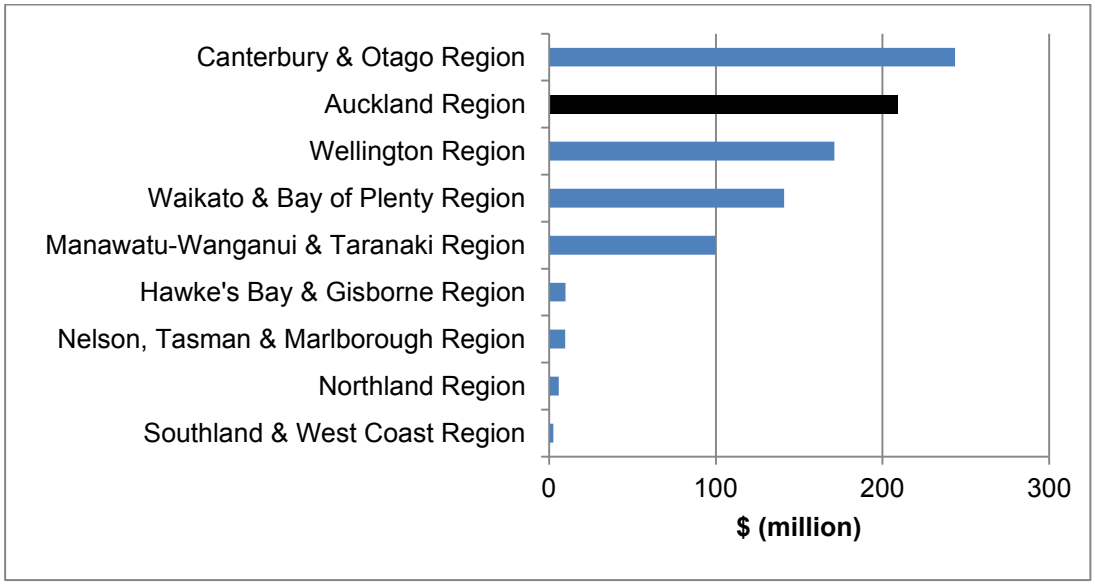
5. The role of education and research organisations



Education and research organisations are a key source of scientific and technical expertise, and research capability for innovation. In addition, they create the skilled workforce necessary for innovation.

Education and research organisations spend a significant proportion on R&D, and expenditure by the government and higher education sectors has increased over time. In 2008, this expenditure was estimated to be $1,099 million (Statistics New Zealand, 2009), whereas in 2002, national expenditure was $892.2 million. In 2002, Auckland was the largest regional spender. The total public R&D spend for Canterbury and Otago, which has been combined in *Figure 9* to protect data confidentiality, made up 27 percent ($243.4 million). The Auckland region was close behind with a public R&D spend of $209 million, or 23.43 percent.

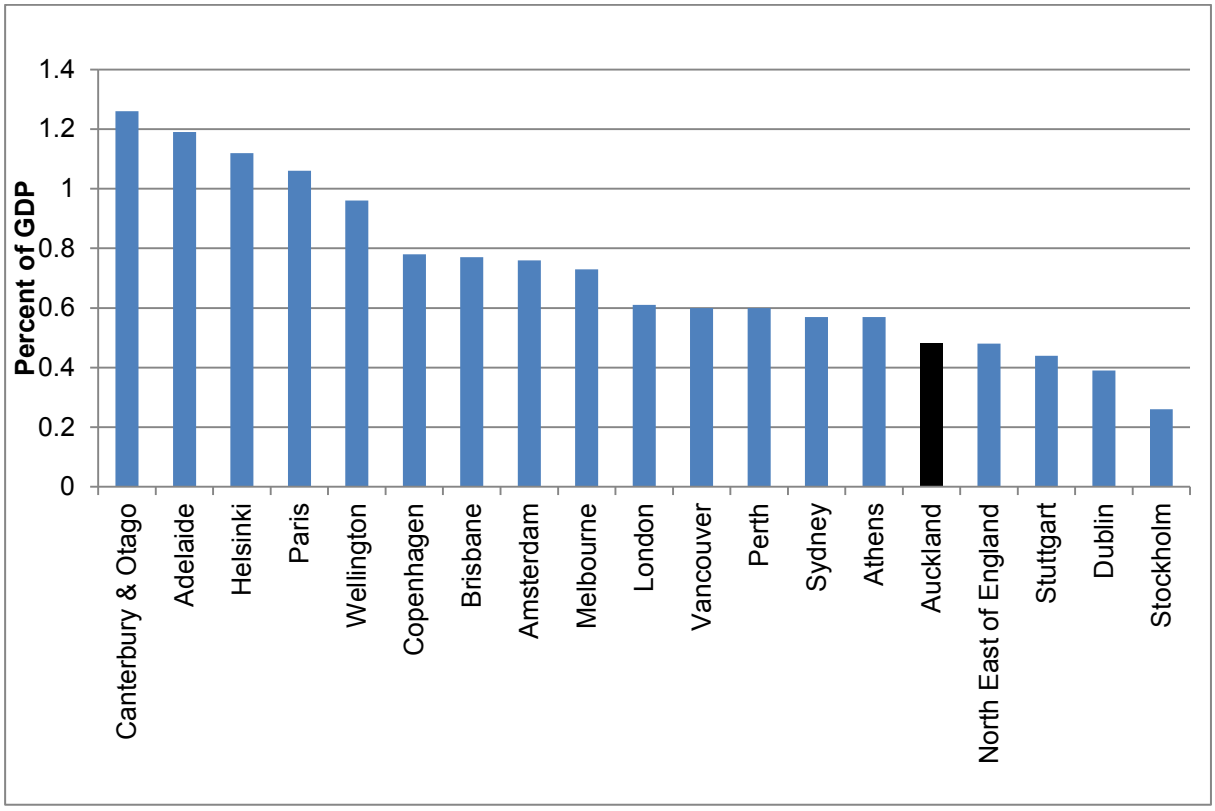
Figure 9: Total government and higher education expenditure on research and development, 2002



Source: Statistics New Zealand. (2007). *Regional assessment of research and development feasibility project*.

Auckland's research organisations (universities and Crown research institutes) make significant investments in R&D in national terms. Yet when the regional spend is compared with other international city-regions (as a percentage of regional GDP), Auckland appears at the lower end of the league table (*Figure 10*). The higher ranking for Wellington reflects the large number of Crown research institutes based in the region.

Figure 10: Public R&D expenditures (as a percentage of GDP), 2002



Sources: Technolopolis. (2006). *Strategic evaluation on innovation and the knowledge-based economy in relation to the Structural and Cohesion Funds, for the programming period 2007-2013.*
Department of Education, Science and Training. *Australian science and technology at a glance 2004.*
Statistics New Zealand, regional GDP estimates.
Statistics New Zealand. (2007). *Regional assessment of research and development feasibility project.*
Statistics Canada. *Science Statistics.* November 2007 edition.

So who are these R&D spenders in Auckland and how well are they connected to firms in the Auckland region? While Auckland's education and research organisations spend relatively modest amounts on R&D internationally, is the knowledge they gain utilised in the best way? To what extent do organisations and firms uptake research and how do they do it? The following discussion describes the education and research organisations in Auckland and the extent to which they are connected to other innovation actors.

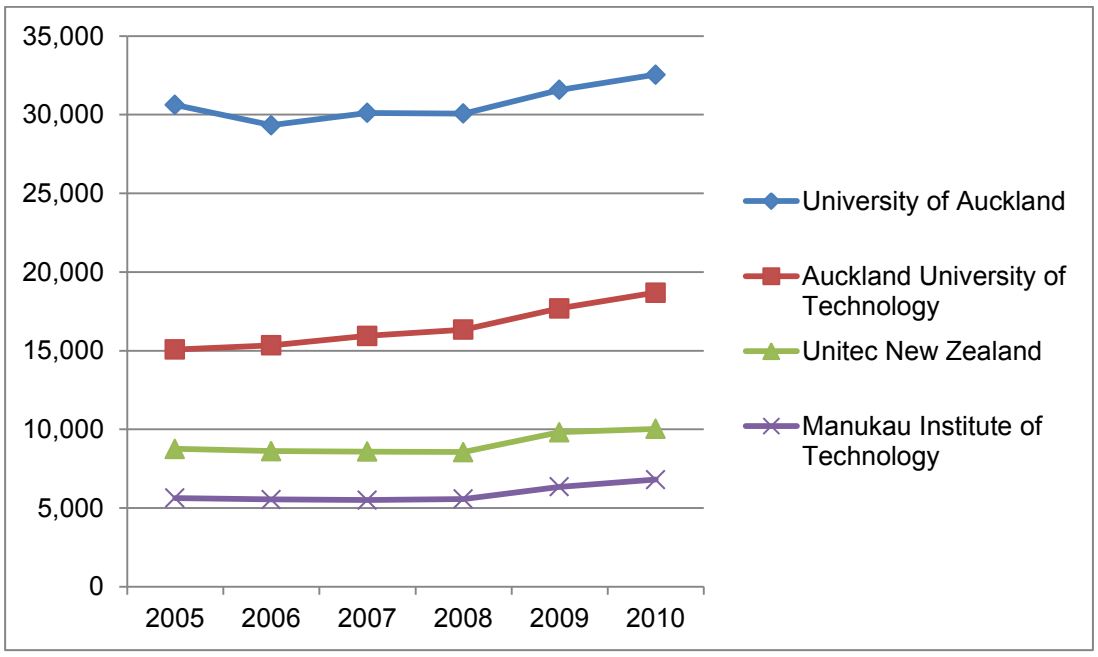
5.1. Tertiary education providers

Universities play a central role in the Auckland regional innovation system. In addition to the two local universities (the University of Auckland and Auckland University of Technology), Massey University has a substantial presence. Auckland is also home to a number of institutes of technology and polytechnics (notably the Manukau Institute of Technology, Unitec, the Auckland Central campus of Whitireia

Community Polytechnic, and the Manukau branch of Te Wānanga o Aotearoa)[14] as well as private education providers.

The University of Auckland is the largest of these institutions, with 32,545 full-time equivalent students enrolled in 2010 (Ministry of Education, 2011). All providers have shown growth in the period 2005-2010, particularly the Auckland University of Technology (*Figure 11*).

Figure 11: Enrolments at main Auckland-based tertiary education institutions by full-time equivalent students



Source: Ministry of Education.

While there are difficulties in comparing the quality and performance of universities,[15] the University of Auckland is New Zealand's highest-ranked university. In 2009, the *Times Higher Education Supplement* (THES) World University Rankings[16] placed the University of Auckland as 61st in the world, the University of Otago as 125th and the University of Canterbury as 188th. However, the THES ranked six Australian universities higher than the University of Auckland.

Auckland-based tertiary education institutes appear to have considerable critical mass in many areas of basic and applied research, supported by a number of

[14] A tertiary education institute guided by Māori principles and values.
[15] They include the problem of established reputations reinforcing rankings, the problem of language bias in bibliometric data, and the validity of peer review assessments. See Van Raan's (2005) conference paper for a fuller discussion of the issues.
[16] The THES score is based on several indices: peer review from academics and graduate recruiters, staff/student ratio, research citations per staff member, and the proportion of international staff and students.

research institutes and research centres within the universities and institutes of technology. The University of Auckland is home to three of the country's seven Centres of Research Excellence (funded by TEC)[17] as well as the Liggins Institute, the Auckland Cancer Society Research Centre, the Auckland Bioengineering Institute, the Wine Industry Research Institute (WIRI) at the Tamaki Campus, and the Yacht Research Unit in the Department of Mechanical Engineering in Auckland. In addition, the University of Auckland has what is regarded as the most successful commercialisation centre in Australasia – Auckland UniServices Ltd (*Exhibit 1*).[18]

Exhibit 1: Auckland UniServices Limited

Auckland UniServices Limited (UniServices) is the commercial research and knowledge transfer company for the University of Auckland. It manages the university's commercial research and consultancy partnerships, forms new business ventures based on university research, and owns and develops the university's IP.

Vital statistics in 2009

Founded	1988
Annual revenue	$114 million
Research and support employees	750
New spin-out companies	4
Investment raised for new companies	$5.6 million
New licenses	23
New records of invention and patent filings	83
International projects	In 30 countries with $44.8 million in income to the University

Source: University of Auckland Annual Report 2009.

The food and beverage sector has a range of research capability available in Auckland through the universities, with the University of Auckland, the Auckland University of Technology (AUT), and Massey University providing relevant research in areas such as nutrigenomics, wine, sports science (e.g. for sports water), and food science and technology. However, while the Auckland region's education sector has

[17] They are the Maurice Wilkins Centre for Molecular Bio-discovery, the National Research Centre for Growth and Development, and Ngā Pae o te Māramatanga.

[18] UniServices Ltd is the largest organisation of its kind in Australasia, and was described by the OECD as "an outstanding performer" (OECD, 2007, p. 132).

diverse research strengths, some sectors are not well served, particularly some service areas such as finance, insurance and digital content, although these sectors rely more on consumer and market research agencies as well as private education providers like the Media Design School and the Freelance Animation School.

Overall, the interviews for the sector studies highlighted that while firms were well aware of the education and training role of the institutes of technology and polytechnics (ITPs) and the universities located in the region, they were less aware of their research. None of the ITPs were mentioned in relation to their involvement in business innovation (firms also did not mention industry training organisations).

Further, it has been hard to build effective research-industry linkages. Interviewees did mention the role of serendipity in innovation. For example, Weta Digital and the Auckland Bioengineering Institute's work in biomechanics for animation – funded in part by a three-year million-dollar grant from the Ministry of Science and Innovation – arose from unexpected events. Serendipity is recognised as an agglomeration effect, arising from a larger, denser population and clustering. The success of Silicon Valley is attributed to these types of mechanisms through the development of locally-based interactions due to a critical mass of similar firms and institutions. Perhaps Auckland is not fully capitalising on agglomeration effects and creating the right environment for research, science and business to work together.

Firms complained about the difficulty of engaging with researchers. Auckland firms perceived difficulties or reported having encountered problems engaging with Crown research institutes, universities and other research providers (see also Norgrove & McCardle, 2006; IGrow NZ and Vantage Consulting Group, 2007; AERU & Flicka, 2009). They reported concerns about intellectual property protection, costs, control of the process and access to information. They also complained that researchers were strongly motivated by public funding requirements and that firms and research organisations tended to operate on different time scales and with different emphases (for example, universities focusing on theory rather than application). This last point is not surprising. Research – even applied research – may take several years, whereas firms typically seek to address immediate problems and find it hard to see the value of multi-year research programmes.

Consequently, firms were less willing than one could reasonably expect to undertake collaborative work with research organisations. Of the firms interviewed, few had regular or formal linkages with education and research organisations. University staff commented that often these difficulties expressed by firms are perceptions rather than the reality. They may be based on incidents that occurred many years ago, rather than a reflection of the current environment for collaboration. It is also clear that some universities have very strong relationships with firms and industry. Nevertheless, universities and research institutes also experienced difficulties working with firms. They commented that while there were initiatives which brought them closer to industry, often tangible outcomes or actions did not result from these initiatives.

The commonly-cited challenges were time and resources. While firms liked the opportunity to discuss their innovation challenges in a safe environment with researchers and academics, they often lacked the scale and resources to follow up or commit to projects. When collaborations did happen between research providers and firms, this was generally with large firms. Large primary producer firms appeared to have reasonable links into these areas and some work is regarded as world class by companies.

However, small firms and fast moving consumer goods (FMCG) companies considered that the communication of university research programmes needed improvement. Small and medium sized enterprises (SMEs) noted that the major barrier was not knowing who to initiate contact with, or how, due to the size and breadth of universities and Crown research institutes. A few companies had reasonably strong relationships with research organisations but these were generally large companies with personal relationships with individuals, rather than relationships at the organisation level. This may explain why collaborations occur with larger firms; SMEs are less likely to have the resources, networks and relationships with research providers (Ascari Partners et al, 2011).

Finally, it is apparent that many Auckland SMEs do not have the capabilities to absorb and get real value from research expertise so they tend to find it difficult to understand the relevance of available expertise and that some intermediation would be required to translate research into a form that they can understand and use.

A 2008 OECD review of tertiary education noted that there are several ways to encourage increased knowledge transfer between tertiary education providers and industry. These include extending industry co-funding requirements to public investment in research and education, incentivising the movement of researchers between providers and industry, and better matching curricula to the needs of industry. While there are a number of initiatives available in Auckland that reflect these options – such as research consortia support, elements of the Technology New Zealand programme and technology transfer vouchers – they do not appear to be sufficient.

Positively, there appears to be increasing interest in cooperation between tertiary education providers and other research providers in Auckland to build critical mass in specific fields. This includes working together on joint research proposals to MSI, such as in materials research.

However, the interviews suggest that the current high level of contestability in research funding continues to inhibit cooperation between providers and fragments scarce resources and expertise. In areas of industry strength for Auckland and New Zealand – such as food and beverage, marine, and health technologies – it would seem preferable to coordinate the use of the collective equipment and expertise to help industry be more competitive.

Recently, the marine sector and university commercialisation offices around New Zealand have initiated collaboration sessions in Auckland through the Capitalising on Research and Development Action Group initiative. This work takes a market-led approach to identifying projects in which industry-research linkages can be strengthened by identifying sector problems. It also looks at opportunities to which R&D could add value.

While many of the issues described above are best tackled via incentives and funding at the national level, regional and local government should take a more active part in establishing and supporting collaborative mechanisms like these, or by developing other innovation infrastructure (both hard and soft).

The Learning Quarter is a local initiative which shows how action at the regional and local level can better link universities into the regional economy. The Learning

Quarter covers 63 hectares within the central business district and encompasses the University of Auckland and the Auckland University of Technology. The two universities, together with the previous Auckland City Council, have partnered on a ten-year action plan to guide and improve economic, social, cultural and physical development of the area. While much of the plan includes improving the look, feel and physical access to, and within, the Quarter, actions also include increasing business access to the universities. While this component of the initiative is in its investigative stage, these are the types of spatially-specific interventions that should be supported.

5.2. Crown research institutes (CRIs)

There are eight CRIs in New Zealand, each of which is based around a productive sector of the economy or a grouping of natural resources.[19] Only two CRIs have head offices in Auckland (Plant & Food Research and NIWA).[20] Two CRIs (AgResearch and GNS Science) lack an Auckland presence.

Institutes of technology and polytechnics (ITPs) and universities and are generally not accessed for innovation, and CRIs are used even less.[21] In 2009, 6 percent of businesses used CRIs or other research institutes or associations, while 8 percent used universities or ITPs (Statistics New Zealand, 2010a). Most firms that were interviewed – other than those in the food and beverage processing sector – were relatively ignorant of the role of CRIs. They neither understood which capabilities they could access in CRIs, nor did they know which institution had the relevant expertise. Firms which had contacted CRIs expressed concern about the length of time it takes to get a project with a CRI agreed and started, and they also noted their frustration with CRIs wanting to own and control IP. This may arise from firms not actually recognising the value of protected IP and the belief that CRI research –

[19] They are Industrial Research Ltd (IRL), NZ Forest Research Institute Ltd (Scion), AgResearch Ltd (AgResearch), the Institute of Geological and Nuclear Sciences Ltd (GNS Science), Landcare Research New Zealand Ltd (Manaaki Whenua Landcare Research), the Institute of Environmental Science and Research Ltd (ESR), Plant and Food Research Ltd (formed from the merger of Crop & Food Research and HortResearch), and the National Institute of Water and Atmosphere Research Ltd (NIWA).

[20] Plant and Food's corporate offices and the largest regional campus are located in the suburb of Mt Albert. Research teams in gene technologies, food, insect science and post-harvest science are based there. NIWA's corporate office and regional campus is in Newmarket. The OECD's 2007 review of New Zealand's innovation policy noted that nine CRIs spread over 50 sites nationally appear to be excessive and may lead to inefficiencies (note that this was before the merger of Crop & Food and HortResearch).

[21] As we saw in the previous section, national innovation surveys show that universities, polytechnics, CRIs and other research organisations are not generally regarded as important sources of ideas and information for innovation by the majority of innovating businesses (see *Figure 11* in section 5, *The roles of education and research organisations*).

being partially government funded – should be at little or no cost. Overall, it is apparent that IP arrangements need to be understood and agreed between CRIs and businesses before the commencement of any projects.

Primary-sector and manufacturing industries are greater users of CRIs and other research institutes than service industries due to their focus. Food and beverage processing firms in Auckland interviewed for this study had had contact with AgResearch and Plant and Food Research (see *Exhibit 2*), although primary producers were more likely to have a research relationship with CRIs or other research institutes and to understand the long-term nature of basic research than FMCG firms, whose involvement was patchy.

Exhibit 2: Research institutes, universities and firms working together to ensure competitiveness in the global wine market

Plant and Food Research, universities, research centres and the wine industry (including Auckland-based firms like Pernod Ricard and Villa Maria) have been working on a six-year, $9.6 million wine research programme called the "New Styles of Sauvignon Blanc". The initiative is funded by the Foundation for Research, Science and Technology.

The programme aims to provide wine producers with the knowledge and resources to match grapes and yeasts to produce the wine and styles they want. It includes styles and ranges of aroma profiles targeted to specific export markets. The research will contribute to the expansion of the export market and a higher overall price per bottle for premium wines.

Within New Zealand and Auckland there are different styles of sauvignon blanc and the research programme has started to identify where these different characteristics come from and how they are influenced. These include seasonal conditions, soil type, cropping levels and the yeast used in winemaking. The programme will develop novel IP based around new yeast strains, new analytical and sensory facilities and innovative viticultural practices.

Most of the research is undertaken at the University of Auckland, where chemists are examining methods for juice and wine analysis, and how different yeasts influence the aroma and flavours. Plant and Food Research in Auckland is looking at how the chemistry and sensory properties link together, and how these vary within New Zealand. The sensory programme also compares sensory profiles from different regions in New Zealand with sensory profiles of French sauvignons.

Now in its last year, a number of workshops have been held to showcase results. New discoveries have been made each year which will help keep and improve New Zealand's position in the market of its flagship variety.

The lack of public and private sector collaboration among universities, CRIs, and industry has emerged as the greatest weakness in Auckland's regional innovation system. Auckland's strength is its critical mass of educational and research institutes which provide internationally-renowned research capability as well as skills for the domestic economy. However, linkages with industry and across the public, primary, secondary and tertiary sectors appear to be poor. While individuals and groups within firms and educational/research organisations do have strong and fruitful relationships, it certainly does not appear to be of the systemic nature that allows innovation to flourish.

The incentives for industry and education/research to work together are not strong. Funding through the Performance Based Research Fund (PBRF) traditionally places emphasis on research output, rather than research utility, and does not encourage relationships with industry or the wider community. However, recently released guidelines for the PBRF assessment for 2012 better recognise commercial and applied research. This will help foster equal treatment of commercial research and incentivise better relationships between business and academia. The Centres of Research Excellence in Auckland are also expected to facilitate networks of knowledge and to transfer knowledge from universities. The Ministry of Science and Innovation (MSI) is also in the process of implementing the recommendations of the CRI Taskforce (2010), which include funding for inter-institutional collaborative research partners and explicit business engagement strategies as part of CRI Statements of Corporate Intent.

On the other side, industry does not always have an appreciation of the value of research from universities and other research institutes, they may have limited capacity to absorb and use such research, and/or they may not know where or how to access it.

At the very least, the findings suggest that additional industry/market-led collaborative sessions between research organisations and business in Auckland – like the marine industry example – would be of value. These provide deeper linkages between larger groups in the two sectors as well as aid in addressing long-term

industry issues. The findings also suggest that it would be beneficial to clarify IP ownership arrangements.

In addition, market-facing interventions may be required to foster better relationships between the two parties for innovation. To tackle this issue, innovation vouchers have been introduced in a number of OECD countries such as Australia, UK, Austria and Denmark. Rather than offering grants for firms to work on research problems themselves, the voucher system requires firms to work with others. It encourages firms to fund work they might not be able to do otherwise, while also talking to other parties to identify who might be best placed to carry the work out. The researchers and universities are also able to be paid for the work through the voucher system, and are likely to improve accessibility to their services as a result.

In November 2010, MSI launched its technology transfer voucher scheme, which will encourage the transfer of technology from the laboratory to the marketplace. It provides 50 percent of funding towards business R&D projects conducted with public research organisations (CRIs and universities). One of the aims of the voucher scheme is to improve responsiveness and engagement between businesses and public research organisations. Businesses in Auckland are able to access these vouchers through MSI and ATEED.

The initial parameters of the programme are relatively high, with vouchers typically worth between $100,000 and $1 million and this may be prohibitive to smaller firms. Further, the voucher system could be improved by allowing firms to work with other firms, rather than restricting them to work with accredited, largely public-funded research organisations. Nevertheless, the Auckland region should be gearing itself up to respond to this new initiative. Auckland could learn from the regionally-based voucher scheme in the North West of England called Creative Credits, although this programme is aimed at better firm involvement with the creative sector. It includes an online gallery of potential organisations a business can work with.

The linkages between firms and educational/research institutes could also be strengthened by “translators” who can act as a bridge between the two sectors. Both parties find difficulties in relating to each other due to language, backgrounds, motivations and timeframes. These translators, who have backgrounds in both

fields, could facilitate better interactions between both parties for innovation outcomes.

Universities in Auckland offer multi-disciplinary courses and business plan competitions which foster the development of these translators. For example, the University of Auckland offers a team-based, final-year/post-graduate paper in "Innovation and New Product Development Processes" for students from the Engineering, Business and Creative Industries faculties. The paper introduces students to real world problems from industry partners. Other universities around New Zealand are also increasing their offering in this area. Lincoln University and Canterbury University are partnering to provide the Graduate Certificate in Applied Science and the Graduate Diploma in Applied Science programmes to marry science and entrepreneurship.

University commercialisation offices, like UniServices, already perform a translation role and are investigating other methods to increase engagement with industry. Further, the development of a national network – which will bring together university and CRI commercialisation and technology transfer offices – aims to improve coordination and efficiency. However, these intermediaries should also exist within the private sector and within industry. Further investigation of translation provision is warranted. Recommendations should also consider how it can augment and improve translator roles which are already in place.

5.3. Innovation infrastructure

How does knowledge pass from researchers to firms? Other than through networks and relationships, technology transfer offices (like UniServices), science and technology parks, and incubators can facilitate exchanges between researchers and firms.

Business incubators are designed to enhance the success of early-stage, self-sustaining entrepreneurial companies. They offer business support resources and services (such as access to finance, management advice and support), access to technical and market information, and cheap rental accommodation for the fledgling businesses. Such support for start-ups in the initial growth phase is intended to reduce the failure rate. Incubators in Auckland include The Icehouse at the

University of Auckland, Massey University's E-Centre and AUT's Business Innovation Centre. A number of firms have graduated from these incubators, grown and made inroads into international markets. These include Biomatters, a scientific software firm which has sold software to 43 countries and 50 states in the US; and MCom, which provides mobile banking and mobile payments software to some of the world's largest banking and financial institutions.

The IceHouse has been particularly successful, putting 65 start-up companies through an accelerator programme and over 2,000 owner/manager companies through learning and development programmes. The IceHouse was also named by Forbes.com as one of the world's top ten technology incubators in 2010. The Business Innovation Centre's eight incubated companies have raised $6 million in private equity capital since 2005. Massey's E-Centre has joint ventures and a memorandum of understanding with a major Indian conglomerate and an incubator in Beijing. These relationships will help to facilitate business match-ups, technology transfer, shared market information and provide easier access and support to New Zealand companies doing business in India and China.

However, incubator links with CRIs and universities in Auckland are not as good as they could be. Relatively few start-ups that enter incubators are actually generated from university or CRI research. New Zealand universities and CRIs operate technology transfer offices to manage IP and contract research, which can help to fund companies and build a business case. Compared to incubators, their commitment to growing a business is at an earlier stage and mainly relates to business structure. By creating further value and putting a network around business development, incubators should be able to complement the efforts of these offices and speed up the commercialisation process.

Most incubators have spent time and effort developing relationships with technology transfer offices. However, while some of these relationships are paying dividends, others are less effective. Interviews with parties on both sides highlight a number of issues that are preventing some of these relationships from developing further. There is no one formula for cementing relationships between incubators and universities and CRIs (MED, 2008). Rather, the development of these relationships is a long-term endeavour and depends on the people and organisations involved.

Trust, frequent quality interaction, incentives and university/CRI confidence in incubators appear to be important.

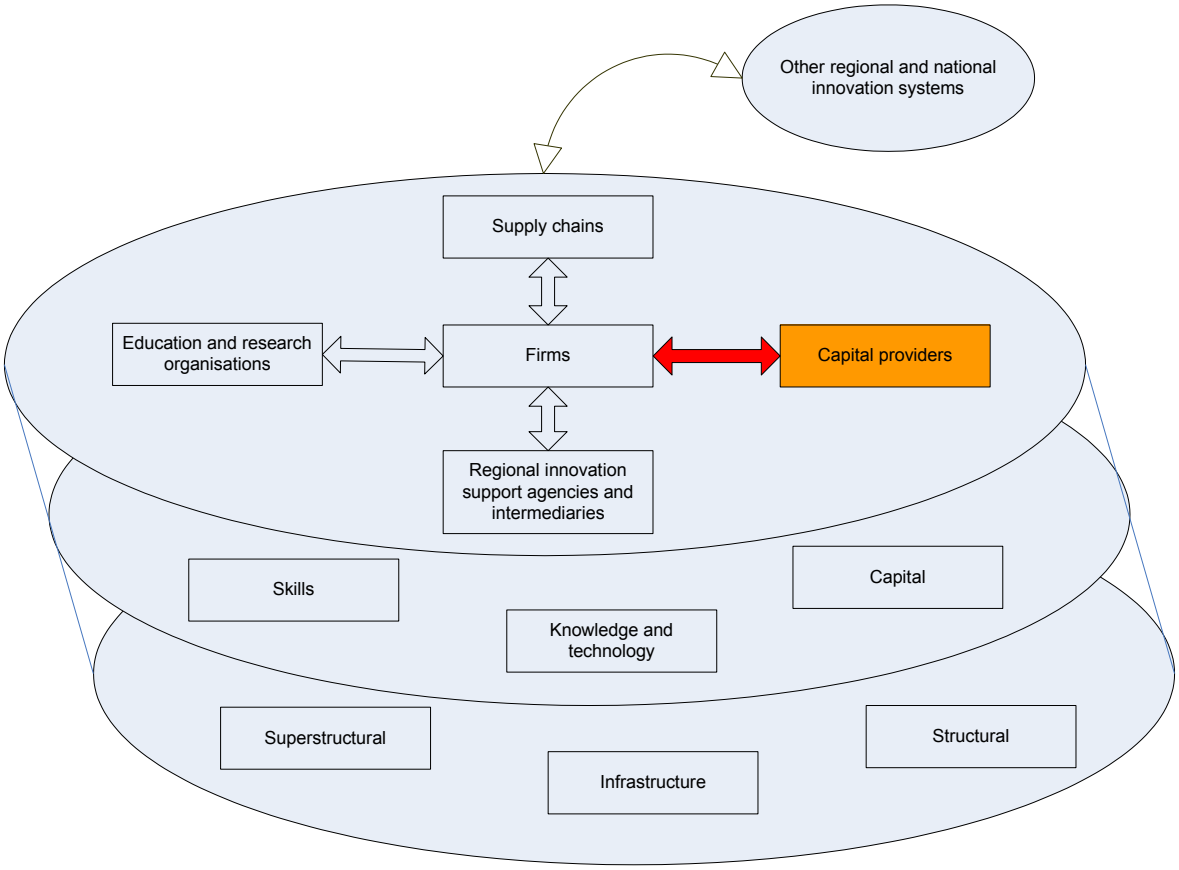
Beyond incubators, however, Auckland lacks the kind of science and technology park (STP) infrastructure that is common in most major city-regions of the world. For example, Australia has some STPs, Finland has 13 and the UK has over 60. STPs go by a variety of names including research and technology parks, science parks, hi-tech parks, and bio-valleys. Like incubators they generally consist of both hard (buildings and labs) and soft (business management advice, network support) infrastructure. However, in contrast to incubators they are larger, spatial arrangements that cluster corporate, government and large multi-national companies together as well as very small companies. The primary difference between STPs and research centres is that the latter typically only house research organisations, institutes and specialist laboratories and they do not have a significant commercial presence.

The Allen Consulting Group (2007) found that STPs contribute to national and regional prestige in science, technology and innovation by creating “critical mass” or clusters of specialised industry and research expertise that grow and attract further investment. While evidence of the impact of STPs on economic outcomes (such as per capita incomes) is mixed, their contribution to skills development, improved industry-research linkages and other qualitative factors was found to be considerable. It should also be highlighted that even for the more successful STPs, large investments have resulted in returns to the region, but this may take decades to eventuate (OECD, 2005a).

During this review, several projects to create innovation centres or technology parks for Auckland sectors have been advanced, including food and beverage processing, materials, digital content and marine projects. The food and beverage project is the most advanced. The hub at Manukau will include open-access, pilot-scale facilities that will enable product testing, scale-up and market testing focused on processed foods. It is supported by the Auckland Council and Massey University. The Manukau centre will also be linked to other regional hubs around New Zealand.

The development of these centres fills a critical and missing piece of the food and beverage industry's innovation system. These types of STP/innovation centre arrangements should be supported and it will be critical to move beyond the development of facilities and to consider the soft infrastructure and how researcher and business interactions will be facilitated through the centres. The region should have a role in supporting STPs which have clear industry backing, are feasible and in areas of competitive strength while maintaining and facilitating soft infrastructure where appropriate. The development of such parks or centres in the Auckland region would provide a tangible and visible demonstration of the region's commitment to research and business links, and provide a focal point for science and industry interactions.

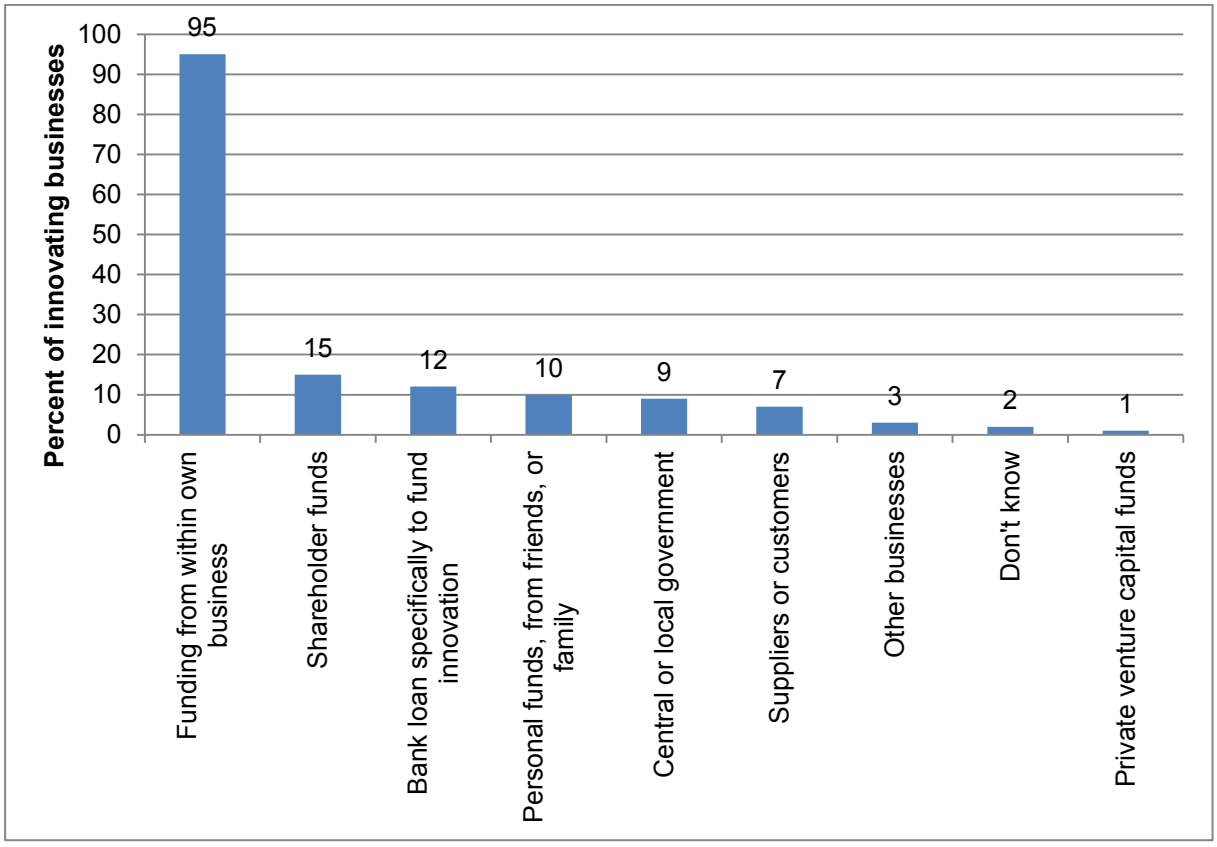
6. Capital providers



Where do New Zealand firms access capital for innovation? Nearly all (95 percent) fund innovation from within the firm itself, according to national data from 2003.[22] Internal funding came from cash flows, additional investment by the owners, or retained earnings. Shareholders' equity was used by 15 percent of firms, and loans from friends and family by 10 percent. The low reliance on banks seems to indicate a difficulty of accessing loans for innovation projects. Only one in eight innovating firms used a bank loan to finance a specific innovation project, while a mere one in a hundred used venture capital. While venture capitalists invest in particular products or technology which are commercial and scalable rather than all innovative activities, this indicates that firms may not be considering the range of capital providers available. Government grants (9 percent) were used almost as often as bank loans (*Figure 12*).

[22] This is a consistent finding in innovation and finance surveys (see Statistics New Zealand, 2008; Statistics New Zealand & Ministry of Economic Development, 2005) as well as discussions with firms in Auckland in all sectors.

Figure 12: Sources of funds used by innovating firms in the last three years, 2003



Source: Statistics New Zealand. (2004). *Innovation in New Zealand: 2003*.

6.1. Venture capital and private equity

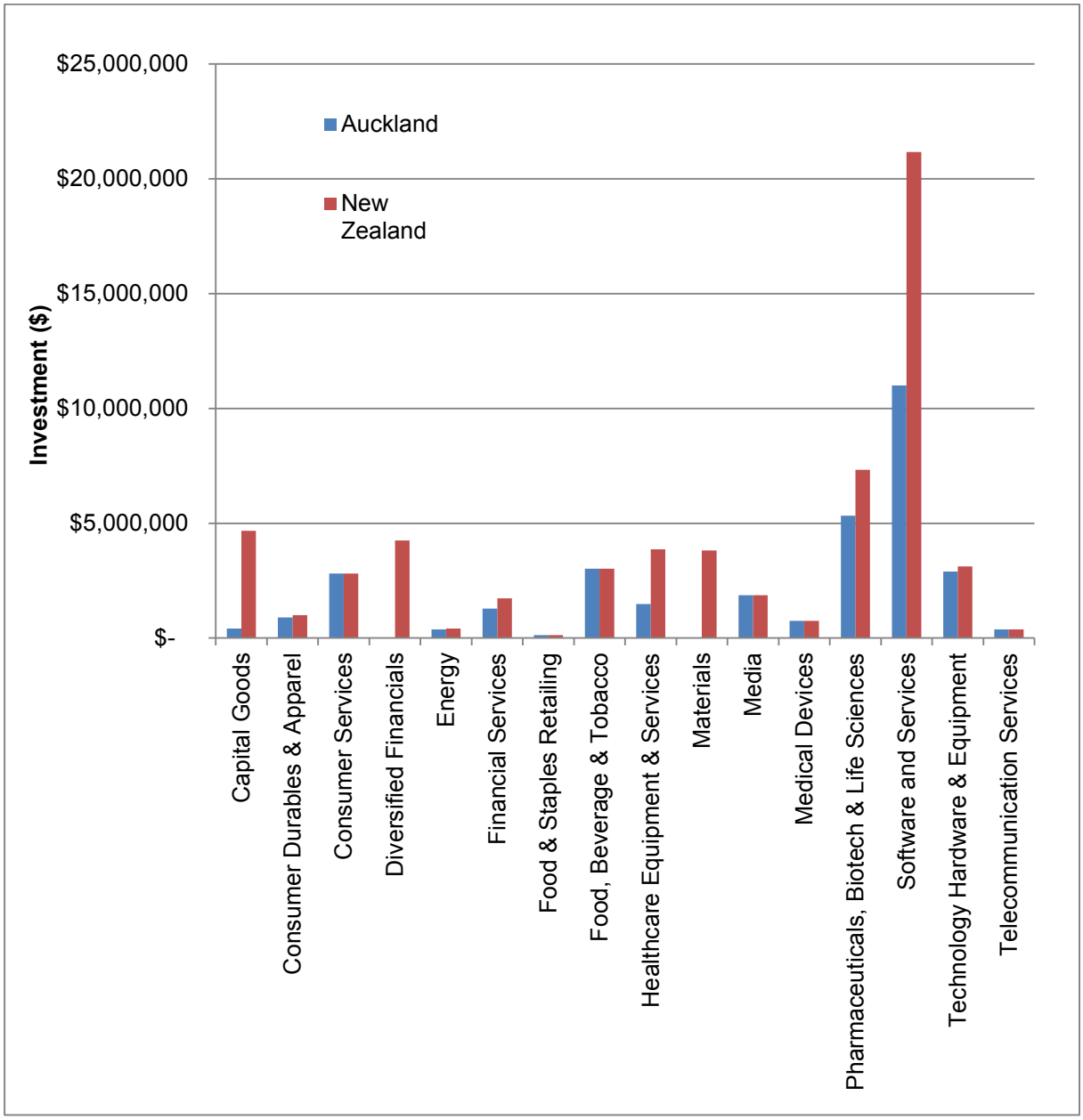
Firms receive venture capital based on investors' expectations that they will grow faster, list earlier and innovate more than other firms (Lerner, Moore & Shepherd, 2005). In general, New Zealand's capital markets are rather under-developed (MED, 2007). They are weak with shallow pools of capital and it is likely that this is constraining innovation. The stock market is small and national savings (especially household savings) are low. Firms and investors alike have noted that a lack of pension funds and a bias towards real estate investment in New Zealand mean that there is a limited pool of domestic equity finance available (e.g. AERU & Flicka, 2009). Unlike banks in the UK or US, banks in New Zealand also do not provide early-stage funding for innovation (Metro Innovation Project, 2009) and are considered to be significantly more risk averse than those elsewhere.

New Zealand's angel and venture capital markets are immature, although the venture capital industry has developed significantly in recent years. In 2007, the total value of venture capital deals reached $82 million, surpassing all previous years, but fell in

2008 to $66 million (Ernst & Young & New Zealand Venture Capital Association, 2009). Yet, by OECD standards, New Zealand has a very small venture capital market. In 2004 it was ranked 20th in the OECD with 0.01 percent of GDP. However, by 2007, New Zealand had climbed to 11th and increased its share to 0.04 percent of GDP (Lerner & Shepherd, 2009). The OECD mean is around 0.25 percent (MED et al., 2007).

The private equity market is also small. However, a significant proportion of private equity is captured by Auckland-based firms. In the period from January 2006 to July 2008, Auckland firms accounted for 60 percent of deals and approximately 55 percent of the finance available. About a third of the equity investment in Auckland firms was for "software and services" companies, with "pharmaceuticals, biotechnology, and life sciences" also showing prominence (about 16 percent) (*Figure 13*). While both sectors dominated in the rest of New Zealand (software accounted for about 35 percent of equity investment; and pharmaceuticals, biotech and life sciences about 12 percent), outside Auckland, capital goods, diversified financials, materials, and healthcare equipment and services all attracted investment. However, there was only modest Auckland investment in those sectors.

Figure 13: Investment by sector for January 2006 to July 2008



Source: NZ Young Company Finance

Different sectors have different requirements, varying levels of competitiveness and they attract different investors. For instance, pharmaceuticals, biotechnology and life sciences generally require considerable early-stage funding due to the high cost of product testing, clinical trials and meeting the regulatory requirements of particular markets. Investors operate in industries they know and invest in propositions they understand. Firms in the medical technologies sector have had positive experiences with angel investors (AERU & Flicka, 2009). However, there were other comments about the lack of experience on both sides of the angel investor market for funding

health technologies, with suggestions that investors did not understand enough about particular companies or the sector and its needs, including longer time to market and the need to fund development, clinical trials and marketing (LECG, 2008).

Historically, most New Zealand equity investment has been in ICT. The knowledge, expectations and experience of investors in the ICT industry cannot be readily applied to life sciences. Likewise, software investors may find it hard to assess a value proposition in creative content. Software firms are able to access angel or venture capital funding and government grants for R&D but investors consider creative content to be a high-risk proposition.[23]

Traditional finance companies, venture capitalists and angel investors have undertaken little investment in the digital content sector. Creator firms interviewed indicated they had limited access to external funding sources, relied either on NZ On Air funding or self-funding, and said that a lack of funding support limited their involvement in international co-productions. These sentiments have been echoed in a number of other reports on financing and the creative/digital content sectors (see Deloitte, 2008; PricewaterhouseCoopers, 2006; NZIER, 2006; Eve Bay Studio & NZIER, 2007; and LECG, 2008). However, a subsequent national study considered funding issues in more detail and found that while lack of finance was considered by the firms interviewed to be a major reason for missed opportunities, other reasons drive the lack of finance (PricewaterhouseCoopers, 2009). Those reasons include competitive features of the entertainment and media value chains, lack of scale or a track record, limited connections in the market, small firm size, lack of management strength to create businesses that can compete internationally, and cost competitiveness.

Firms in the biotechnology, medical technology and scientific research sectors in Auckland commented in a follow-up study that they considered New Zealand investors to be more risk averse than those in other countries (for example, Australia and the US) (Ascari Partners et al., 2011). It is perceived that New Zealand investors will only invest in a tangible product. This makes it very difficult for firms in the initial R&D phase of business to secure private funding because they would not have

[23] According to a study completed in 2002, up-front costs for creative projects are generally high and the probability of success, even domestically, is low (NZIER, 2002).

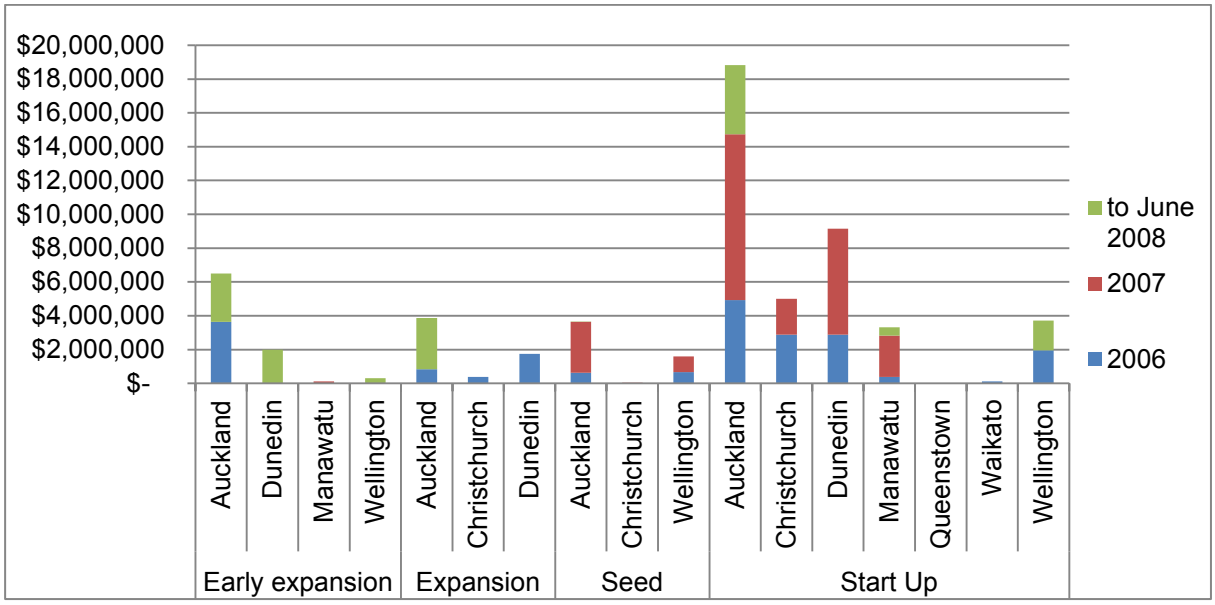
already developed a tangible product. In addition, firms perceive that New Zealand investors are short-term focused and do not understand the risk of entrepreneurship and failure associated with the R&D of new technologies, in comparison to American investors for example. While many of the comments discussed in this section focus on the capabilities of investors, it is clear that the lack of management capability and "investment-readiness" within firms are core underlying issues (see section 8.3, *Capital*, for more discussion on this).

In Auckland, early-stage investment is provided by a small number of investment organisations and individuals (Metro Innovation Project, 2009). Most private financing has been applied to start-ups, with little expansion capital available (*Figure 14*).

Skills, experience, and international linkages are also considered to be incomplete. Few investors have experience of the entire investment-to-exit cycle, formal linkages to international venture capital or angel firms, or knowledge that spans several sectors. To address the lack of capital, suggestions have included three to four new angel networks and early stage funds; growth in venture capital; new venture capital funds with bigger pools of capital; more significant seed funds; strengthening of linkages between early-stage funders and venture capitalists to encourage increased follow-on funding; and institutional investment in the venture capital market and angel syndication, including syndication with international partners (Metro Innovation Project, 2009). But, in order for the supply of capital to grow, new investors must enter the market.[24]

[24] The promotion of successful investments coupled with investor education, establishment of new angel networks, early-stage funds, sector specific networks in the Auckland region, and new and larger venture capital funds are likely to stimulate supply as well as replace the natural membership churn within investing groups. Increasing both national and international syndication will also improve flow. Syndication allows mitigation of risk by investing collectively as well as greater deal size. It also improves the ability of investors to invest in sectors where individual knowledge is weaker or sectors that have higher capital intensity as well as access to other regional or international funds.

Figure 14: Investment by stage and by city or region



Source: NZ Young Company Finance

In investors' view, more people will enter the market if there is better promotion of successful investments and better education of the benefits of investing. Education is important for the early-stage funding industry as it builds investor confidence, increases investment activity and can result in more successful ventures. Some investor education has taken place, such as the Kauffman Foundation's "Power of Angel Investing", or through publications such as NZVIF's *Best Practice for Angel Investing* and *Young Company Finance*. However, investor education has been on a small scale and on a one-off basis. The working group also noted that there is currently limited access available for investors about the profiles of opportunities that are seeking investment and that greater promotion of opportunities would deliver significant benefits.

Overall, firms indicated that access to capital does not appear to be a great inhibitor to innovation. Firms generally fund innovation from internal resources. However, this may have some impact on the extent of radical innovation that takes place in the region as well as business establishment and expansion. The Metro Innovation Project working group has already made a number of recommendations to improve access to capital in Auckland and New Zealand. Key recommendations that align with the findings of this review include investor education and encouraging the formation of new passive and co-investment funds.

6.2. Foreign direct investment

Foreign direct investment (FDI) can be defined broadly to include:

- greenfield and brownfield investments made by overseas investors
- investments made by multinational corporations (MNC) expanding into the Auckland/New Zealand market
- equity investments in businesses
- investments made by institutional or portfolio investment firms
- expansion capital from international sources
- industry and research consortia that have sought joint venture partners or investment overseas (Knowledge Matrix, BERL, IMSED and PricewaterhouseCoopers, 2009).

New Zealand's inward FDI, as measured as a percentage of GDP, is high by OECD standards (OECD, 2008). This has in part compensated New Zealand's low domestic savings rate. The Auckland region dominates as the investment destination for New Zealand, with 56 percent of projects and 60 percent of host companies. Additionally, some 24 percent of Auckland's employees work for a foreign-owned firm (Knowledge Matrix et al., 2009). Auckland also performs reasonably well in FDI attraction when compared with Pacific Rim and other comparator regions like Sydney, Melbourne, Brisbane, Adelaide, Vancouver, Seattle and Copenhagen, and particularly so in the sectors of biotechnology, business services, ICT, food and beverage, tourism, and transport and logistics (Knowledge Matrix et al., 2009).

Inward investment has benefits to innovation in a number of ways. These include new technology, stimulating the competition for skilled labour and competition in general, broadening the local firm's international outlook and connections, and providing skills to firms in much-needed areas such as international sales, marketing and distribution. If targeted correctly, it can also create new high-value jobs that build on sectors or areas of potential, or carve out market leadership in a completely new area. In Auckland, there has been evidence of FDI leading to employment growth within firms, increased exports into multi-national corporations' other markets, greater scale to develop innovative business ideas and property development.

However, there are also risks to innovation from FDI. Many firms interviewed in a follow-up study on firm success factors in Auckland contended that there is a trend for large, often foreign-owned firms to buy out successful innovative New Zealand firms for their intellectual property and/or to reduce competition (Ascari Partners et al., 2011). The impacts are sometimes negative if innovative ideas and technology are taken offshore and the previously successful New Zealand firm gets hollowed-out. In addition, firms interviewed considered that successful and innovative New Zealand-owned firms that have been purchased by larger foreign-owned firms have tended not to have grown. For example, a large successful firm which was recently purchased by a foreign-owned company said its business had been split into multiple divisions. Instead of focusing on developing new innovative products, which the company was known for, it now simply focuses on incremental product improvement and reacts to what competitors are doing. Much of the inward investment into Auckland has been predatory acquisition by Australian firms seeking market penetration; although, as discussed above, there is also some productive investment.

While Auckland also attracts the largest proportion of immigrants to New Zealand, this has not influenced inward investment significantly. This is likely due to the large proportion of immigration into Auckland under family reunification and humanitarian categories. Nevertheless, a large number of Auckland's migrants are high net worth individuals who anecdotally have difficulties pursuing business investment opportunities due to language, cultural and business practice barriers (Knowledge Matrix et al., 2009). Investment also appears to be skewed towards property rather than other sectors of Auckland's economy. There is untapped opportunity for increasing investment and investment quality from migrants. Committee for Auckland and the Auckland Business Angel network are working on how to better engage business migrants with Auckland business interests.

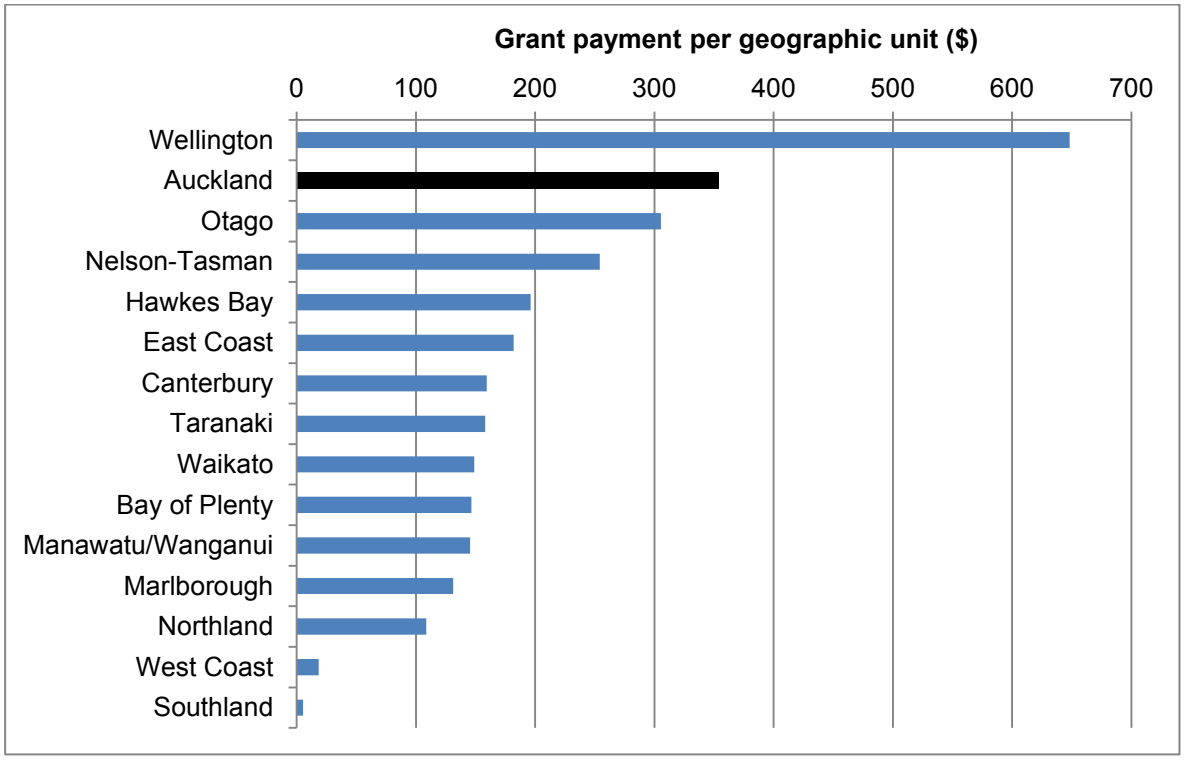
ATEED now acts as a single point of contact for FDI for Auckland which should enable regional coordination in this area. Prior to the governance structure changes, Auckland Plus acted as a single point for investment attraction. At the same time, all the other territorial authorities also had their own investment and business attraction strategies and they were not necessarily consistent with each other. A truly regional business attraction and investment attraction strategy is needed to ensure Auckland

benefits from international investment. The strategy should also consider areas of Auckland's competitive strengths and their investment needs, and better leverage migrant investment. Local government can have a greater role in targeting and facilitating investment through closer collaboration with Investment New Zealand, New Zealand Immigration Service, angel networks and the private sector.

6.3. Government grants

Nationally, several grant programmes are available to support innovation. MSI supports investment in R&D by firms through its Technology New Zealand schemes, while NZTE provides co-funding for business development as well as funding for building economic capability within a region. The Auckland region attracts the greatest value and number of NZTE and Technology New Zealand grants of any region in New Zealand, although this is unsurprising given that the region is home to the largest number of businesses. The Auckland region receives about $33 million of the $50 million in funding that is available from Technology New Zealand annually. However, when the value of NZTE grants paid to firms as a proportion of the number of firms in the region is shown, Wellington firms are disproportionately successful (*Figure 15*). This may signal that firms in the Auckland region have difficulty accessing or drawing down on their grants. Alternatively, they may perceive they do not need government support or think they have the requisite capability to grow and innovate. However, when the type of grant is examined, Auckland firms appear to be more successful in accessing export and high-growth focused programmes.

Figure 15: Dollar value of NZTE grants paid to firms by region, as a proportion of the number of firms in the region as at February 2008 (2001-2008)



Source: NZTE administrative data and Statistics New Zealand Business Demographic Statistics.

In general, firms interviewed appreciated access to public funding; however, the time, documentation and compliance costs required to access funding was a consistent frustration aired by firms across the sectors. While firms knew they had accessed funding, they often could not tell what the grant programme or the source was. Further, many did not draw down all of their funding. For many, the system was seen as confusing and complex with considerable upfront and ongoing paperwork which dissuaded businesses from using it. The recent consolidation of NZTE's grant programmes addresses some of these issues but further changes may need to be considered.

Grant scheme criteria are also more suited to some sectors than others. For example, firms focused on digital content production were less likely to access funding than firms who developed technology to enable digital content. Health technology firms had particular concerns about access to funding for development beyond prototyping and support for clinical trials, which are necessary to gain

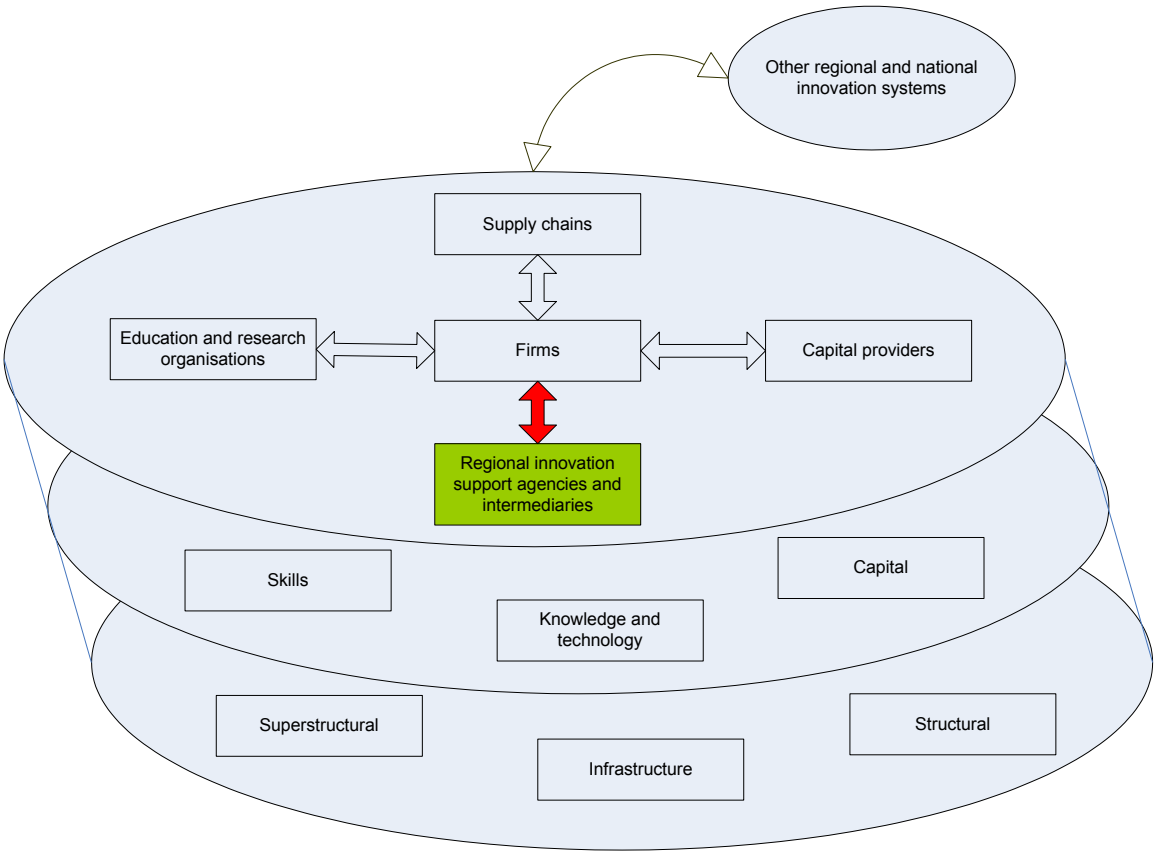
regulatory approval for new products.[25] Some private sector scientific research and biotechnology firms – particularly the new start-ups – also noted that government research funding can be difficult to access because firms often have to compete with much larger CRIs and universities for the funding (Ascari Partners et al., 2011).

The findings suggest that a single point of access should be established to access innovation funding support and ensure coordinated provision of services between providers, and that compliance costs need to be reduced through simplified applications and better client/data management. Consideration also needs to be given to whether current grant funding meets the needs of key sectors. Some sectors are not well serviced by government business assistance, such as service sectors. Their lead times, products/services and/or requirements may differ from more traditional sectors and this needs to be considered in the design of any assistance.

[25] Development beyond prototyping falls outside the Frascati Manual definition of R&D and therefore is not funded by FRST. Phase 1 clinical trials can be funded through FRST.

7. Support agencies and intermediaries

Prior to the Auckland governance changes, there were nine economic development agencies or units in Auckland as well as intermediaries of one kind or another, the local offices of NZTE and MSI, numerous industry associations and innovation support consultants. Their innovation activities ranged from supporting firms through to providing R&D expertise and assisting businesses with expansion into new international markets.



7.1. Economic development agencies

Before November 2010, nine economic development agencies (EDAs) serviced the Auckland region: one regional agency, an EDA for each of the seven local authorities, and the Pacific Business Trust to support Pacific businesses. EDAs provide a range of services, including local investment promotion, migrant settlement support, tourism and events promotion, youth employment initiatives, and business training and advisory services (some of which are funded by central government). At a regional level, AucklandPlus – which was part of the Auckland Regional Council – was responsible for regional investment promotion and marketing. It also

coordinated business and local government involvement in major industry projects in Auckland, such as the marine industry action plan and the development of the food innovation centre in Manukau. All local authorities had a tourism focus and provided various amounts of funding to Tourism Auckland, the region's tourism promotion agency. In addition, local authorities carried out further tourism development activity themselves or contracted it to their EDA.

EDA activities generally varied according to:

- the focus of each local authority – that is, tourism, industry development and/or investment attraction and promotion
- the contracts awarded – MSI Technology NZ as a partner, employment programmes, mentoring by Business in the Community
- projects and pilot initiatives – which were generally in accordance with local authority objectives or in conjunction with other agencies.

EDAs generally did not have a strong innovation focus, although they certainly provided support for firms and sectors in their local area. They were a useful first contact for firms seeking funding through NZTE and MSI (Norgrove & McCardle, 2006), and provided information and access to business networks. However, the lack of coordination and role clarity between EDAs, NZTE and MSI, as well as other business support organisations like Employers and Manufacturers Association and Auckland Chamber of Commerce, resulted in confusion for firms about who to turn to.

Some EDAs were more active in certain sectors and with the firms within their boundaries than others. Enterprising Manukau was noted for its work with food and beverage processing firms as well as its support for the food innovation centre at Manukau; and Waitakere Enterprise was heavily involved in the work to establish the Hobsonville marine precinct. Tourism Auckland was also noted as a key source for tourism information and was seen as useful for tourism operators.

EDAs are constrained by their ability to support firms within their territorial boundaries, although other EDAs may be better placed to assist. They support industry development but do not necessarily have an innovation focus. Their services and firms overlap with each other, and other similar agencies and services

are available at a national level, such as those provided through NZTE. There appears to be duplication of economic development support services and fragmentation of resources across a range of small-scale initiatives. Capability within economic development agencies also differs, meaning service levels encountered by firms vary and the effectiveness and efficiency of major sector projects has been hampered.

ATEED brought together a number of the EDAs into one organisation. This is likely to improve the innovation support that firms in Auckland receive. However, improving EDAs' contribution to the regional innovation system and business innovation activities will require devolution of some NZTE business assistance programmes (including grants) to EDAs, more funding or better use of funding for Auckland EDAs to provide better advice to a wider range of firms, and explicit articulation of their role in improving innovation performance.

7.2. Industry associations

Industry and employer associations provide a support network for firms and facilitate industry development. Some perform research or fund R&D, mainly in the primary industries through compulsory levies or contract fees. For example, Dairy NZ and Meat and Wool extract levies from farmers under the Commodities Levies Act. Levies on New Zealand wine sold by licensed winemakers and the farm gate price of all grapes sold for winemaking purposes in New Zealand help fund research by the New Zealand Winegrowers Association. Nationally, industry and employer associations are a well-used source of ideas or information for innovation (28 percent of innovating businesses in 2009, Statistics New Zealand, 2010). More than three times as many innovating firms used them than CRIs or universities.

Firms interviewed for the sector studies reported on the importance of their industry associations – such as the Heavy Engineering Research Association, Plastics New Zealand or the NZ Composites Association in the advanced materials sector, and the New Zealand Bankers Association in the finance and insurance services sector. Industry associations can also provide linkages for firms to engage with other organisations, particularly education and research institutes. The Marine Industry Association has actively supported the collective ideation sessions with universities in

Auckland. The New Zealand Winegrowers Association provides a link between their members and research institutes in Marlborough and Tamaki, Auckland.

For the Auckland region, unions and business associations – such as the Employers and Manufacturers Association and Auckland Chamber of Commerce – also provide networking, business support and advisory services, skills training and education, and business promotion for members. Interestingly, none of the firms interviewed mentioned either of these organisations in relation to innovation. This may be due to firms' generally narrow definition of innovation and, while they used the services of these organisations, they may not consider them core to innovation.

While each industry is well supported by associations (most industries have multiple associations or representative bodies), they are arguably too fragmented and the areas of responsibility are not always clear for firms that work across multiple industry segments. Various economic development commentators have criticised industry associations for focusing on the immediate interests of their members at the cost of long-term activity (e.g. Wilson, 2002). Indeed, many associations appear to be focused on lobbying activity rather than business growth and innovation *per se*.

7.3. Private sector support

Supporting industries can be a powerful tool for the creation, diffusion and adoption of knowledge (Seo, 2006). Various consultancies are also associated with innovation, such as business management services, market research services, scientific research, consulting engineering services and technical services. Approximately 45 percent of such enterprises in these industries are based in the Auckland region, suggesting that firms in Auckland have ready access to these services.[26] Additionally, New Zealand firms appear to consider them a trusted source of information for innovation, with 47 percent of innovating businesses in New Zealand utilising them (Statistics New Zealand, 2010).

Consultants play a role in helping firms instil innovation management techniques into their organisations and developing an innovation culture. For example, ASB uses the Australian consulting firm 2nd Road to help it develop into an innovative organisation.

[26] Only some of these firms are likely to contribute directly to firm innovation. For example, much of the technical services industry comprises routine activities such as warrant of fitness testing and the certification of lifts.

Many Auckland firms mentioned the importance of market research and consumer testing, particularly those in food and beverage processing and finance and insurance services. For example, the finance and insurance sector is a heavy user of market research agencies for customer insight. For the insurance segment, research agencies play a critical role in the development of new products.

Market research capability and practices play an important role in innovation as well as business performance. Quantitative analysis of the links between business practices and business success in New Zealand firms finds that market research is one of the factors most positively associated with firm success (Fabling & Grimes, 2007).

While market research services are available in Auckland, firms (food and beverage processing SMEs, in particular) considered there to be barriers to access, both in terms of the cost of market data and reports, and the lack of skills to analyse and interpret the information so that they could benefit from it. While EDAs and other business advisors already play a role in connecting firms to private sector support, the region could consider how it could facilitate more coordinated access to areas where there appears to be a particular gap – that is, market research and innovation management.

7.4. Government support agencies in the region

Given the concentration of people and businesses in Auckland, many government agencies have offices and provide services in Auckland, including NZTE, MSI, and Work and Income New Zealand. The grant-funding programmes that NZTE and MSI provide have been discussed elsewhere in this report. Beyond funding, these agencies also provide many services and programmes that contribute to innovation. For example, sector development and support, market development services, employment and skill training initiatives, and investment and export promotion and attraction. However, the large majority of firms interviewed for the sector studies were self-sufficient and have limited interaction with government or regional agencies. Many were unaware of the support that is available.

NZTE was viewed positively by a number of firms. Market development assistance was well used by some businesses, with many appreciating the ability to attend trade

shows and other events. Attending under a united New Zealand banner was also considered to be particularly positive. Through this process many firms were able to find out more about the capabilities of others in their sector in New Zealand, providing opportunities for collaboration. However, once firms returned to New Zealand, few followed up on these opportunities.

A few firms in some sectors – such as food and beverage processing and digital content – had become disillusioned with NZTE at times. They felt that some firms with real innovation and growth potential fall between what they perceive are the core markets occupied by NZTE (fast growing, internationalising companies), MSI (high tech) and EDAs (small business). With NZTE increasingly focused on medium-large businesses, this situation is likely to be exacerbated and attention needs to be given to ensuring the pipeline of growing SMEs (some of which will become the larger, higher-growth companies of the future) has access to appropriate innovation support.

Finally, as has been noted earlier, access and use of business assistance was also considered by firms to be confusing. In particular, firms said there was a lack of clarity of the roles of NZTE, MSI, and industry and regional agencies, and there was not a seamless transition between agencies when firms' needs change.

While agencies, intermediaries and consultancies are concentrated in Auckland, they do not appear to contribute to innovation to their full potential. The support system is provided by many different players, and firms find that while support is available it is difficult to navigate – both in terms of determining what support is relevant and where to source the right assistance at the right time. In particular, the lack of coordination and role clarity between EDAs, NZTE and MSI results in confusion for firms who may be struggling with innovation problems. The findings suggest that a single point of access should be established in Auckland to access business assistance and innovation support and ensure coordinated provision of services between providers.

Overall, there appeared to be little appetite for additional business support (see also Norgrove & McCardle, 2006). However, this may be a case of lack of awareness of the support required ("you don't know what you don't know") together with the tendency for owners to work in their business rather than on the business. In addition, there is a need to improve the promotion of existing market research and

testing services, and for consideration to be given to the provision of training and advice for market analysis. Any single access point, therefore, should also consider linkages with private sector providers and consultants.

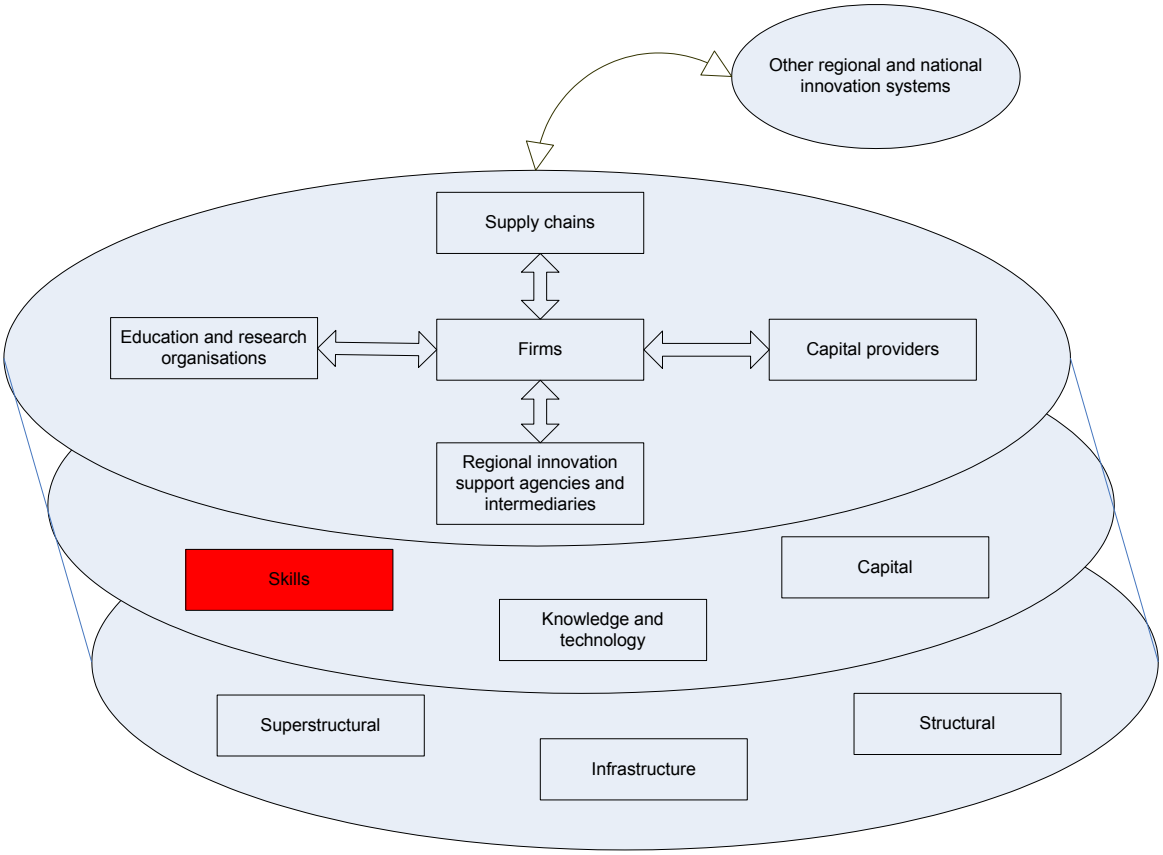
For some sectors, the support available appears to be too fragmented across a range of small-scale initiatives delivered by different parties. Better value for money may come from focusing resources on fewer, critical projects.

A number of initiatives in progress are likely to improve the innovation system in this area – for example, one economic development agency within the greater Auckland Council and changes to the delivery of business assistance. NZTE and MSI have created an expanded network of "regional partners" to help small businesses access information, funding (Technology NZ funding and support, NZTE capability development vouchers and associated capability development support), training and business development services. NZTE and MSI have recently signed an agreement with ATEED for delivery of this programme to the Auckland region. These processes are likely to provide better coordination, role clarity and direction for innovation support in the region. Nevertheless, the region should consider how any single access point or a more streamlined system could be implemented at the local level and how this may link with the private sector.

8. Innovation inputs

This section explores the pools of resources that exist in Auckland to support innovation. They are centred around skills, knowledge and technology, and capital. This review focuses in particular on inputs that are most likely to make high-level contributions to innovation performance, rather than all the issues and challenges associated with these inputs.

8.1. Skills



Innovation depends critically upon skills – not simply technical skills (the ability to perform a particular function or operate particular equipment), but also managerial skills to get the most out of a firm's resources, foundation skills (literacy, language, numeracy), and the ability to learn and interact with people. An important issue is whether available education, training and immigration initiatives support business innovation in the region. Key metrics include the availability of graduates, the number of scientists and engineers, the proportion of knowledge workers in the regional workforce and the impact of migration on the region.

8.1.1. Foundation skills

While innovation studies generally focus on higher-level skills for research, science and technology, it is also important to examine foundation skills in Auckland. This has been consistently highlighted in national and regional studies as a limiting factor. The OECD (2007) remarked in the review of New Zealand's innovation policy that there is a "rather long tail of under-achievement in education" (p. 82).

Literacy and numeracy continues to be a significant problem in Auckland for individuals and firms, as is the case nationally. In 2006, the Adult Literacy and Life Skills Survey found that 43 percent of adults aged 16-65 have literacy skills below what is required to participate fully in a knowledge society, and 51 percent of New Zealand adults have low numeracy skills (Ministry of Education, 2008a). Further, 35 percent of respondents to the 2007 industry and training survey reported some difficulties with literacy and numeracy, and over 50 percent of firms in the manufacturing, construction and infrastructure area reported such issues (Business New Zealand and Industry Training Federation, 2008).

In Auckland there are a number of factors to take into account. They include:

- below average educational achievement levels from students attending low decile[27] schools. Over half of New Zealand children enrolled in a decile 1 school at July 2008 are in Auckland (Ministry of Education, 2009a).[28] Of these decile 1 schools in the Auckland region, 93 percent of their rolls are Māori and Pacific island students. OECD (2007b) analysis of student performance finds that students who attend schools with higher socio-economic backgrounds tend to perform better
- about 5 percent of students in New Zealand leave secondary school with little or no formal qualifications. For Māori, the percentage is 10 percent, and for Pacific students it is 6 percent (Ministry of Education, 2008). The challenge of improving Māori and Pacific students' educational attainment is an especially Auckland

[27] A school's decile indicates the extent to which the school draws its students from low socio-economic communities. Decile 1 schools are the 10 percent of schools with the highest proportion of students from low socio-economic communities, whereas decile 10 schools are the 10 percent of schools with the lowest proportion of these students. A school's decile does not indicate the overall socio-economic mix of the school.

[28] This data excludes schools which have a missing decile and are "not applicable". Not applicable can apply to decile rankings of schools if they are private (as private schools do not need to provide the Ministry of Education with the information required to calculate a decile) or if a decile does not apply to the type of school.

challenge as it is home to 67 percent of the Pacific population and one in 10 Aucklanders are Māori (Statistics New Zealand, 2006)

- language, literacy and numeracy issues are generally localised, so within the Auckland region there is great diversity. For example, the literacy and numeracy of residents within the previous North Shore City and Rodney District boundaries are significantly above average, while residents of Counties-Manukau are significantly below average. Waitakere City was significantly below average in prose literacy but not in numeracy (Lane, 2010)
- a high proportion of the workforce born overseas, many of whom do not speak English as a first language
- the rapid shift in the mix of business products and services placing an increased demand on workers, particularly where this process is driven by changes in technology.

A large proportion of the population does not have the foundation skills necessary to contribute to innovation in a meaningful way. While it is recognised that not everyone should be, or needs to be, skilled at a high level in science and technology, foundation skills in literacy, language and numeracy should be present to support the innovation system. A focused effort on addressing foundation skills in Auckland is required. Given the skills and demographic profile in Auckland, targeting groups of people who are likely to provide larger innovation gains in the longer term would seem to be a useful first step. In particular, a programme of activity to improve Māori and Pacific participation in education and training, including literacy and numeracy programmes, apprenticeships, and pathways from schools into universities should be developed in Auckland. Foundation skills in the workplace could also be improved through raising awareness of the benefits and contribution to workplace performance and innovation, and matching workplaces to available assistance and training.

8.1.2. Skills in high-tech occupations and the number of researchers

Employment in science and technology occupations, and the number of researchers and employment in high-tech occupations are useful indicators of innovation performance. While Auckland generally performs well on these indicators nationally (Department of Labour, 2009), research shows it is not performing as well in comparison to cities in other countries. The Auckland urban area had higher employment in medium and high-tech manufactured goods than some Australian and

European cities, though it was still rather low. Auckland's employment in knowledge-intensive, high-tech services (as opposed to goods) is broadly similar to that of Melbourne, Brisbane, and Adelaide, yet lower than Wellington's (MED et al., 2007).

The OECD (2007) review of New Zealand's innovation policy, as well as interviews with Auckland-based firms, suggest that while it may be easier to recruit scientists, engineers and mathematicians in Auckland compared to other regions (33 percent of New Zealand's scientists and engineers[29] are located in the Auckland urban area) (Statistics New Zealand, 2006), it appears that the overall supply of graduates is insufficient. While University of Auckland produces the most science and engineering graduates of any New Zealand university, there are significantly more graduates in other disciplines (Ministry of Education, 2007). And, across New Zealand, there are low numbers of science and engineering PhD graduates (MED et al., 2007).

The supply of skills is hampered by many complex factors, including issues related to promotion (too little) and pay rates in other countries (too attractive).[30] However, Auckland and New Zealand are not alone in these factors. Across OECD countries, almost 40 percent of high school students who are top performers in science would not like a career in science (OECD, 2009). New Zealand 15-year-olds are ranked very highly in science performance, second to Finland. However, half of the strong performers and 35 percent of top performers do not consider it as a career choice. Science and engineering career options should be promoted throughout the education system along with articulation of clear career pathways once individuals enter the workforce. Skills action plans and projects which align education, industry and (regional and local) government organisations are avenues to explore. Further, it would be valuable to consider incentivising tertiary education and research in favour of these skills (for example, through media campaigns, scholarships and subsidies).

In developing policy options, it should also be recognised that it is beneficial for Auckland's talented individuals to be internationally mobile. They can provide key

[29] NZSCO99 groups 23 (design, engineering, science and transport professionals) and 31 (engineering, ICT and science technicians).

[30] Materials-based manufacturers in Auckland were concerned not only about the difficulty of employing graduates in engineering, but about the limited extent that the graduates were prepared for the workforce, and the time and investment required to make them productive.

international connections to Auckland as well as aid the transfer of international knowledge and technology. This is further discussed in relation to Auckland's international linkages; however, it appears that Auckland may not be capitalising on these opportunities as much as it could.

Innovation often depends on research. National R&D surveys show the total number of researchers per thousand employees has been above the OECD average for over 20 years.[31] Since New Zealand's total spending on R&D is comparatively low, this means that most of those researchers are employed by public sector research organisations. The number of *business* researchers per 1000 employees is significantly and consistently below the OECD average (Williams, 2004), although numbers are growing at the fastest rate in the OECD (MED et al, 2007).

Auckland's scientific research sector[32] is mainly based within Auckland city. In 2008, 1,770 people were employed in the sector (excluding universities) and there was high employment growth – it grew by 124 percent between 2000 and 2008 compared with a 30 percent rise nationally. Firms within the sector, many of which specialise in biotechnology, consider that four demand factors have driven growth:

1. International trends for environmental sustainability and sustainable production
2. Increased awareness by Auckland firms of the need to produce innovative, value added products
3. Increasing lack of in-house R&D capability so work is contracted out
4. Ease of access to private equity in Auckland compared with other parts of the country.

Nonetheless, technology transfer remains an issue. The majority of researchers in Auckland are likely to be within the public sector and employed by CRIs who, as discussed previously, have little collaboration with industry, particularly small firms. While the private sector research sub-sector seems to have grown, none of the firms

[31] "Researchers" are a subset of the OECD's Human Resources in Science and Technology (HRST) occupations. HRST are defined, according to *Canberra Manual* (OECD and Eurostat, 1995), as people having graduated at the tertiary level of education in a science or technology field of study, or people employed in a science and technology occupation for which a high qualification is normally required and the innovation potential is high.

[32] As defined by the Australia and New Zealand Industrial Classification, the sector consists of research institutes (except universities) that are mainly engaged in undertaking research in the agricultural, biological, physical and social sciences. It includes aeronautical research, biological research, food research, medical research, agricultural research, industrial research, farm operations and space tracking.

spoken to in the course of the review mentioned accessing their services. This again highlights the lack of strong linkages between research and industry. While weak collaboration has been identified previously as a barrier to innovation, this suggests that a the underlying issues are a lack of researchers employed by firms, a small private sector research industry and a lack of awareness of (public and private) research services. Auckland firms interviewed for this review also remarked that there are few people who can bridge the gap between research and industry.

As previously discussed, funding of intermediaries who are able to effectively link business and research is likely to improve innovation performance. This would have the benefits of improving the public profile of both research skills and its importance to business as well as stimulate the private sector research services market. The size and ambit of CRIs is likely to be an inhibitor to the growth of private sector research. Some firms mentioned that it was often hard for them to access government funding for research as they had to compete with larger universities and CRIs.

8.1.3. Sector-based skill shortages

Skilled tradespeople and unskilled labour were considered to be relatively easy to access. SMEs in particular commented that an advantage of being in Auckland and New Zealand is that they are able to attract skills which they consider would be more difficult in a larger country where there is greater competition for skills and the pay differentials tended to be more significant between large and small firms (Ascari Partners et al., 2011). However, all firms and sectors commented that there were skill shortages. They found recruiting highly-skilled people from overseas to fill the gaps can be difficult. Relative to other global cities, the cost of living in Auckland is high whilst income levels are low. Obtaining skilled staff appears to be more difficult for large and fast growing companies that have a high demand for such staff. For example, both Fisher and Paykel Healthcare and Navman noted that the relatively low supply of highly-skilled staff in New Zealand (university graduates in particular) had either previously been, or still is, a major constraint on their growth (Ascari Partners et al., 2011).

Matching skills supply and demand has been challenging for some sectors. The interviews revealed that there is demand for food technologists, ICT professionals,

engineers and employees in the medical technologies sector. Key challenges for some of these sectors were international talent searches which are highly competitive, lack of knowledge about the career opportunities in the sector, poor image, lack of in-work training and upskilling, lack of practitioners in the teaching profession, and graduates leaving New Zealand within a few years of graduation.

Whilst the marine industry has a dedicated industry training organisation, firms interviewed considered that they did not meet industry needs. The industry was no longer able to rely on keen sailors who were prepared to start at the bottom and build up their skills over time as apprentices were in short supply, and there were more attractive and better paid options in the industry (such as competitive sailing or crewing on superyachts). The adoption of more efficient sector-wide practices and productivity tools such as lean manufacturing were also being examined.

Industry concerns about the way in which tertiary education in New Zealand is meeting the need for more and higher-skilled graduates was noted in the 2008 OECD review of tertiary education in New Zealand. There are a number of ways in which industry and tertiary education engage to shape investment and ensure industry relevance, including tertiary education organisation charter requirements, internship initiatives and private sector representatives advising on and teaching in courses. However, the OECD noted that despite these efforts there are some ongoing challenges:

- Time lags in identifying needs, and training sufficient graduates to meet those needs, can result in a mismatch.
- Forecasting demand for skills is inherently difficult (the current economic downturn is a clear illustration of how quickly circumstances can change) and current high demand areas may be outdated tomorrow.
- New Zealand's relatively small pool of labour and aging population will mean that it will be difficult to meet growing demand by increasing local supply.

In addition, firms and industry should acknowledge that they play a key role in ensuring there is on-the-job training for their employees. It is rare that an individual will be able to immediately slot into a role as soon as their qualifications are conferred.

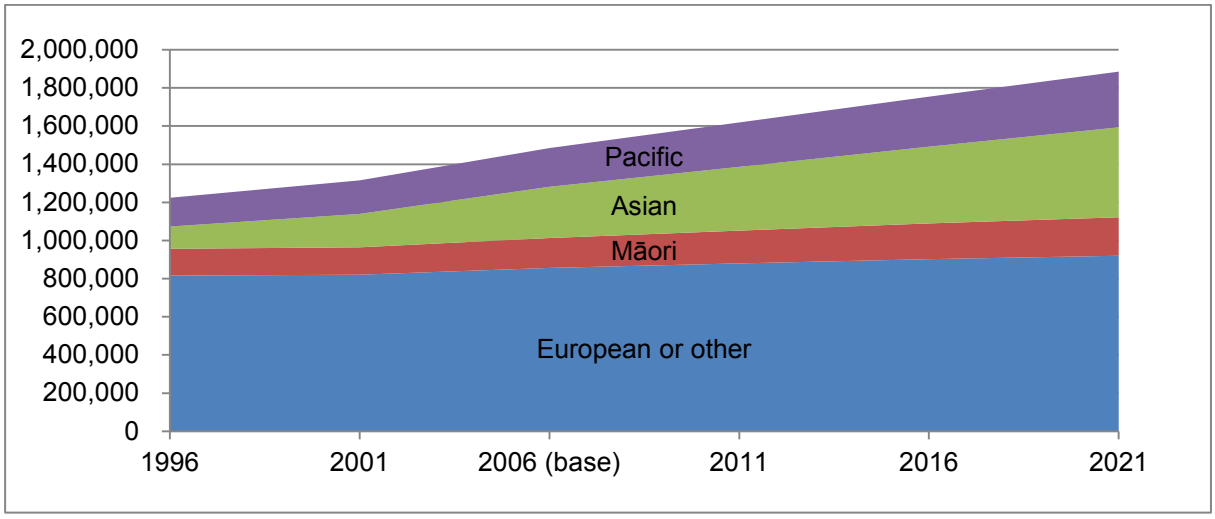
A focused approach to targeting the skill needs to sectors of competitive strength in Auckland would be of value. This could include the development of skills action plans for key sectors. Additionally, better forecasting of demand and the extent to which current supply is relevant and of sufficient quality will both support workers making career choices and also inform the delivery of tertiary education and training.

8.1.4. Migrants and skills

Migrants contribute to the transfer of knowledge and ideas as well as expand our international networks. As noted above, migrant skills will be increasingly important given New Zealand's small domestic talent pool.

Migrants from overseas make up a relatively large share of Auckland's population, the city being the principal destination of immigrants to New Zealand. Due to the impact of migration, and fast-growing Māori and Pasifika communities, Auckland has very rapidly become one of the most ethnically-diverse cities in the world. It has been projected that by 2021 up to half of Auckland's workforce will be non-European (Statistics New Zealand, 2008a; see *Figure 16*).

Figure 16: Ethnic population projections for the Auckland region



Source: Statistics New Zealand, sub-national ethnic population project tables, 2008.

Auckland, as a city-region, competes with other city-regions for skilled migrants and it needs to ensure that the skills of migrants are well utilised. The main path to residence in New Zealand is the Skilled Migrant Category. Places are allocated using a points system that favours people aged between 25 and 55 with sufficient English language skill, a high level of education, work experience, and a job (or job offer) in New Zealand. Special entry is available for business people and entrepreneurs who would bring investment capital to New Zealand. However, many migrants also enter under family reunification and humanitarian categories.

Additionally, international students are a potential source of future skilled migrants for Auckland and are key to the export education industry. Twenty-seven percent of international students who began their study between 1999 and 2001 transitioned to employment or residency in New Zealand. Between 1999 and 2002, over half of New Zealand's international students began their study in Auckland (Department of Labour, 2007). There was variation at the country and type of study level, with Chinese and South Korean students more likely to be in Auckland compared with those from Japan and the US. School and English language students were more concentrated in Auckland and 32 percent of international tertiary students were in the Auckland region. The Auckland region also has significantly more international PhD enrolments than other regions (Ministry of Education, 2009).

An examination of the employment status, occupation, educational qualifications and income of migrants in Auckland provide some clues as to whether Auckland's migrant population has effectively integrated into the labour force. Some disparities are evident. The Pacific Island immigrant population has a marginally lower employment rate, is least educated, is found in lower-skilled occupations and earns the least. The best-educated immigrants are from North America and they also earn the most. The Asian-born population has the lowest labour force participation rate (59 percent). Since many are likely to be students, this may explain the large proportion earning $5,000 or less. While the Asian-born population is the second most highly qualified after those born in North America, this does not appear to translate into higher-skilled occupations.

There have been concerns expressed over several years that, although the majority of migrants settle in Auckland, many do not settle well. Recent analysis indicates that skilled migrants, in particular, have achieved good employment outcomes in New Zealand. The longitudinal immigration survey[33] found that 71 percent of migrants were employed six months after they obtained permanent residence in New Zealand, and 74 percent after 18 months in New Zealand (2009d). Two thirds of these employed migrants were working in a skilled job after 18 months, and 9 percent moved from a lower-skilled job to a higher-skilled one in the preceding nine months. Four out of five were satisfied or very satisfied with their jobs. At the six-month point, 62 percent of migrants reported that they had not experienced difficulties in finding employment. Those that reported difficulties reported the most common problem was a lack of New Zealand work experience, followed by their skills or experience not being accepted by New Zealand employers (Statistics New Zealand, 2008b; Dunstan, Boyd & Crichton, 2004).

It is unclear whether certain segments of the migrant population face greater settlement and employment obstacles in Auckland than others as there is a lack of data at the regional level. There is also considerable action being undertaken to improve the settlement experiences of migrants in Auckland through initiatives being undertaken through the Auckland Regional Settlement Strategy and Action Plan, and

[33] The Longitudinal Immigration Survey: New Zealand (LisNZ) is a longitudinal survey designed to trace the pathways of migrants and to produce a detailed, ongoing information base of their experiences and settlement outcomes. Migrants are interviewed six, 18 and 36 months after they have taken up permanent residence in New Zealand.

through programmes such as OMEGA's (Opportunities for Migrant Employment in Greater Auckland) mentoring and paid-internships programmes.

Skilled immigrants play an increasingly important role in innovation in the region, from filling skills gaps in areas in which local supply cannot to providing linkages to international knowledge and expertise. Immigration policy and better settlement support should be reviewed to ensure the necessary skills can enter the Auckland region and that those skills can be effectively integrated. Introduction of mechanisms to better utilise the international connections, knowledge and investment that migrants have should also be examined. It appears that thus far there is latent capability and capacity that has not been tapped into.

8.1.5. Managerial skills

Lack of management resources is consistently cited as one of the factors hampering innovation activity by New Zealand firms. Management capability and leadership capability are critical in determining both business strategy and business success (Castanias & Helfat, 2001; Thompson & Heron, 2005). Notions of management draw a distinction between leadership and management (see Zaleznik, 2004); however, for the purposes of this paper, management and leadership are considered together under the heading managerial skills.

International league tables rank New Zealand well on business practice indicators but less well on the availability of competent managers (see the World Economic Forum Global Competitiveness Index, the World Competitiveness Yearbook and the IMD World Competitiveness survey). A number of studies in Auckland and New Zealand have found that many owners and managers often lack the drive and ambition to grow firms into larger businesses (e.g. Ascari Partners et al., 2011; Austin, Fox & Hamilton, 1996; Cameron & Massey, 1999). Auckland stakeholders interviewed indicated that New Zealanders tend to be more reactive in business and focus on securing short-term opportunities rather than considering longer-term growth. Clearly, these approaches to strategy and leadership will constrain innovation.

Conversely, there were also examples in Auckland of the link between strong managerial skills and innovation performance. The strong, sustained commitment of the CEO and a good alignment between the firm's goals, management teams and

processes were considered to be key to the innovation success of some firms interviewed as part of this review, such as those in the advanced materials sector. This includes being able to recognise opportunities or constraints and being responsive to them. Many successful firms in fast growing segments of the materials industry, and surviving firms in the declining segments, were responsive to customer demand and changes to the industry. Many of these firms were able to adapt their business model and reduce cost structures in a timely way in order to continue to survive and thrive. Examples include:

- Some manufacturers recognised the importance of having some degree of control over the distribution of products and acted accordingly – including developing their own overseas sales, marketing and distribution capacities, rather than relying on third party distributors.
- Many manufacturers were increasingly importing third-party products for resale in New Zealand. A number of exporters started doing this when exchange rates were very high to help offset foreign exchange losses from exports.
- Some manufacturers changed their focus in product development as a result of the global recession. A number of firms noted that they are becoming more focused on developing core products that help business customers improve productivity and reduce cost.

Overall, however, the interviews for this review regularly identified both a lack of leadership and management skills as considerable weaknesses in relation to firm innovation in most sectors. Firms in the digital content "creator" segment and the marine sector were usually operated by owners with creative and technical skills rather than business skills, and subsequently focused less on business growth than on supporting a lifestyle and/or instead concentrated purely on product innovation. While technical, creative and practical backgrounds are valuable, they are no substitute for management skills. Succession planning is also an issue for family-owned firms (typical of the food and beverage processing sector).

International experience is also increasingly becoming an essential requirement for managers, particularly for export-focused firms. While Auckland and New Zealand are considered to be a solid training ground for managers who are generalist and adaptable, New Zealand experience does not provide exposure to the dynamics of

foreign countries and international markets. Strong commercial skills – preferably gained by working in large or multinational organisations – were desired by firms and considered to be scarce in New Zealand. Past studies of international perceptions of New Zealand businesspeople also show that market-relevant knowledge and skills, including language and cultural skills, were areas to work on for those dealing in Asian economies (Asia New Zealand Foundation, 2007). More generally, while New Zealand businesspeople are perceived as holding high business ethics, they are seen as lacking in business acumen and the drive to succeed (NZTE, 2007). International customers and businesses considered New Zealanders "nice, but naïve". In response, NZTE's global mindset programme is designed to provide a New Zealand-specific solution to improving internationalisation capability.

Large firms have greater resources available to them to develop managers and leaders. Those interviewed described in-house management development programmes and/or use of external providers (domestic or overseas). They spoke of the strong need to identify, develop and promote talent inside the firm. Unlike small firms, they typically conducted regular performance reviews and had individual development plans.

Nevertheless, management capability continues to be a major area of concern for Auckland and New Zealand's innovation system. It is a key barrier to innovation and business performance in general. Management and leadership capability is developed through a variety of mechanisms and there is considerable support in the region available to firms. They range from university-conferred MBA programmes to training workshops, often at little or no cost. For example, prior to June 2010, NZTE offered the fully-subsidised Enterprise training programme[34]. However, between 2002 and 2008, 13 percent[35] of firms in the Auckland region attended a training course, the smallest percentage of total firms of all regions (the highest being the East Coast region at 55 percent). This may indicate that Auckland firms have difficulty accessing this programme, that they perceive that they do not require this type of training and/or they are able to access other types of programmes by other providers in the region.

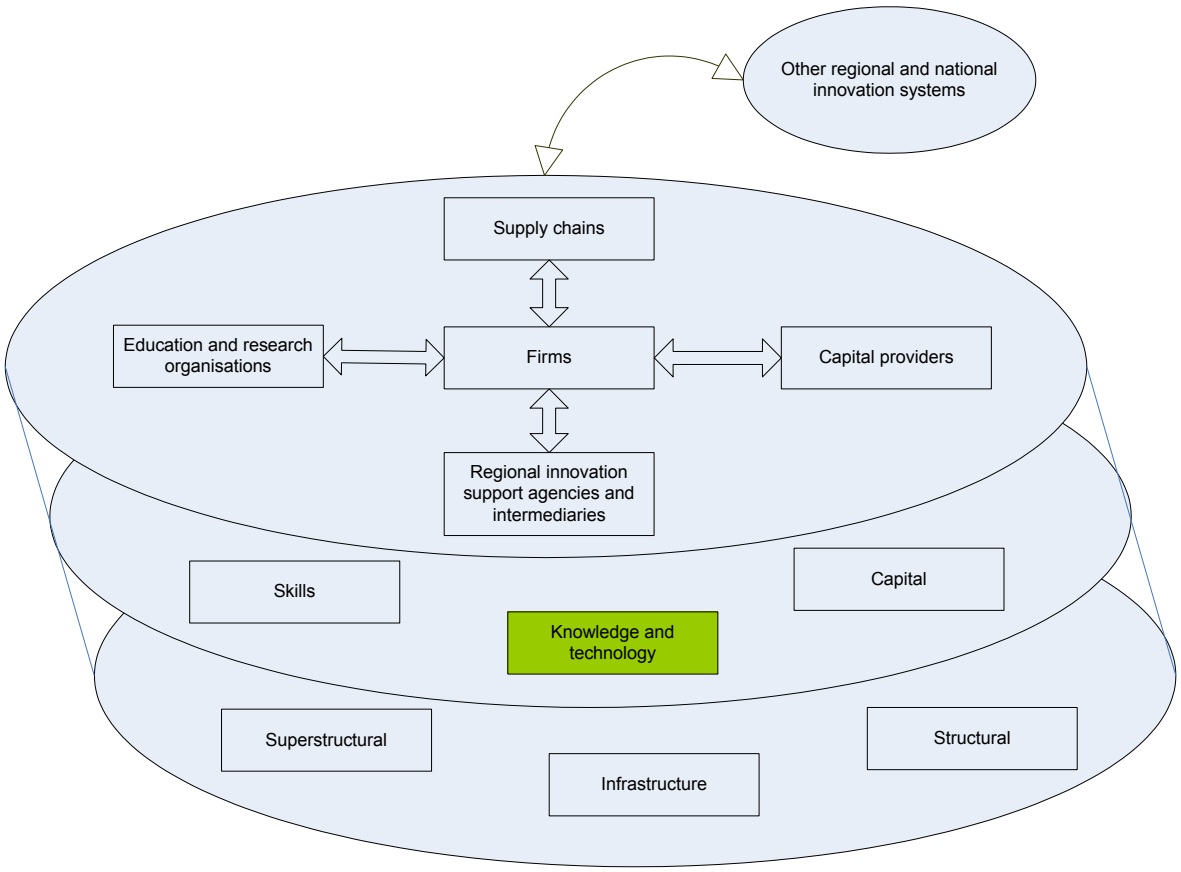
[34] The scheme offered businesses a partial subsidy to access business training and capability services provided by the private sector after the business had been assessed by nominated organisations/regional partners.

[35] Note that this figure double-counted firms who attended courses, capability assessments, follow-up coaching and/or one-to-one business support in multiple years.

Given that these types of programmes have been available in Auckland and New Zealand for many years and management capability continues to be an issue, it is likely that other mechanisms should be investigated. The types of management programmes and training on offer generally require time (sometimes significant time) away from the business, which can be a deterrent for Auckland's predominantly SME population. This suggests that experiential learning, learning by doing, and learning from others (colleagues, customers, suppliers, other businesses) on the job may be better avenues to pursue. There is a need for a more customer-focused approach in Auckland that involves the development of direct relationships so that businesses' needs are clearly identified and responded to. A new model of delivery is needed which moves away from the "one-to-many" way of delivering management and leadership support to a more tailored process.

A MED review of management training advisory services delivered by NZTE, and also conducted in response to the findings of this paper, concluded in the implementation of a new model of management capability development delivery in New Zealand. This will involve a nationwide Regional Partner Network (for example, EDAs and Chambers) that will assess local businesses. They will then channel businesses to services that meet identified needs and enable eligible businesses to partially cover the cost of these services through a voucher system. This tailored process is likely to improve delivery and the outcomes sought; however, it should be flexible enough to be used for on-the-job training, experiential initiatives, sector-specific services and training for a group of organisations.

8.2. Technology and intellectual property



In a strong regional innovation system, it is expected that the technology required to support innovation is readily available or able to be developed, and that it is generally up to international standards. New Zealand's comparatively low labour productivity, coupled with low capital stocks, may imply a low level of technological sophistication (MED et al., 2007). National data and surveys present a mixed picture. New Zealand is above the OECD average for investment in fixed capital assets, yet only half of New Zealand firms consider they have fully up-to-date equipment (Statistics New Zealand, 2009a).

New Zealand firms are also specifically acquiring technology for innovation. They are incorporating are incorporating computer hardware and software, new machinery and other equipment into their equipment into their businesses to support innovation (*Table 3*

Table).

Table 3: Activities supporting innovation, last two financial years as at August 2007 and 2009

Activity	Done to support innovation		Done, but not to support innovation	
	2007	2009	2007	2009
	Percentage of all businesses			
Employee training	21	22	47	44
Acquisition of computer hardware and software	24	21	53	55
Implementing new business strategies or management techniques	17	17	38	33
Acquisition of machinery and equipment	16	15	21	20
Organisational restructuring	14	15	12	12
Marketing the introduction of new goods or services	11	10	20	23
Market research	9	9	10	12
Significant changes to marketing strategies	8	9	6	6
Design (e.g. industrial, graphic or fashion design)	8	8	8	10
Acquisition of other knowledge	6	7	5	6

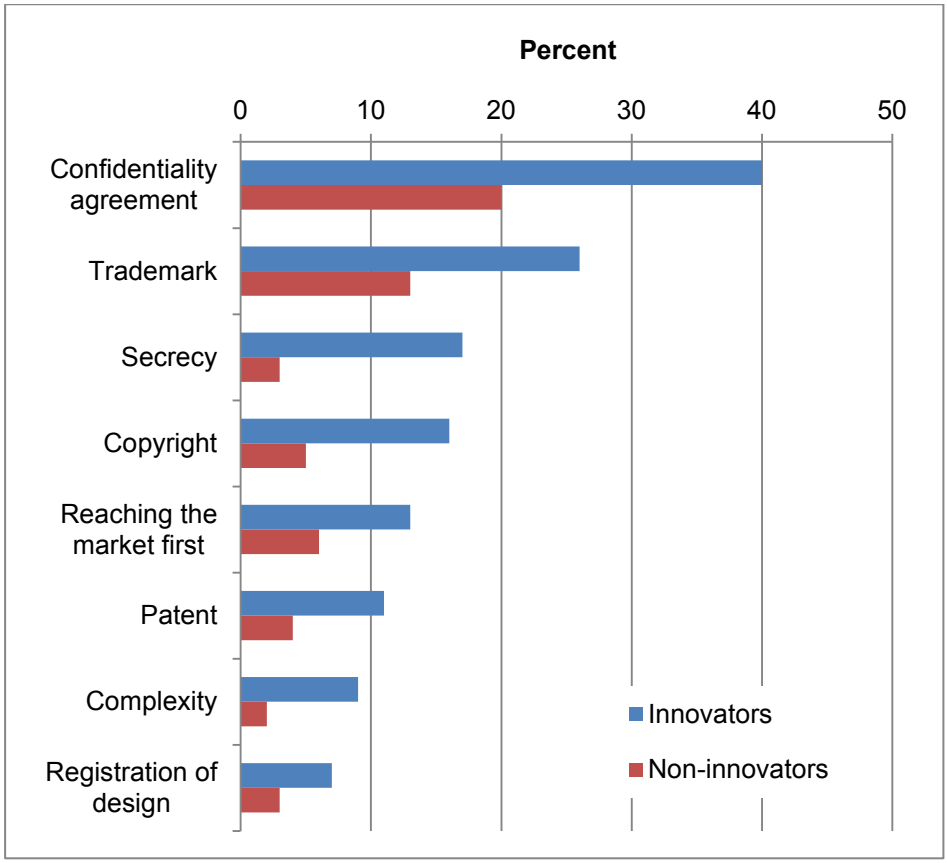
Source: Statistics New Zealand, *Innovation in New Zealand: 2009*.

New Zealand firms, in general, also appear to recognise the importance of the protection of IP, the opportunities it creates, and its relevance for exporting (UMR Research, 2007). In a survey of attitudes to IP, the three most cited barriers to formal protection were the belief that IP rights were ignored by other businesses, the costs of protection, and the difficulty in enforcing rights in export markets. The pace of change and IP law were also cited as barriers (UMR Research, 2007). While firms do appear to consider IP important, they may be underestimating its contribution to successful innovation. Few firms in the sectors studies discussed IP and IP protection. This suggests that there are opportunities to improve IP information and advice in the Auckland region.

There were some clear differences in technology acquisition and management between sectors in Auckland. For example, superyacht firms in Auckland have gained significant advantages through understanding materials technology, which has also led to benefits in the recreational vessel industry. While materials technology is a strength, the sector typically adopts and adapts industry standard technology platforms. For example, imaging and design tools are widely used but off-the-shelf, standard technologies are used rather than sector-specific ones.

The marine sector is also generally collaborative so technological advancements are typically communicated widely within the sector (Glass & Hayward, 2001). While secrecy is used as a form of IP protection by 17 percent of innovative firms in New Zealand (see *Figure 17*), marine firms interviewed appeared to rely on this the most. Given the fluid workforce, this becomes a significant challenge. To combat this, firms instead tend to focus on continuous improvement. As said by one of the interviewees in the marine sector, "copying happens – the main thing is to be ahead of competitors".

Figure 17: Methods for protecting intellectual property (last financial years at August 2009)



Source: Statistics New Zealand, *Innovation in New Zealand: 2009.*

When compared with other boatbuilding firms offshore, most Auckland firms do not have the scale to invest in leading-edge technology. From production to sales, Bavaria Yachts in South Germany is one of the world's busiest yacht producers, with some 3,000 yachts leaving the factory per annum. Bavaria has twelve computer numerical controlled (CNC) machines to cut components, decks and hulls (Springer, 2006) while an Auckland boatbuilding firm may have only one. There is considerable

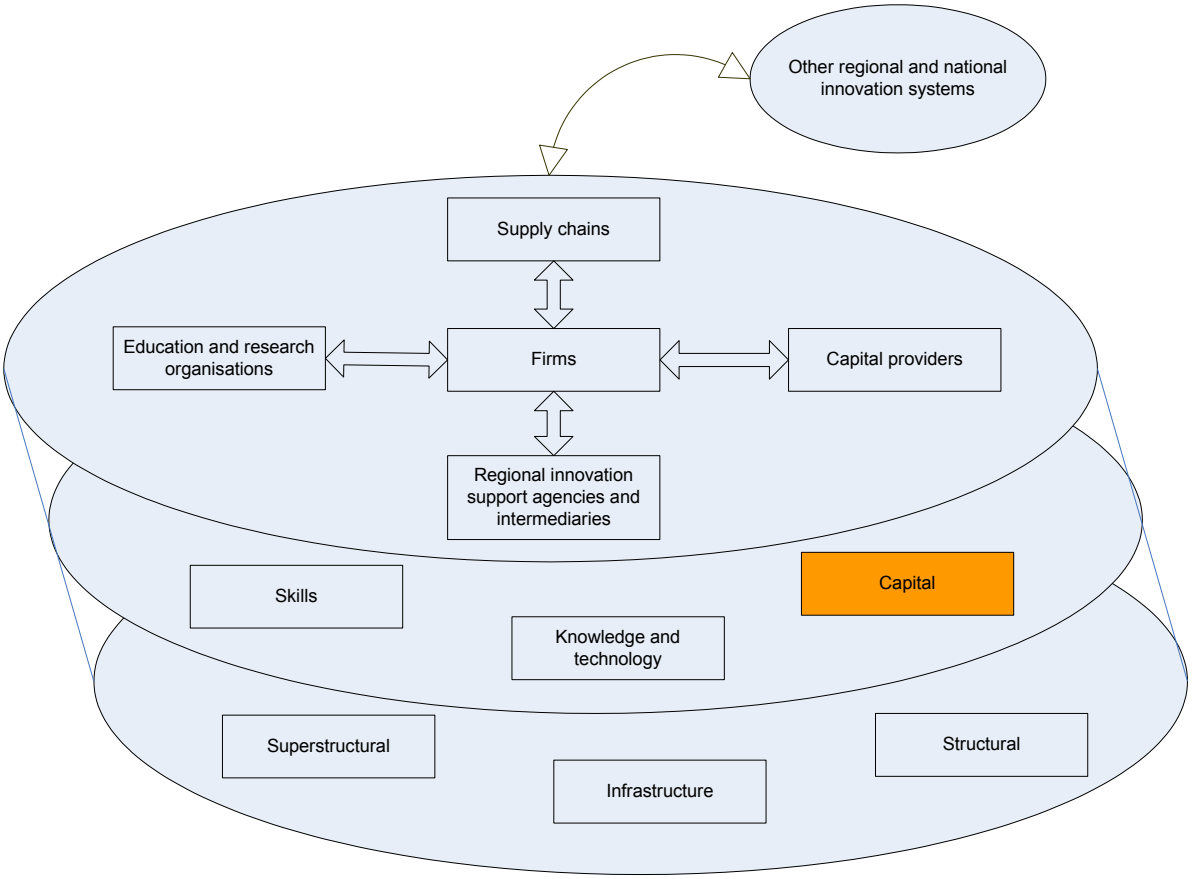
scope for the marine sector to be more collaborative in its approach to technology and shared infrastructure.

For Auckland digital content firms, there seemed to be no barriers to accessing the latest and or any technology, with many major technology vendors based in Auckland City. Firms use current technology platforms to ensure maximum distribution for their content across the full range of media. A number of Auckland firms and institutes have developed highly-regarded technology platforms, which in some cases are world-leading. These include the work of the Bioengineering Institute at the University of Auckland in understanding and modelling of the human body, AUT's body surface scanning equipment, and Right Hemisphere's product graphic management system.

In the food and beverage processing sector, there were views expressed that the high cost of capital for new technologies and the low return on investment for small production runs often means that New Zealand is a slow adopter and must wait until equipment prices reduce before the technology can be introduced into the local market.

Firms in Auckland may not be utilising technology to its full potential to enhance innovation. Business investment spending has fallen during the recession in Auckland, which is also likely to hamper innovation and productivity in the longer term. Given that firms in Auckland are relatively small with limited resources, collaborative approaches to technology should be further explored.

8.3. Capital



In relation to innovation, New Zealand businesses consider that the cost of developing or introducing it is the second-largest hurdle they face, the largest being the "lack of management resources" (Statistics New Zealand, 2010). This is consistent with EU findings, namely that four factors constrain innovation: access to finance, scarcity of skilled labour, lack of market demand, and expensive human resources (The Gallup Organisation Hungary, 2007). The lack of equity capital and the funding of innovation from cashflow have already been discussed previously in this paper.

However, on the demand-side, the persistent themes are that many firms are not investment ready and there are few quality investment opportunities (see also Metro Innovation Project, 2009).

Many owners are not prepared to give up a share of their business or may over-value it. This was particularly evident within the marine industry which has negative attitudes towards equity and foreign investment (Knowledge Matrix et al., 2009).

Others are simply unable, through lack of skill, to prepare their firm for the investment process. While investors are interested in firms with high export potential, many firms are considered to lack knowledge of overseas markets. It is also perceived that firms seeking investment do not ask for help from advisors or other intermediaries and, for those that do, their ability to pay is limited. These challenges are not unique to Auckland or New Zealand. Similar findings have been reported in Canada. For angel investors in Canada, the high rejection rate of proposals was largely due to unrealistic valuations and lack of product and market knowledge (Liu, 2000).

Various services are available to firms to address these demand-side challenges. Auckland's three incubators offer expertise, networks, tools, and an environment for entrepreneurs and start-ups to increase investment capability. NZTE offers the free Investment Ready Training programme within its suite of business development services.[36] In some cases, angel networks and investors work with firms to get them investment ready. However, the service offering is not consistent across New Zealand, and questions have been raised about its sustainability (Metro Innovation Project, 2009).

The findings of this review are consistent with the conclusions of the Metro Innovation Project (2009). Current initiatives being implemented on the demand-side are addressing some of the issues but the following gaps still exist and need to be better addressed:

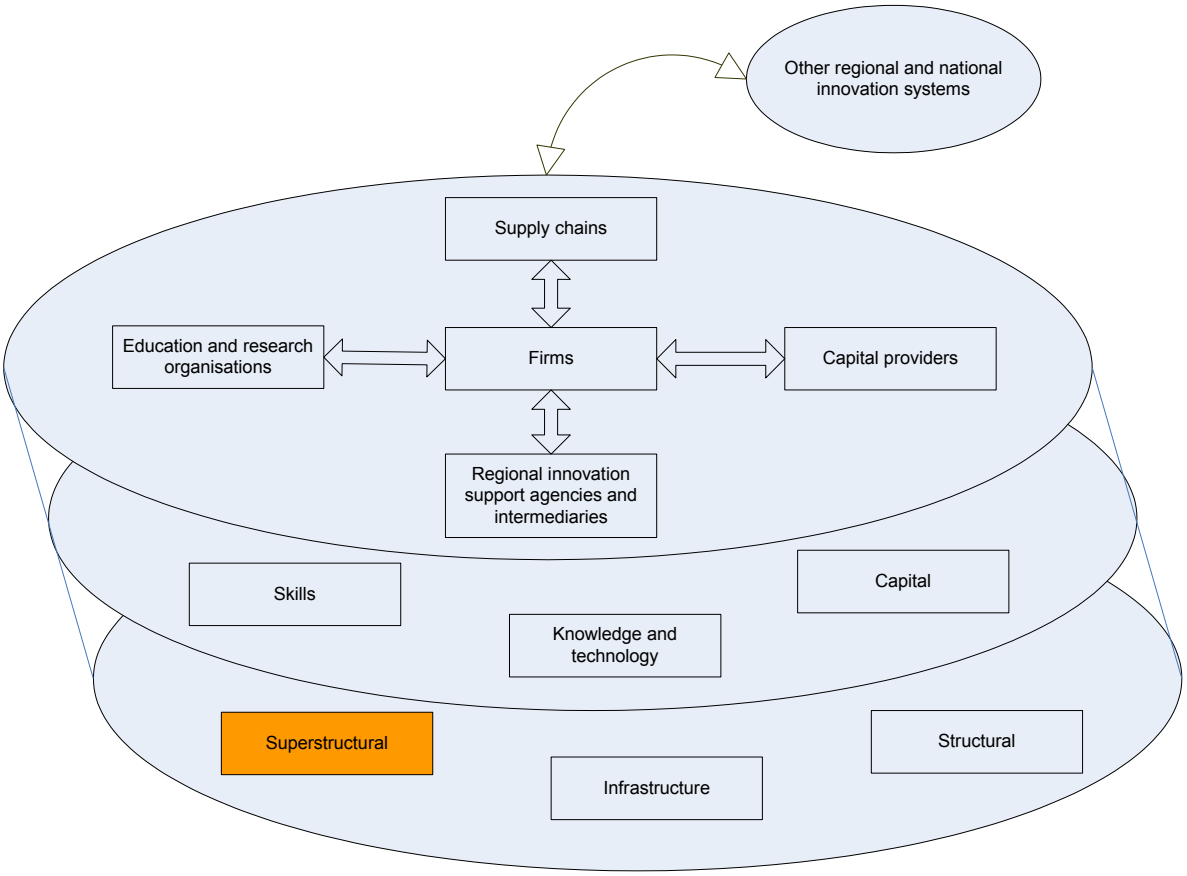
- the ability to "increase the pipeline" of investment-ready companies, which is influenced by the infrastructural capacity and the number of incubators, science parks and other organisations that support the creation of high-growth SMEs and start-ups
- an education process to enable SMEs to have a better understanding of what products are appropriate for the global market, and a communication process to lift the aspirational and attitudinal capability of SMEs through promoting the benefits of investment

[36] Training covers the capital-raising process, what investors look for, preparing the business case or business plan, valuation, legal implications, finding an investor, the deal process and doing the deal. Training may lead onto the Escalator Service, which provides assessment and advice on investment readiness, deal preparation and deal broking, investment-specific workshops and other information. However, the Metro Innovation Project (2009) working group noted that there does not appear to be a strong linkage between the Escalator and Investment Ready programmes.

- a need for investors to relay their investment knowledge to entrepreneurs so that they can develop a better understanding of what investors are looking for
- a central portal on sources of early-stage funding, including grants, and who to approach for more information or how to seek investment.

9. Framework conditions

9.1. Superstructural



Organisational culture, embeddedness, trust, rules, and conventions are known as *superstructural conditions* (Cooke, 2001). Regional innovation systems that have generated superior performance over the long term have been associated with superstructural conditions such as shared norms, rules and conventions, interactions based on cooperation and trust, a culture of learning and a sense of community. At the firm level, human resources policies would foster trustworthy labour relations, teams within the firm would be highly cooperative, and the firm would be open to innovation knowledge exchange with other firms and other actors in the region (Saxenian, 1994, quoted in Cooke, 2001). Regional structures and governance processes would encourage consultation and networking.

9.1.1. Culture and social norms

There are three key cultural and social norms that impact on innovation in Auckland firms:

- enterprise culture or attitudes to business growth and success
- innovation culture or attitudes in business to implementing or trying new or improved ways of doing things
- consumer attitudes to adopting or trying new products or services.

Enterprise culture

While New Zealand has a fairly high number of start-ups, a high birth rate of firms, many SMEs, a good deal of entrepreneurial activity and high proportions of individuals who own their own business (OECD, 2008a; MED, 2007a; MED et al, 2007), it is arguable that New Zealand does not have an enterprise culture. It is perceived that New Zealand businesses operate in a culture that not only is not supportive of business activity and success but may also be a barrier to it (e.g. Research New Zealand, 2003). Lack of support is manifested in two ways. First, New Zealanders view entrepreneurial failure negatively, rather than as a natural part of the learning path to success (e.g. Research New Zealand, 2003). Second, New Zealanders do not appear to esteem entrepreneurial success (the "tall poppy syndrome"). Both factors are considered to act as strong disincentives for potential entrepreneurs at the same time as fostering conservative business practices. Specific inter-related inhibitors include:

- Attitudes, values, and behaviours in the community are considered to be unsupportive of engaging in business and sometimes hostile to success or failure.
- Celebration and reward for success and risk-taking in the areas of sport and cultural activities are not currently extended to business activities.
- New Zealand has to want to succeed and should provide the environment that makes success possible and allow talented people to enjoy their successes.
- Business and the economy is not a high-interest subject for most New Zealanders (Frederick & Carswell, 2001; Science and Innovation Advisory Council, 2001; LEK Consulting, 2001; Research New Zealand, 2003).

The picture painted of a typical New Zealand entrepreneur is of a person based in Auckland, operating a six-person "lifestyle" firm that services the local or domestic market (Frederick, 2004). Once that entrepreneur has the 3Bs – the bach, the BMW, and the boat – they have no desire to grow the business any further (Frederick,

2004). This lifestyle firm tag and the pursuit of leisure activities or non-financial considerations (for example, independence and self-employment rather than wealth creation and business growth) may be at odds with entrepreneurialism and the optimal creation of value from innovation. The 2007 OECD review of New Zealand innovation policy also borrows the "bach, BMW and boat" label but notes that "the significance and importance of this syndrome is hard to judge". Moreover, New Zealand is not the only economy with a large proportion of lifestyle firms. Further, the perception of business owners selling their businesses once they reach a certain stage – or the belief that businesses are not growth/export-oriented – may not be due to lack of aspiration but, more likely, is related to the difficulties that small firms face in transitioning their business in a geographically-isolated country. Finally, in some sectors geographical isolation and a lifestyle focus may actually serve as a spur to innovation, for example, in the marine sector.

Innovation culture

It is a commonly-held belief amongst New Zealanders that they are innovative folk. This view, which approaches myth-like status, is based on the "do-it-yourself" (DIY), "all you need is a piece of No. 8 wire" approach, where one uses whatever is at hand to solve a problem. In times gone by, resource-poor New Zealanders living in a small and remote pioneering society had to be able to work within constraints and devise practical solutions to the problems they faced (as discussed earlier in this paper). Yet the pathway from idea to commercialisation does not appear to be well bridged. Kiwis' "No. 8 wire" approach to life suggests that New Zealanders are *creative and inventive* rather than innovative.

The practical, "jack-of-all-trades" nature of New Zealand's inventive heritage may predispose it to incremental rather than disruptive innovation. The innovations described by firms in the sector studies were predominantly practical, problem-solving and incremental in nature, and based on trial and error and adaptation. Incrementalism may also constrain the commercialisation of such inventions as there is a marked tendency to "make and use" rather than an intent to "make and sell". Further, the inclination towards individualism and DIY may create barriers to seeking specialist advice that would improve commercialisation and capability. The potential

contribution of specialists – who can provide expert advice about growing businesses and help with innovation – is undervalued.

However, this creative and open culture also provides advantages. One factor that featured strongly in industry workshops undertaken for the review was a genuine belief that Auckland and New Zealand benefit from the flexible approach to solving problems and the willingness to collaborate with the customer to create solutions, rather than just promoting a particular "model". Marine sector customers, for example, particularly valued the greater willingness of Auckland boat builders to involve them in the development process, compared to European firms. Comments were made in the screen production segment of the digital content sector that New Zealand firms are more open to new ways of working than US counterparts, a trait valued by Asian countries such as Korea and Taiwan.

The extent to which innovation, particularly radical innovation, occurs is impacted by the fact that Auckland firms generally do not place great emphasis on innovation in their business strategies, they do not have sophisticated innovation management processes, and they are more creative rather than innovative. This is consistent with the messages received during the review that firms produce incremental rather than radical innovation.

Openness to new goods and services

Another well-held view in Auckland is that the region is a good location for introducing new goods and services because New Zealanders are open to trialling products, and the diverse population allows firms to test products across multiple communities. This appeared to be the case in most industries studied, including food and beverage processing and health technologies.

It was particularly apparent in the marine industry, where owner-managers of firms and their employees were often keen sailors (Chetty, 2002). This allowed them to test products themselves, consider refinements and implement them. Some in the industry are professional sailors who compete in the international race circuit and want to be involved in "build[ing] the toys they play with" (Chetty, 2002). Being involved in sailing also brings the businesses closer to their customers. Participating

in races and events allows them to keep up with trends, technologies and needs. Being visible and involved in sailing also helps market the business and the industry.

The implications of these cultural findings for central or local government or industry are somewhat limited by the difficulty in changing widely-held social attitudes, and the risks of appearing to engage in "social engineering". There are a few economic development and education programmes and strategies in Auckland (and nationally) which have focused on instilling a business and enterprise culture, mainly through the primary and secondary education system. These include the Education for Enterprise (E4E)[37] scheme as well as stand-alone initiatives, courses and programmes in schools such as the Young Enterprise Scheme (YES), the Primary Enterprise Programme (PrEP) and the Enterprise Studies Programme (ESP).

However, there may be a role for industry groups and regional government in promoting an "enterprise culture" in Auckland through publicising innovative products, processes and ways of working in the region. This should include successful entrepreneurs, growth businesses, international marketing approaches, and distinctive features or capabilities that exist in Auckland. The scale and target audience of existing initiatives that promote business success – such as regional events and awards – should also be broadened. The policy "signals" sent by central and local government may also have an impact on cultural values and attitudes. Implementing policies that assist businesses (for example, reducing regulatory hurdles and promoting investment) send a message that businesses' contribution to wealth creation is valued.

Additionally, while culture does influence innovation and business aspiration, the difficulty of transitioning firms at critical phases is also likely to be a deterrent. Support at the national and regional level should assist businesses through these difficult stages and ensure that the movement between different support agencies is smooth.

[37] E4E is a teaching and learning process directed towards developing skills, competencies, understanding, and attributes which equip students to be innovative and to identify, create, initiate and successfully manage personal, community, business and work opportunities, including working for themselves. It is not intended as an additional programme, rather a context and approach to learning. In the Auckland region, Alfriston School, Alfriston College, Onehunga High School, St Francis School, Takapuna Grammar School, and Te Matauranga School are E4E schools which incorporate an enterprising approach into their teaching and learning.

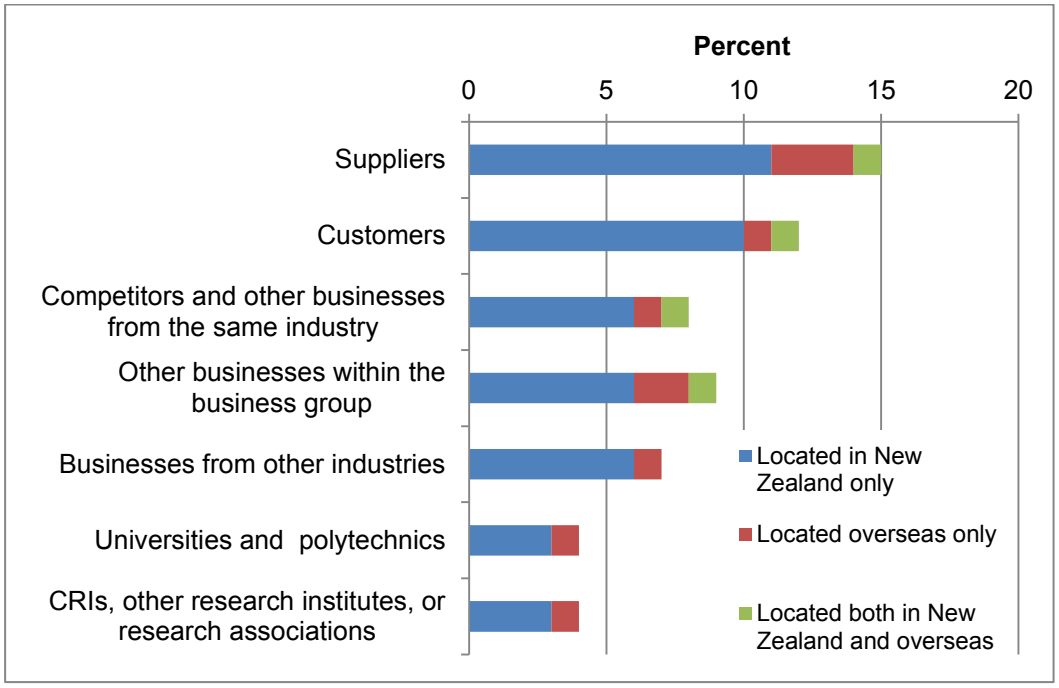
9.1.2. Collaboration and linkages

A strong regional innovation system has high levels of collaboration and linkages between and within businesses and organisations. Benefits of collaborative arrangements[38] can include the emergence of collective resources, such as skills, market information, training and suppliers; increased specialisation and more distinctive differentiation; flexibility to adapt quickly to market conditions; pressure to innovate as a result of closer relationships; and more efficient ways of innovating through learning from others and their successes and failures (Brockeslby et al., 2004; Benson-Rea & Wilson, 2003).

As noted, the sectors studies revealed that many firms are reluctant or unable to enter into more structured collaborative arrangements with other firms, which is consistent with previous findings on this subject (e.g. Innovation Working Group, 2003). Firms who engage in firm-to-firm collaboration for innovation are in the minority and collaboration with universities and research institutes is even less common (*Figure 18*). Cooperative arrangements are even less common with universities and research institutes. Given agglomeration effects in Auckland, it may be expected that firms in Auckland would be more likely to enter into cooperative agreements than those in other regions. Conversely, the sprawling nature of Auckland may mean it is harder for firms to collaborate, compared to what might be found in small towns. These ideas have not yet been tested empirically, although the interviews suggest that while some collaboration takes place, it is certainly not the norm.

[38] There are also potential downsides from collaborative arrangements, such as preventing entry of competition, becoming too insular rather than externally focused, and difficulties in maintaining intellectual property.

Figure 18: Proportion of innovating firms with cooperative arrangements, last two financial years at August 2009



Source: Statistics New Zealand, *Innovation in New Zealand: 2009*.

International linkages are also poor. While they occur, they are a small percentage of total collaborations (less than three percent). Innovation is becoming increasingly global, leveraging off advancements in science that occur offshore, foreign investment and skills from abroad. If Auckland and New Zealand firms continue to confine their advancements within geographical boundaries they will be left behind. Auckland and Auckland firms' international linkages are discussed further in section 10, *Local, national and international linkages*.

Of the cooperative arrangements that do exist in Auckland and in New Zealand, most appear to be transaction-based; formed on an informal, ad-hoc basis; or at only one step in the value chain – rather than being more systematic linkages. Aspects of New Zealand's business environment may impede such collaboration, such as:

- the absence of large firms which often facilitate collaborative arrangements offshore and act as conduits for small firm suppliers
- the small scale of businesses, industries and value chains, which imposes limits on the extent of specialisation and exchange possible
- distance from markets, which naturally reduces the number of interactions and flows of tacit knowledge

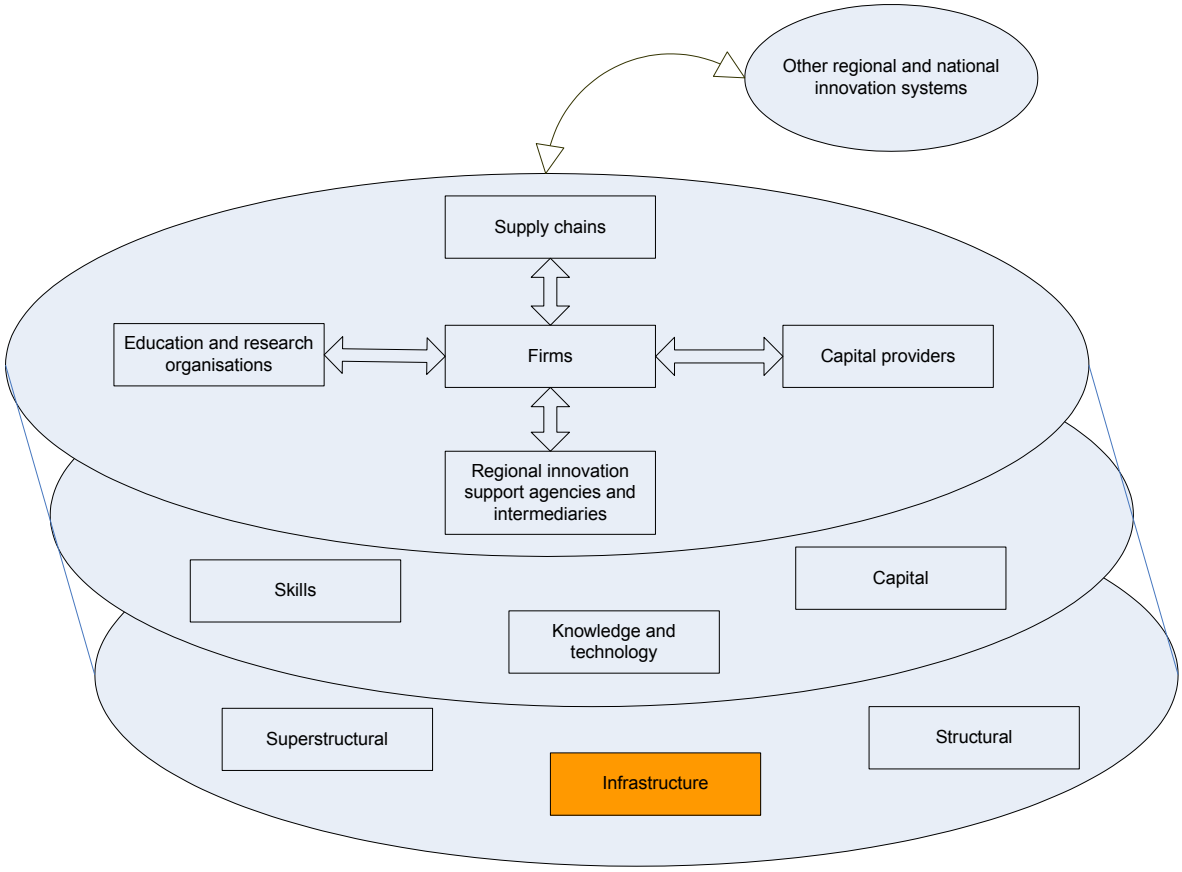
- the competitive nature of most firms, given most are focusing on the small domestic market.

A sense of mistrust and high competition was found in the health technologies sector (LECG & IGrow, 2008) as well as the digital content sector in Auckland where there has been a tradition of competition for domestic advertising and television work and this has impeded collaboration.

The maturity of industries appears to influence collaboration. The digital content sector is making tangible steps to improve the level of collaboration (for example, through initiatives like Nextspace) and there is an increasing willingness to do so for the good of the sector and its firms. The marine industry has a greater collaborative approach to business and innovation due to its greater history in Auckland and New Zealand. There are also some other key differences in the conditions for cooperation that are apparent for this sector compared to others. First, there is a social network that underpins business collaboration, where long-term social relationships have stemmed from attendance at the same schools, sailing together, competing in international and national races, and belonging to the same yacht clubs since youth (Chetty, 2002). Second, there is specific infrastructure in Auckland that attracts firms to locate near each other (for example, berthage) and this increases the extent of informal interaction. Third, there has been a strong champion in the Marine Industry Association, which has encouraged cooperative activity such as through the marketing of events.

While Auckland firms in other sectors do not demonstrate strong collaborative activity, the above factors suggest ways in which increased collaboration can be achieved. Indeed, international empirical studies show that trust and cooperation between firms in a region can be intentionally created (Isaksen, 2001). For example, club goods may be used – that is, assets accessible by, and beneficial to, firms and institutions in a region that sustains collective learning capability. Current regional and national initiatives – such as the pilot food and beverage processing plant, and the health technology hub – include collaborative activity between firms, and between firms and other organisations, as intentional outcomes.

9.2. Infrastructure



Understanding the contribution of broader infrastructure is increasingly being recognised as key to innovation performance. It is argued that dealing with transport, housing and planning needs may have a larger impact on innovation than more focused traditional innovation support policies (Webber, 2008). For Auckland, it is likely that the combination of fast-paced urbanisation and lagging investment in infrastructure has constrained Auckland's innovation potential. While Auckland ranks consistently in the top five cities in the Mercer Quality of Living Survey, its city infrastructure (electricity, water availability, telephone, mail, public transport, traffic congestion and airport) ranked at 43rd in 2009.

Regional government should continue to invest, along with central government, in transport and broadband as a priority for the medium-term as well as contribute to national spatial plans to ensure infrastructure investment is well coordinated. Further, there are opportunities to improve Auckland's urban form and community amenities to attract and retain skilled people to the region.

9.2.1. Transport

Transport infrastructure allows goods to move around the economy and it brings people and firms together. Time spent commuting around the greater Auckland region has increased dramatically over recent years and the capacity of the road network appears to be stretched. Meanwhile, Auckland's public transport patronage has declined greatly since the 1950s (Abusah & de Bruyn, 2007). Auckland has a low patronage rate relative to cities in New Zealand, Australia, Canada (Auckland Regional Transport Authority, 2006).

Firms interviewed for this review, as well as in previous studies, report that roading infrastructure does inhibit intra-regional connectivity.

> "…Roads were identified as a real problem, in that businesses can only arrange four meetings a day to client sites in Auckland, which inhibits networking and market development. It's a major cost of doing business in Auckland. One of the keys to developing innovation capability has been identified as improving people networks, which work best through face-to-face meetings and interaction, but transport difficulties act as a large constraint" (Norgrove & McCardle, 2006, p. 58).

Firms were resigned to the difficulties of travelling around Auckland. Marine firms reported difficulties for staff and suppliers in commuting between different manufacturing locations. For one firm, that meant that up to three hours a day was spent travelling between the firm's business locations. Food and beverage processing firms also expressed concerns over road transport, with the lack of a good, fast connection between the airport and seaport being a particular issue.

The government has already recognised the need for greater investment in transport in Auckland and nationally, and has made a number of commitments to accelerate this investment. This includes several billion dollars over 10 years for investment in the state highway network, including completion of the Auckland western ring route, which will link the cities of Manukau, Auckland, Waitakere and North Shore, relieve congestion and contribute to better links for business and freight between the key industrial hubs. In November 2009, the Minister of Transport announced funding of $500 million towards the electrification of Auckland's rail network.

9.2.2. Telecommunications

Given New Zealand's distance from the rest of the world, a well-functioning telecommunications network is essential. Broadband in particular is central to the development of the weightless economy. It not only supports the digital content sector but broadly improves firm capacity to collect, process, and exploit information, participate in international networks, and to interact with customers. Telecommunications also supports research networks.

Compared with most other OECD countries, New Zealand has low, but rapidly increasing, residential broadband uptake. Broadband is relatively cheap in New Zealand at low speeds (both upload and download) with small data caps but expensive at high speeds (especially high upload speeds) and with large data allowances (OECD, 2007c), limiting its usefulness for business. Further, the business models offered by telecommunication companies in New Zealand can be prohibitively expensive. Cost issues are likely to be more pronounced for smaller businesses and firms that only occasionally need to access, share or transfer large volumes of data.

Most companies interviewed referred to Auckland's broadband infrastructure. They considered it a barrier to bringing innovations to market and felt it hampered international competitiveness. Comparisons were made with other regions that have high-speed networks, such as Wellington's CityLink.[39] For digital content firms, broadband was cited as the single biggest barrier to innovation.

However, in 2010 the government announced a commitment of up to $1.5 billion for the roll-out of ultra fast broadband to businesses, schools, hospitals and 75 percent of homes over the next 10 years. It is expected that this investment will be at least matched by the private sector. Although the details are still being worked through, this investment will lead to significant improvement in broadband infrastructure over the next decade.

[39] CityLink is currently building a fibre-based network within the core Auckland CBD and intends to provide a range of services similar to that already provided within the Wellington CBD.

9.2.3. Energy

Auckland accounts for almost one third of New Zealand's national energy consumption. Waikato provides the bulk of Auckland's energy supply, although 25 percent of Auckland's electricity is produced within the region. The electricity demand from the Auckland region can approach current levels of supply (Auckland Regional Policy Statement & Auckland Sustainable Cities Programme, 2006).

While New Zealand's liquid fuel, industrial gas, and industrial and residential electricity prices are all less than the average of OECD countries (MED, 2009), there are concerns about the security of supply. The fragility and age of Auckland's transmission system resulted in national reliability indicators peaking sharply after 2006 (MED, 2009a). Extreme weather events, failure of transformers during routine substation maintenance and tripped circuits on main lines have all resulted in extensive interruption to power supplies (sometimes for several days) to large areas of Auckland over the last three years.

Some firms made reference to the inadequacies of the current power supply, which hindered the installation of certain equipment. The marine sector commented that Auckland's energy supply (and broadband infrastructure) is unable to cater for the requirements of larger boats with complex systems, including navigation, air conditioning, generators, pool technologies, radar and entertainment systems. For others, it presented a stimulus to reduce energy consumption or seek alternatives.[40]

While there may be innovation opportunities in energy use, security of supply plays a part in enabling innovation in the region. This can be enhanced through diversification of supply locations and increased diversity in generation, including renewables. Work is underway to develop a new transmission line between Whakamaru and Otahuhu. Additionally, a new large gas-fired generator is proposed for North Auckland by Genesis which, along with other energy investments being contemplated, should provide greater security of supply and better system resilience. Transpower, in its role as system operator, is facilitating the wider Auckland region's response to security of supply issues, working closely with the Electricity Commission and participants in the region, including distributors, generators, and retailers.

[40] For instance, Villa Maria has employed a night-air cooling system in its winery. The system extracts cool night air, which is pumped into the cool-stores over a shallow pool of water, keeping the wine cool without the need for refrigeration. Charlie's uses off-the-grid energy sources.

9.2.4. Other community infrastructure

Auckland ranks highly in quality-of-life indicators. In 2010, the Mercer Worldwide Quality of Living survey tied Auckland with Vancouver in 4th place, below Vienna, Zurich and Geneva. Auckland has ranked in the top five in the last five years. This indicator is a broad-based composite measure and takes account of 39 factors, including the political and social environment, the economic environment, the socio-cultural environment, medical and health considerations, schools and education, public services and transport, recreation, consumer goods, housing and the natural environment.

While the quality of life is high, Auckland's cultural and urban environment offer has received criticism. Earlier reports have found that Auckland has inadequately invested in cultural infrastructure (LEK Consulting, 2001). Cultural infrastructure can help a city attract and retain skilled workers. The Anholt City Brand Index shows that "pulse" is Auckland's second weakest dimension, with "presence" the weakest (Anholt, 2007). Pulse refers to the city's leisure activity potential such as heritage, contemporary culture and popular entertainment, while presence is city familiarity and its contribution to the world in culture, science and city governance. Individuals in countries around the world struggled to identify any landmarks, products, events or people associated with Auckland, with 88 percent not able to think of anything. Auckland also ranked relatively poorly when individuals were asked to consider whether there would be interesting things to do and new things to discover. Lifestyle features such as sporting attractions, design and fashion, nightlife and the arts were all weakly ranked compared to Sydney, Melbourne, Vancouver and Hong Kong.

9.2.5. Sector-specific infrastructure

In many of the sectors studied, specific infrastructural issues or projects were raised as being critical for future innovation performance. It is apparent that there are practical actions that can, and are, starting to be undertaken at a regional level. Key examples:

- For the **marine sector**, infrastructure for clusters, coastal access and berthage were particular concerns. Developing the Viaduct/Westhaven/Wynyard Point area as a hub for marine firms was considered important for the clustering of

firms. Also evident was the need to expand the Auckland region's ability to house larger boats as the trend in the marine industry is for the construction of increasingly-large boats. Turn-around space for manoeuvring into berths, refit space, heavy duty haul-out facilities and access to larger cranes is needed (the initiative in Hobsonville is dealing with some but not all of these issues).

- For the **advanced materials sector**, the factors that were identified as key to innovation performance were facilities that bring researchers and businesses together across multi-material platforms and applications, and soft infrastructure, including knowledge networks to ensure materials advancements around New Zealand are connected. The Materials Accelerator research network has recently been established to bring industry and research together at the start of the innovation process. The network has a team based at the Tamaki Campus of the University of Auckland. Partners include AUT, GNS Science, IRL, Massey University, Scion and Victoria University of Wellington

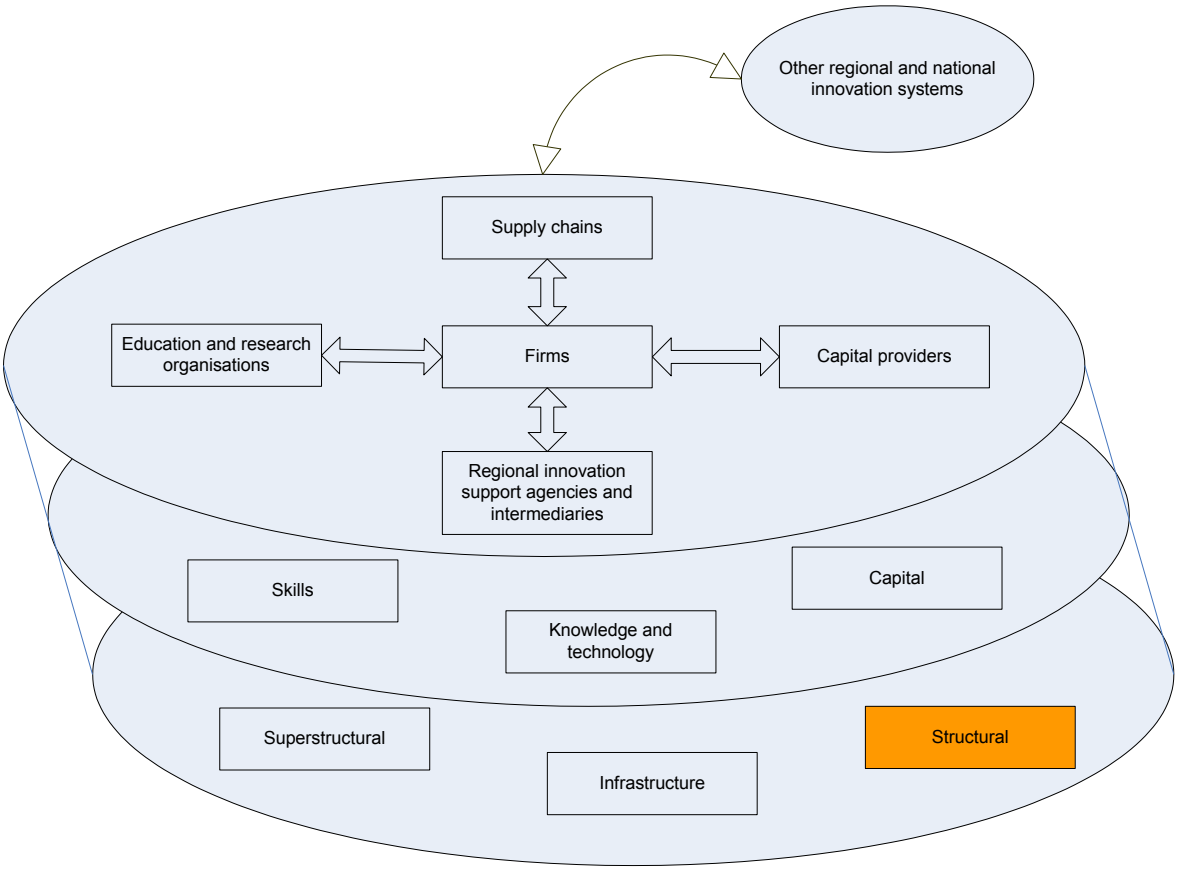
- A **food manufacturing** product development centre is under development in Manukau. Proposed originally by Massey Univerisity, New Zealand Food Innovation (Manukau) Ltd is being developed at the Auckland International Airport with the support of local and central government. The centre intends to provide open-access, commercial-scale food and beverage pilot facilities. This will enable businesses to trial innovative processes and products. The centre is also part of the New Zealand Food Innovation Network (NZFIN), which has hubs in Waikato, Palmerston North and Canterbury. The regional hubs take account the different roles and strengths that cities and regions within New Zealand can play to develop an internationally-competitive food manufacturing industry.

- For the **health technologies sector**, firms indicated that they face barriers of high costs and complexity in engaging with district health boards (DHBs) as customers to trial their product and service ideas. However, gaining a reference site in the domestic market is often a precursor to allowing firms to take products and services to international markets. It was also reported that clinicians within DHBs frequently have new product and service ideas that could potentially benefit clinical practice domestically and internationally as well as generating economic value. However, these are often not commercialised because DHBs are focused

on the delivery of health outcomes and clinicians lack the capability to commercialise ideas. A proposed northern innovation hub at Counties Manukau DHB may address these constraints. This will involve a small team of people who will focus on identifying and evaluating health service and technology ideas, and taking these through structured testing processes in clinical environments. They will also bring together the necessary market information, investment funding and expert advice to develop the ideas into commercial products and services.

- Several reports have been commissioned by industry members and regional authorities on infrastructure needs in the **film industry** and they indicate there is demand for increased studio infrastructure (see MED, 2009b). Occupancy rates for current infrastructure are about 85 percent (compared to an international average of 60-65 percent) and anecdotal evidence suggests large budget productions are choosing to film outside of New Zealand due to a lack of studio space. The government is currently considering a proposal to underwrite film production studio infrastructure in Auckland.

9.3. Structural



Innovation policy clearly encompasses science and technology, research and development, technology, education and infrastructure. Such policies can provide incentives for certain behaviours, such as collaboration, but may discourage others. In addition, because of the broad nature and complexity of innovation systems, policies which are not typically associated with innovation can either stimulate or block innovation – for example, by increasing the uncertainty and costs of product development processes or distorting the choice of technologies. This review found that some national policies are not well aligned and therefore inhibit business innovation. Examples are education and research funding which incentivise research publications rather than industry-focused research, and the presence of many CRIs in the primary sector but only one in the high-value manufacturing and services sector. There is work underway at the national level to improve policy alignment and implementation toward economic growth and innovation.

At the regional level, as previously discussed, governance of the innovation system and implementation of innovation initiatives have struggled. This paper intends to

provide direction on areas to focus on. Businesses interviewed also commented on environmental regulations, employment law, standards and rules about procurement which influenced their innovation activities.

Thirty-four percent of New Zealand businesses consider that government regulation hampers innovation in some way (Statistics New Zealand, 2010). Auckland firms across the sectors commented on what they considered to be negative impacts of regulation to their business and innovation: the Resource Management Act, the New Zealand Building Act and Building Code, health and safety, and the Hazardous Substance and New Organism Act. They considered that legislation and government regulations imposed high costs on their firms which could limit innovation and export potential.

For digital content firms, compliance costs related to filming and production permits in Auckland were considered to be particularly burdensome. Parks, beaches and other public places are attractive locations for filming. However, firms complained that obtaining access to locations was difficult, and some would not seek filming permits because of what they considered to be excessive bureaucracy. Film Auckland and local authorities are working together to facilitate filming.[41] Conversely, the more relaxed approach to the regulation of medical technology in New Zealand compared to overseas jurisdictions is regarded as a benefit by health technology companies, and leads overseas companies to use New Zealand for pilot studies and research (AERU & Flicka, 2009).

Concerns about environmental sustainability are increasingly leading to new rules and regulations across markets. They could either hamper Auckland firms or provide opportunities in the international marketplace. Given the capability strengths of Auckland firms and research organisations in materials technologies, the region appears to be well placed to focus product and process development on lightweight and sustainable materials. Many firms in this sector commented on the sustainability of products and processes. Some were more proactive in incorporating sustainability at all levels, while others were more reactive by meeting the requirements of

[41] Film Auckland chairs a working group of local authority representatives and industry representatives (mainly location managers and producers) which meets monthly to resolve location issues. The group was instrumental in the single film permit application that is used by all local authorities in the Auckland region – the first of its kind in New Zealand. Local authorities within the Auckland region also operate a "film friendly" philosophy to ensure that filming requirements are dealt with in a manner that helps rather than hinders the filming process.

government policy and regulations (nationally and internationally) so their products and processes remain “acceptable”.

Food and beverage processing firms were especially conscious of the impact of sustainability both on their products and processes, and on innovation. Emissions trading schemes, carbon credits and the food-miles debate were top of mind. The early adoption of international standards[42] and the use of carbon product labelling by Auckland firms not only enables them to manage their operation in a more sustainable way, but allows them to be positioned to gain additional (international) market access.

Firms in some sectors did express concerns about consumer and government information gaps on environmental sustainability issues. This relates to a perceived lack of strategy and coordination in relation to the advantages New Zealand has around sustainability, whether there is effective monitoring of offshore markets, competitors and international trends and developments, and how this information is disseminated to firms. For example, in order to plan for the future, both materials and marine firms considered it important to undertake industry research to understand the elements of sustainability that are important for their respective sectors as well as their market applications. Information and assistance could be provided to industries on useful and meaningful standards and certification programmes, and on overseas markets and competitors to ensure that firms are well informed about international sustainability trends.

Public procurement can play a valuable role in stimulating business innovation. The government is also a large customer of business innovation, being the largest New Zealand purchaser of many goods and services. The current procurement policy framework expects government departments to follow a number of principles. These principles are encouraged, rather than demanded, in other public sector agencies. They include open and effective competition; full and fair opportunity for domestic suppliers; improved business capabilities; and a requirement for sustainably-

[42] An example is the Publicly Available Standard, PAS2050:2008, launched by BSI British Standards, the Carbon Trust and the UK Department for Environment, Food and Rural Affairs on 29 October 2008. The new standard is a consistent way of analysing greenhouse gas emissions associated with goods and services throughout their lifecycle – from the sourcing of raw materials to manufacture, distribution, consumer use and eventual disposal. PAS 2050 strengthens current international measurement standards such as ISO 14064, the GHG Protocol and ISO 14040.

produced goods and services wherever possible with regard to the economic, environmental and social impacts over their lifecycle (MED, 2007b).

Despite these guidelines, a number of business groups and programme evaluations have identified barriers to participation for SMEs and innovative firms (Ministry of Economic Development, 2005). These include unnecessarily specific tender documents that limit competition and innovation; the use of international and multinational prime contractors who have little interest in subcontracting or partnering with SMEs; unclear identification of tender evaluation criteria and the proposed budget; imposing process costs which are disproportionate to the size of the tender; slow tendering and too much unnecessary information required; and risk-averse attitudes leading to choosing suppliers with existing relationships or known brands. Mandatory rules for departments and procurement education for departmental staff are intended to address some of these challenges. They will include innovation as an evaluation criterion.

Government policy, however, does not support preferential treatment for domestic SMEs as over time this will likely lead to increased costs for government as well as the economy as a whole by reducing competition (MED, 2005). This is not a position held by many other countries – for example, the US and Malaysia. However, it should be recognised that long-term negative effects can occur from preferential policies. In Malaysia, preferential treatment for ethnic Malay suppliers has been criticised for stifling entrepreneurship and perpetuating dependency and inefficiency. In the US, political patronage in the allocation of contracts has been raised as a concern. Further, the awarding of contracts to SMEs led to dependency as they simply maintained their contracts rather than introduced innovation or improved their competitiveness. Preferential treatment for SMEs also became more of a compliance exercise, rather than procurers recognising the value that SMEs can bring to the goods and services they supply.

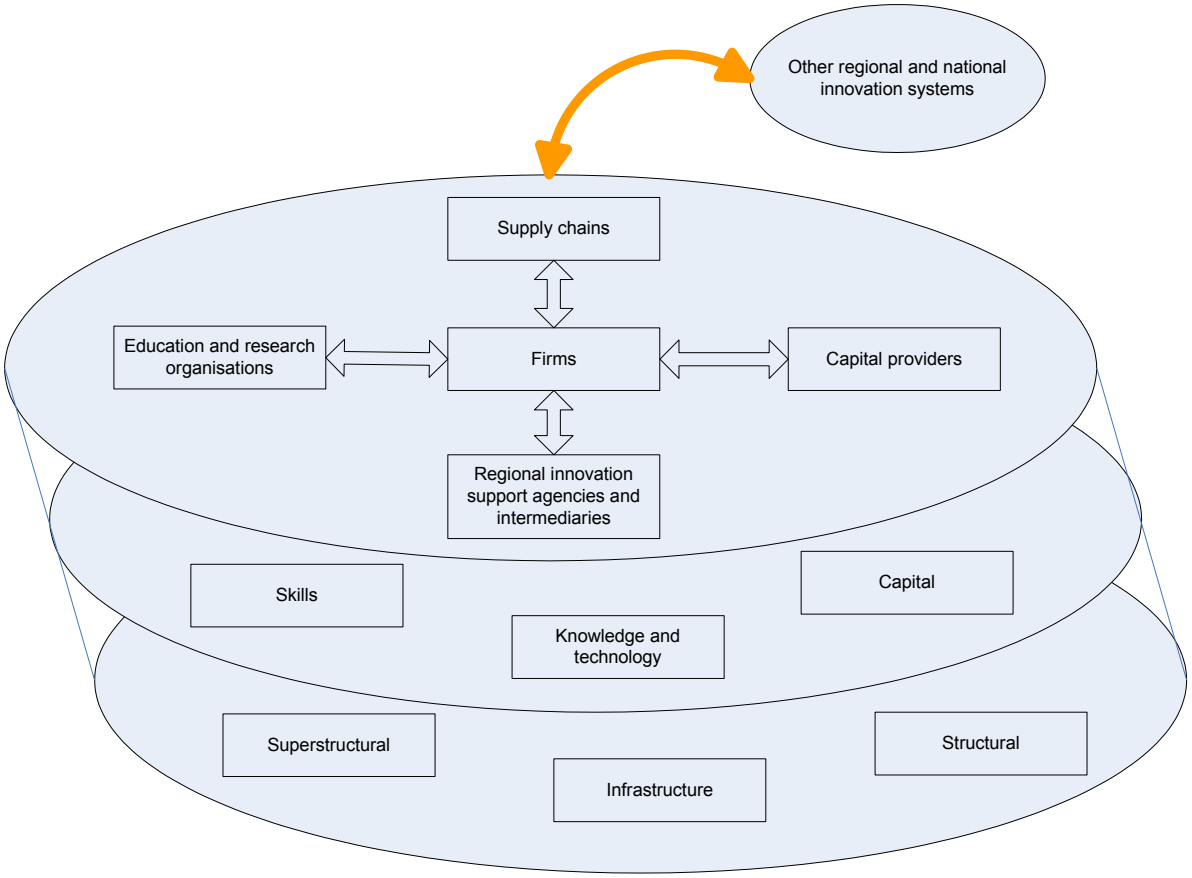
Policy in New Zealand focuses instead on removing barriers to fair competition to encourage SME participation through education and other initiatives. At a regional and local level, few of the firms and industry representatives interviewed commented on the openness of regional/local government and other public sector bodies in using SMEs or innovative firms. This may, in part, be due to the types of sectors focused

on in this review, with the exception of health technologies. Firms in the health technologies sector commented that the district health boards in Auckland and the larger primary health organisations were the only organisations of scale that could drive innovation. However, firms perceived that public procurers preferred offshore multinational firms rather than domestic suppliers. While they were able to sell their products offshore, they faced difficulty selling them in New Zealand (AERU & Flicka, 2009). Innovation is also not thought to be a priority for public health organisations who have competing resource, funding and risk minimisation pressures. Further, firms found the costs of engaging in procurement with DHBs to be high, especially proposals which were innovative (LECD & IGrow, 2008).

It is clear that at all levels of the public sector, more can be done to stimulate innovation in the Auckland region. Local and regional government and the new Auckland Council (which will have considerable scale) should continue to ensure procurement practices level the playing field for Auckland's SMEs and innovative firms. Further, Auckland's schools, hospitals, prisons, universities and the like play a critical role in demanding innovation from its suppliers.

10. Local, national and international linkages

10.1. Sectoral and cluster-based systems



Clusters are a geographically proximate, inter-connected group of companies and associated institutions in a particular field, linked by commonalities that can benefit from collaboration (Porter, 1998). Firms in the sectoral supply chain may locate close to the cluster, providing specialised inputs and adding to its competitiveness.

Famous international clusters include ICT firms in Silicon Valley and biotech firms in the San Francisco Bay Area and around Harvard University in Cambridge, Massachusetts.

Self-formed clusters are not yet particularly evident in the Auckland region, except in the marine sector and the health IT sector, which is part of a larger national network. The effectiveness and value of these clusters have also been mixed (LECG & IGrow, 2008), although they have been instrumental in the coordination of major projects or in presenting a united front for those seeking investment. Additionally, various

streams of local and central government work have been advancing embryonic cluster development in Auckland. There are some promising emerging clusters of firms and related institutions that are arising out of these efforts, such as the 3D digital graphics cluster Nextspace (see *Exhibit 3*) and the food and beverage processing cluster of firms in Manukau City. However, as noted earlier, collaboration for innovation has yet to emerge and it is too early to assess the effectiveness of these interventions.

Exhibit 3: 3D digital graphics cluster – Nextspace

Nextspace is a not-for-profit contract research and innovation centre which is closely linked to the software company, Right Hemisphere. The development of this virtual and physical cluster was a key component of the government's Spillover Agreement with Right Hemisphere in 2006. The government provided a US$8 million loan to that company in return for its commitment to fostering New Zealand's 3D digital content and graphics industry. Right Hemisphere's technology enables manufacturers to take the 2D and 3D design data created by engineers using computer-aided design (CAD) software and re-use this data to automate the publishing of 2D and 3D manuals and marketing material. This includes design graphics, photos and other information required for publications, such as maintenance and training manuals, and marketing materials. These are usually produced in two dimensions and at great expense, particularly for products such as airliners, cars and heavy equipment.

Right Hemisphere's technology enables manufacturers to accelerate their product development times, increase revenues, and reduce product lifecycle costs. Current customers, including Lockheed Martin, Abbott Laboratories, Boeing, Daimler-Chrysler and Mattel have achieved up to a 50 percent reduction in documentation costs, 20 percent faster "time-to-market" and substantially-improved customer satisfaction.

The Auckland Nextspace facility aims to:

- facilitate opportunities for local businesses to provide services to their own and Right Hemisphere's customers, as well as directly to Right Hemisphere
- establish education programmes that deliver graduates with expertise so they can be a pool of talent for New Zealand's 3D digital industry, and drive its research and development
- establish a group or cluster as a forum to bring together private companies, educators, researchers, and other organisations involved in 3D digital graphics for networking and education, and to facilitate collaboration
- establish collaborative research programmes between businesses, universities and major international companies. All parties are to be actively involved in the research programmes, setting research objectives, seconding personnel, and sponsoring research projects that contribute directly to their businesses and product development.

Clustering concepts in the Auckland region have had varied success but there are signs that, for some sectors, the conditions are right for fostering collaboration and co-location for innovation. As discussed earlier, sectors of significance for Auckland require clear strategies for growth which consider their connections to other regions

in New Zealand as well as internationally. There are also considerable inter-sectoral linkages – for example, materials with the marine industry and digital content with health. These strategies should consider the extent to which clustering should be encouraged – building on relationships between firms and institutions which have already developed – and how to better foster inter-sectoral linkages.

10.2. Inter-regional linkages

The Auckland regional innovation system is part of a wider national innovation system. Auckland should be expected to play an important role. Activities in the Auckland region – like research and development, design, financial, marketing, legal and skills development – serve to support production in other parts of the country. However, the interviews revealed that until very recently there has been little thinking in the region about how to formally strengthen linkages with other regions that have complementary strengths. More generally, there has also been little consideration of how innovation systems in different regions interact with each other.

McCann (2009) recommends increasing domestic agglomeration effects by increasing the scale of the Auckland-Hamilton-Tauranga city-region. While recent research suggests that current travel times and the insularity of each of these urban economies are barriers to creating a city system (Paling, Sanderson & Williamson, 2011), the consideration of mechanisms to increase scale and thus improve innovation performance have merit.

Linkages with other New Zealand regional systems differed by sector, depending on the location of major suppliers and customers, but generally appeared to be quite weak. City/regional rivalry and the competitive nature of businesses are likely to play a part here. There is some competition with the Wellington region in the digital content sector due to the impact of the *Lord of the Rings* trilogy and the perceived ease of doing business in that region. The digital content sector in Auckland has recently begun thinking about how to convert this competition and rivalry into growth opportunities, like taking advantage of overflow work when favoured Wellington firms such as Weta face capacity constraints. The development of a National Institute of Screen Innovation – which has representation from the digital content community in Auckland, Wellington and Canterbury – is also likely to strengthen inter-regional collaboration in the sector.

While Auckland has the largest marine sector, other regions have strengths. Whangarei produces large steel-hulled vessels and caters to marine defence contracts because of its heavy slip and lifting capacity. Whangarei also completes fit-out work for luxury marine interiors in kitset form. There is a concentration of trailer powerboat manufacturers in Hamilton that benefits from the heavy engineering skills related to its regional strengths in dairy manufacturing. New Plymouth also benefits from heavy engineering capability developed for the local oil and gas industries. Tauranga focuses on recreational boats but is also attempting to break into the refit industry. Nelson supports the local fishing industry, while Invercargill's strengths are in aluminium boats, including commercial vessels and jet boats.

Interviews with firms did not reveal that the national sector was thinking about how it could work together to maximise innovation and market opportunities. While each centre appears to be reasonably defined in its market, this may be the result of accident rather than design. Further, there may be efficiencies and further innovation opportunities from thinking how each region complements each other, and by considering where different infrastructure requirements for the marine industry are best placed.

Food and beverage processing firms had linkages with suppliers in other regions, mainly on an individual basis, but it was surprising how little these were mentioned as a source of innovation. Indeed, one firm described the challenges associated with distance, even though the supplier was based in the North Island. However, the New Zealand Food Innovation Network seeks to create a network of production facilities and innovation centres to serve the needs of New Zealand's food industry. The network model incorporates both hard and soft infrastructure (pilot scale facilities, skills, capabilities, networks, behaviours) required for the sector to deliver innovation and commercialisation outcomes.

The health sector, in partnership with the government, is also examining what models could be adopted to improve health technologies innovation through linkages to other regions in New Zealand. An innovation hub for the Counties Manukau District Health Board is expected to be linked with similar ones in Wellington and Canterbury to ensure a consistent national approach so that areas of specialisation and complementarities between the hubs can be identified.

10.3. International linkages

Auckland's and New Zealand's innovation activities represent only a tiny fraction of innovation worldwide and, in most cases, it is likely to be more resource-effective to obtain knowledge from overseas than to create new knowledge in New Zealand. A recent study of Norwegian businesses finds that greater diversity of international partners (rather than city-region or national partners) had more of an effect on levels of innovation and radical innovation (Fitjar & Rodriguez-Pose, 2011). However, this was mediated by the size of the firm, levels of foreign ownership, and sector and management capability.

Despite this, New Zealand's size and the distance from markets and offshore sources of innovation are likely to be significant constraints to innovation and productivity. The OECD (2008d, e) estimates that for New Zealand and Australia distance reduces labour productivity by more than 10 percent. Further, the International Monetary Fund (IMF) estimates that half of New Zealand's labour productivity gap with the OECD average can be attributed to geography alone (IMF, 2004, as cited in McCann, 2009). Auckland's distance from major markets means that businesses have difficulty accessing international information and technology for innovation, that they tend to internationalise at an earlier point in the business growth cycle than other overseas businesses, they will usually not have the scale of their international competitors, and that they are likely to struggle with international market engagement, particularly in understanding how to enter new markets (for example, logistics, labelling, channel management) or the full cost of doing so.

The OECD (2008e) estimates that Australia's scale compensates for the adverse effects of distance. For New Zealand, Auckland is the only city of significant scale to play a role in driving economic development as well as capitalising on its conduit for the import and export of goods, services and knowledge. Mechanisms discussed previously – such as the New Zealand Food Innovation Network and science and technology parks – are examples of creating scale, and connecting cities and regions across New Zealand to improve innovation and productivity.

Overseas ownership can be an important factor in influencing innovation in Auckland and New Zealand firms. The advanced materials companies interviewed noted that overseas ownership can constrain funding of product or process development when

parent companies prefer activities to occur elsewhere in their network. In the marine sector, some interviewees commented that their experiences of international ownership were not ideal, particularly if parts of the company were sold and technology development moved offshore. However, there were no widespread concerns noted during interviews within and across the sectors.

Conversely, large, overseas-owned firms operating in New Zealand can be important conduits of innovation as they develop the innovation capability of domestic suppliers to the firm through spillovers of better practice (Scott-Kennel, 2001) and upgrade management practices from the offshore parent and associated companies to New Zealand – provided there is strategic alignment. Advanced materials companies indicated that overseas ownership can bring access to extensive international networks for troubleshooting, new product and process development, and establishing new markets. Marine companies commented that overseas ownership made accessing capital for innovation and investment easier, although it may require more "corporate processes" to access it. However, in the financial services and insurance sector, the interviewees did not consider that offshore ownership impacted negatively on the level of innovation. Firms that were part of multinationals did not rely on their parent organisations for innovation input or leadership.

Firms also said they connected with international customers and suppliers by visiting leading clients to view their technology and processes, looking at overseas institutions known for innovation or by attending trade fairs. For example, in the materials sector, Air New Zealand has a strong relationship with Boeing, which supports its work on aircraft interiors. Winstone Wallboards referred to an international congress on co-developing products with partners, suppliers and customers. Fonterra noted that, in a number of advanced materials important to their packaging, technologies available overseas were well ahead of the comparable state of play in New Zealand. In a separate study on the medical technologies sector in New Zealand, examples were given of firms that are have partnerships with overseas distributors or market specialists in order to help with international compliance costs (for example, costs of FDA approval and other regulatory barriers) (AERU & Flicka, 2009).

Apart from the largest companies, most international connections are informal and rely heavily on personal relationships. There were suggestions in the workshops that the region could provide more opportunities for firms and agencies to formally network with international partners. Auckland support and research organisations also had important links overseas which can be better leveraged. For example, Auckland Uniservices is extremely well connected and participates in a wide range of international collaborations on joint R&D projects. They also participate in voice-of-market forums offshore to test the feasibility of new projects in overseas markets. The ICEHouse has developed strong networks and facilitates access to these connections to firms. Businesses have expanded on the back of referrals and networks provided by the ICEHouse.

Firms in the Auckland region on the whole are insular. Apart from the largest companies, firms have international linkages but these are generally informal, not sustained for long periods of time and tend not to be based around innovation. A more systematic approach to international collaboration is needed. The region should consider what forums could be used or leveraged (such as sister city relationships) to enhance international linkages.

10.4. Branding

National branding has been developed through the collective marketing efforts of New Zealand firms, NZTE and Tourism New Zealand at high-profile events and in campaigns. Current international perceptions of New Zealand are based predominately on "clean and green". While clean, green pastoral images work well for major export sectors – such as tourism and primary products – it is irrelevant, and potentially an impediment, to developing credibility in other sectors as it tends to be associated with a lack of technological sophistication. More recent forms of national branding have been used to market New Zealand as a country that is resourceful, has integrity and is refreshing.[43] This has been done through NZTE's brand partner programme and the New Zealand fern mark.

The national branding approach recognises that, whilst firms market and promote themselves individually, they lack a strong incentive to promote and market New

[43] Other Brand New Zealand values are "guardianship" and "welcoming".

Zealand (or sectoral) products and services as a whole. Firms that attended trade fairs and international events with NZTE commented that New Zealand's collective identity and branding was advantageous. Some sectors studied for this report considered that they had solid reputations and branding in international markets (perhaps associated with or incorporating national branding). For digital content firms, the previous "New Zealand: New Thinking" branding was considered to be particularly positive.

However, Auckland's efforts to market its industries externally are piecemeal and would be aided by effective collaboration. Regional strategies and action plans have identified a need to develop a strong Auckland brand. A regional brand which promotes Auckland as a destination to visit, live in, work, invest, study and do business was launched in September 2008. It is too early to tell to what extent the visual brand will be able to connect the region with international markets or its resonance with key Auckland sectors.

11. Benchmarking Auckland: a comparison with regional innovation systems overseas

In this section, an innovation scorecard for Auckland is used, based on a set of measures devised for EU countries.[44] The scorecard is used to compare Auckland's innovation performance with that of other relevant regions to understand the determinants of Auckland's innovation performance, and define some policy responses.

11.1. New Zealand's innovation scorecard

First of all, New Zealand's innovation performance is considered. How does New Zealand compare with other developed countries?

The Global Innovation Scorecard (Hollanders & Arundel, 2006) compares the innovation performance of the 25 EU countries with other major R&D performing countries of the world, including the US, Japan, Australia and New Zealand.[45] In terms of innovation performance, the global innovation leaders were Finland, Sweden, Switzerland, Japan, the US, Singapore and Israel.

New Zealand was ranked with the "next-best performers", a group that includes Germany, Denmark, Canada, the UK, the Republic of Korea, Australia and Ireland. New Zealand was ranked below the EU-25 and was at the bottom of this group overall. However, on other indicators New Zealand scored second highest on Diffusion, in the top third on Innovation Drivers, and was middle-ranked on Knowledge Creation and Intellectual Property, with a low score on Applications.[46] When cluster analysis was applied, New Zealand was mid-ranked in terms of both absolute and relative performance. It is one of 11 countries catching up with the EU-25 level of innovation performance. Australia, on the other hand, is one of seven countries that are forging ahead of the EU-25 (Hollanders & Arundel, 2006).

[44] Innovation is an important dimension of regional economic policy in OECD countries. See, for instance, *OECD reviews of regional innovation: regions and innovation policy* (OECD, 2011).

[45] The choice of countries was based on their share of global R&D spend in 2002. A non-European country's share had to be 0.1 percent to be included. While New Zealand's share was 0.09 percent, it was included as an OECD country.

[46] Diffusion is based on ICT expenditure as a percentage of GDP. Innovation Drivers is based on the number of new science and engineering graduates, the percentage of the labour force with tertiary education, and the number of researchers per million population. Knowledge Creation is based on public and business R&D expenditure as a percentage of GDP, and scientific articles per million population. Intellectual Property is based on EPO and USPTO patents per million population. Applications is based on the share of medium/high-tech activities in MVA and high-tech exports as a percentage of manufactured exports.

When New Zealand's innovation policy and performance are compared with some of those "next-best performers" – namely, Canada, United Kingdom, Australia and Denmark – it is clear that all economies are grappling with similar issues; however, most are working from a higher base of innovation performance. Canada performs well on many indicators due to high education attainment and strong participation in science, technology and research occupations. Despite this, their business investment in R&D is low, but not as low as New Zealand. Their policy focus has now turned to increasing private sector R&D investment (including through 20 percent R&D tax credits), encouraging practical application of research (such as business-led research networks and public-private research commercialisation partnerships) as well as building an educated, skilled and flexible workforce.

The story is similar in the United Kingdom where innovation policy has been developed to tackle some of the country's weaknesses in innovation performance – mainly in the areas of productivity, industrial structure and skills. The new policy focuses on the UK's low business expenditure on R&D. Key policy and initiatives outlined in their *Blueprint for Technology* (HM Government, 2010) include encouraging the public sector to purchase SME R&D through the Small Business Research Initiative; the development of a network of Technology and Innovation Centres; providing R&D tax credits and reducing the small profits tax rate; providing innovation vouchers[47]; giving out innovation prizes; simplifying government business support services and business tax; maintaining the science budget; focusing on technology-based skills; and encouraging industry to work with universities to meet skill requirements.

OECD data shows that Australia's national innovation system has a number of strengths, with the researchers, patenting and venture capital indicators all above the OECD average (OECD, 2008c). Australia's human resources in science and technology, and its scientific publishing are particular standouts. However, Australia's government and business expenditure in R&D, its business collaboration, the number of science and engineering graduates, the rate of product innovation and its triadic patenting are all weak. The Australian Government's innovation agenda,

[47] SMEs are able to buy services directly from an education or research institution of their choice using the vouchers they are given. The intent of the voucher scheme is to i) overcome cultural and social barriers to investing in R&D, ii) reduce innovation costs, iii) introduce a more market-based mechanism for funding tertiary institutions, and iv) incentivise the business support system. The types of businesses given the vouchers are consistent with regional priorities. The UK intends to increase the current 500 vouchers offered to 1,000 by 2011. In the West Midlands each voucher is worth about NZD10,000.

Powering Ideas, outlines a number of innovation priorities and new initiatives for the next ten years (Commonwealth of Australia, 2009). These include a 25 percent increase in government investment in science and innovation in 2009/10, higher value postgraduate awards and research fellowships, wider access to R&D tax credits plus the provision of more tax credits, more funding for business responses to climate change, reconfiguration of the Cooperative Research Centre programme,[48] and a new $83 million Innovation Investment Follow-on Fund.

Denmark enjoys a reputation for high innovation performance. Effective networks exist in the knowledge-based economy due to proximity and agglomeration benefits. There is also little disparity between regions. Their innovation action plan focuses primarily on skills and sectoral strengths: incentives for students to finish tertiary education quickly, an increase in the retirement age, job and green card schemes to fast track labour into under-served sectors and attract skilled immigrants, and prioritised research and projects in industry strengths (such as environment and energy technology, construction, health, design and food) (Danish Council for Technology and Innovation, 2007). Other initiatives target SMEs, recognising that their development must be fostered to ensure continued economic development, rather than focusing purely on larger high-growth/high tech firms. These include the introduction of innovation vouchers in 2008; matchmaking and bridge-building schemes to bring together enterprises and research institutions; more tailored assistance to high-growth potential SMEs; and the doubling of SME contributions to co-finance research projects.

11.2. Regional innovation performance indicators

Innovation scorecards have been developed within the EU to track innovation performance for its members at a regional level (e.g. Technolopolis UK, 2006a; Hollanders, 2006). The scorecards use similar indicators and have been adopted in this review. However, the indicators are constrained by the lack of comparable regional data for Auckland and other regions internationally. They have been separated into the three main parts of the regional innovation system framework to

[48] Cooperative Research Centres (CRCs) are companies formed to undertake collaborative research between researchers and industry with government and sector funding.

provide clues as to which parts of the system may be strong or weak (see *Exhibit 4*).[49]

Exhibit 4: The regional innovation scorecard

Innovation institutions and linkages
• Business R&D: business expenditure on R&D (BERD) as a percentage of GDP • Public R&D: government and higher education expenditure on R&D (GERD) as a percentage of GDP • Percentage of value-added industry: percentage share of manufacturing industry in total gross value-added at basic prices • Percentage of value-added services: percentage share of services in total gross value-added at basic prices • Percentage of value-added agriculture: percentage share of agriculture in total value added at basic prices[50] • Patents: PCT patent applications per million population
Innovation inputs
• Higher education: percentage of the population who has completed higher education • Knowledge workers: human resources in science and technology by occupation and qualification (HRST-core) as a percentage of the labour force • S&T workers: human resources in science and technology by occupation (HRSTO) as a percentage of the labour force • High-tech manufacturing: percentage of the labour force employed in medium and high-tech manufacturing • High-tech services: percentage of the labour force employed in high-tech services
Framework conditions
• GDP per capita • Productivity: labour productivity • Unemployment: unemployment rate (inverse) • Government sector: employment in public administration as a percentage of total employment • Population density: population density per square kilometre • Female activity rate: percentage of female participation in the labour force • Youth: percentage of the population aged less than 10 years

11.3. Auckland's innovation scorecard

Auckland scored well on unemployment, female participation in the workforce and its youthful population (*Figure 19*), which shows some positive signs in innovation system foundation conditions. However, it performed poorly in all other parts of the system – namely, innovation inputs and innovation institutions. Businesses and government are not spending on R&D at the rate at which the EU-25 are, patent applications are low, and output and the structure of the economy also differ from the EU-25. Low performance in all the innovation institutions and linkages dimension is

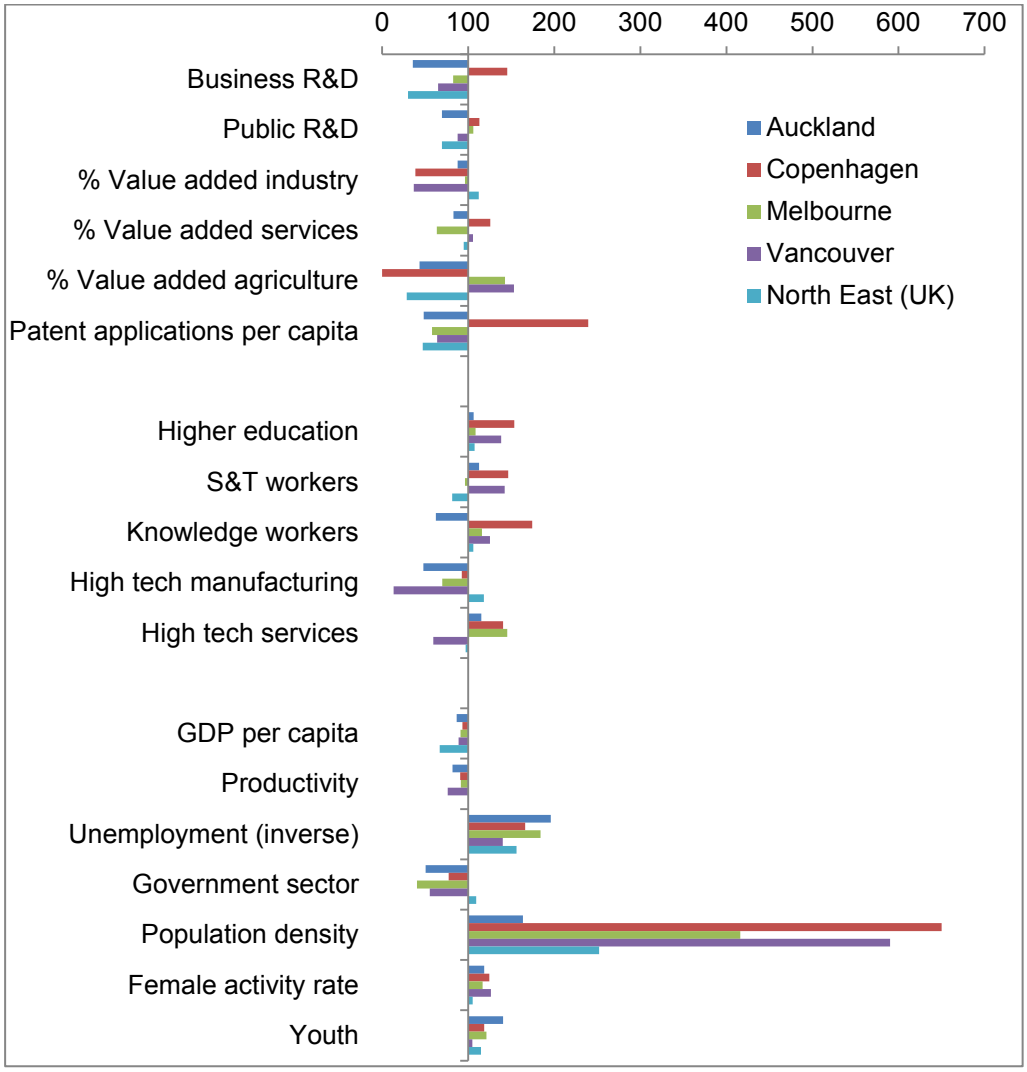
[49] Technolopolis UK (2006a) shows that factor analysis suggests that the indicators can be divided into four factors entitled public knowledge, urban services, private technology and learning families. A typology of regional innovation performance was also developed for that report.

[50] High investment in agriculture appears to have a negative effect on innovation (Technopolis UK, 2006a), perhaps because farm land is not being put to more productive use or that agriculture is not an R&D-intensive activity.

broadly similar to that of the North East of the UK. However, the North East benefits from its much larger manufacturing base.

Compared with the EU-25, Auckland's score looks most like a group of regions that are only just entering the knowledge economy and is described as "generally users rather than producers of technology" (Technopolis UK, 2006). The EU-25 includes regions in Greece, Spain and Portugal (though unlike Auckland they have high agriculture and low population density) and eastern European countries (Poland, the Czech Republic, Hungary and the Slovak Republic) – although for them manufacturing was dominant, unlike Auckland.

Figure 19: Auckland's innovation scorecard compared with Copenhagen, Melbourne, Vancouver and the North East of England[51]



The indicators suggest that, while regions such as Auckland may have the necessary base of people on which a vibrant innovation system can be built (i.e. people who are employed and relatively young), the region's difficulty is in commercialising the knowledge those people hold with input from the private sector. Researchers and

[51] This figure shows the scores for each region relative to the EU-25. The average score for the 25 member states of the EU is 100. All data refers to 2001, 2002 or 2003 where available. While the data points are not timely, these years provide the most consistent and comparable data points for each region.
Copenhagen: Data refers to the Copenhagen capital region, which combines the cities of Copenhagen, Frederiksberg and Roskilde. Copenhagen's population density is almost nine times greater than Vancouver's. For the purposes of this scorecard, Copenhagen's score has been reduced to enable it to appear on the scoreboard.
Melbourne: Where possible, the data refers to Melbourne (Statistical Division). State of Victoria data are used for HRST, R&D and percentage value added.
Vancouver: The scorecard uses the British Columbia province for data on R&D, HRST and percentage of gross value-added industry.
North East: GDP per capita data refers to the Newcastle region as defined by Demographia (2007). All other data in the scorecard uses the North East region (Nomenclature of Territorial Units of Statistics code UKC).

evaluators for the European Commission suggest a number of interventions (Technolopolis UK, 2006):

- the creation of industry clusters in traditional manufacturing sectors to facilitate the uptake of advanced technologies by firms
- strengthening knowledge-transfer mechanisms and technology diffusion to enterprises
- creation of an innovation-friendly environment
- provision of incentives for the creation of spin-offs
- connecting SMEs and other innovation actors, particularly in areas of scientific strength
- fostering innovative SMEs that are internationally focused
- universities and ITPs working with SMEs on market-driven research.

These interventions are consistent with the recommendations of this review. They tackle the weaknesses identified in Auckland's innovation system whilst building on Auckland's strengths.

11.4. How does Auckland compare with other regions?

To identify policy lessons for Auckland, the review examined policy and performance in selected regions of the world using the scorecard.

11.4.1. Vancouver

Vancouver is a useful comparator for Auckland due to its size, density, economic make-up and moderate performance in innovation. Historically, Vancouver's economy was based on mining and timber but it is now considered to be a second-tier city with respect to high-technology and innovation performance, ranked behind Toronto and Montreal. However, it is an emerging hub of innovation for many new industries, including biotechnology, telecommunications, semiconductors and software (Niosi, 2005).

Vancouver's scorecard shows an educated workforce – particularly in science and technology – with a learning and inclusive society that is significantly stronger than Auckland's. Public investment in both R&D and higher education is close to the EU-25 average, yet Vancouver's private-sector investment in R&D lags (although, even

at 65 percent of the EU average it is much stronger than Auckland's 35 percent). Vancouver still relies heavily on its primary sector, notably agriculture and forestry (a score of 153 compared with Auckland's modest 43). Auckland out-performs Vancouver on employment in medium- and high-technology manufacturing and services. Like most other developed city-regions, Vancouver's employment in services accounts for the greatest proportion of jobs, while manufacturing is rather small. Most manufacturing employment is in management and administration rather than production.

Relative to other Canadian cities, Vancouver benefits from its proximity to the entertainment and technology hubs in northern California and the software centres in Seattle as well as its close business ties with Asia. While the cost of living is high in Vancouver compared with many other city-regions, high diversity and high inward migration appear to be factors in Vancouver's high-knowledge base. Like Auckland, Vancouver has both high diversity and migration, and high quality-of-living rankings. Immigrants comprise 40 percent of the population in Vancouver (Statistics Canada, 2006), ensuring the city has a diverse and skilled labour pool with strong international connections.

Turning to policy and programmes that underpin Vancouver's performance, provincial government and regional agencies have made concerted efforts to focus on environmental sustainability. It not only pervades urban development through public-private partnerships,[52] but dominates the local economy – for example, clean tech firms. A fuel cells cluster operates within Vancouver with regional links to Victoria as well as national and international links. This initiative stemmed from the achievements of Geoffrey Ballard and Ballard Power Systems (Holbrook, 2007).

Extensive support and incentives for business R&D are also aligned with this focus. Innovation incentives in British Columbia include the recoupment of provincial corporate income taxes on international income from patents related to wind, solar and tidal power generation, and alternative energy production plus partial abatement of property taxes, exemptions from sales tax and accelerated depreciation allowances for tax purposes. The national government also provides funding for renewable power and heat projects based on the volume of energy produced. More

[52] For example, see Partnerships British Columbia: www.partnershipsbc.ca.

general innovation incentives include national R&D tax credits of 20 percent, with Canadian companies receiving further credits. Additionally the British Columbia Government adds a further 10 percent for those conducting R&D in British Columbia. Business advisory and research and development programmes also operate nationally, and federal and provincial governments have specialist funds as well as procurement policies which support industry development and innovation.

There appears also be distinct industry specialisations and strategic clarity in regional economic development. Key industry sectors for Vancouver are education, film and television production, financial services, life sciences, mining, performance apparel, sustainability-related tourism, transport and logistics, and digital media. These sectors are supported by additional tax credits[53] and, for some sectors, the implementation of specific education and training infrastructure – for example, the Great Northern Way Campus, which is a collaboration between four tertiary providers. It provides a focus on new media and technologies for sustainability and fosters linkages between academia and industry, artists and technology, and innovation and development.

Lessons to be learned from Vancouver's innovation system:

- extensive support and incentives for business R&D
- strong international linkages
- distinct industry specialisation with strategic clarity in regional economic development.

11.4.2. The North East of England[54]

"Innovation is central to the task of restoring the UK economy to long-term growth."

Source: Coalition Government. *Local Growth: recognising every place's potential.* p. 43.

[53] For example, British Columbia offers a 33 percent refundable tax credit for Canadian or international film and television production companies that incur eligible labour costs in British Columbia. Labour costs for digital animation, visual effects and video game development receive a 17.5 percent credit. The Government of Canada provides tax credits for qualified foreign film and video production, amounting to 16 percent of Canadian labour costs, through the Canadian Audio-Visual Certification Office.

[54] This section relies heavily on the O*ECD reviews of regional innovation: North of England, UK* (OECD, 2008b). Note that this information refers to the North East's performance and governance prior to the disestablishment of Regional Development Agencies and the establishment of Local Economic Partnerships in 2010. All English regional development agencies are expected to close by the end of March 2012.

The North East performs close to the EU-25 average on most innovation input indicators. But it performs poorly on innovation linkages, with low public and private investment in R&D; although framework conditions are stronger with a youthful population and a strong government sector. Business R&D expenditure in the North East is even lower than in Auckland.

The North – which comprises the North West, Yorkshire and the Humber, and North East – has been especially affected by shifts in industrial structure. Over the past 30 years there has been a big disinvestment in heavy manufacturing – which was traditionally its core strength – leading to general economic decline. Whilst light manufacturing, electronics, chemicals, and pharmaceuticals have taken their place (often as branches of UK or US-owned larger firms), there has been gradual off-shoring of less technologically-intensive manufacturing. The Greater North has concentrations of service sectors with business and financial service clusters in Manchester and Leeds, although these clusters are subordinate to London – similar to Auckland's relationship with Australian financial centres. The North also has creative and media industry clusters, and the planned relocation of parts of the BBC to Greater Manchester is likely to strengthen them.

Prior to wide-ranging changes across national, regional and local government, the North East developed the Strategy for Success to better utilise the region's research and technology base and generate innovation, competitiveness and long-term economic growth. The initiative had three main components:

- a regional science and industry council
- five centres of excellence in key sectors of digital technology and media, life science, emerging technologies, new and renewable energy, and process innovation (for chemicals)
- funding provided by venture finance company for proof of concept and co-investment.

The centres were intended to stimulate economic development by creating critical mass through co-location of innovation actors, concentrate resources (thus reducing transaction costs) and help align local, regional and central resources. They provide a focal point for regional identity and assist in marketing the region. For firms and

other economic actors within the locale, the innovation sites increase regional credibility, which can help both with sales and financing.

The North East has similar skill challenges to Auckland, with skill shortages and potential for greater educational attainment. The North East's manufacturing base is larger but Auckland employs more people in services. The North East is a net exporter of students while Auckland captures many New Zealand graduates (due to the drift to the country's largest labour market) and has high inward migration.

Innovation performance seems to have improved in the region although it is difficult to determine the contribution made by policy (OECD, 2008). Innovation is slowly moving up in policy priorities for local and regional agencies. However, the nature and quality of service delivery of national programmes has been inconsistent and marginal. Due to lack of funding, regions have struggled to tackle the scale of the issue (UK Technopolis, 2006a).

Lessons to be learned from the North East's innovation system:

- better matching of skills required between industry and education
- industry specialisation
- capability development in both manufacturing and services.

11.4.3. Melbourne

Melbourne scores better than Auckland on all indicators other than the female labour activity rate and youth, with scores close to the EU-25 average on most indicators. The state of Victoria offers new funding for innovation and R&D, supports linkages between industry and research, is committed to improving broadband infrastructure, and offers funding to improve skills at the vocational level (Department of Innovation, Industry and Regional Development, 2008) – all of which may contribute to Melbourne's superior innovation performance.

In 2008, the Victorian government outlined its investment and priorities in *Innovation: Victoria's Future* (Department of Innovation, Industry and Regional Development, 2008). The strategy consolidates Victoria's research and industry strengths in biomedicine, ICT and clean technologies with $300 million in new funding for innovation infrastructure and initiatives, on top of $715 million allocated in the

2008/09 State Budget. The bulk of the additional funding is for R&D to meet Victoria's challenges: health and aging, and climate change.

On the productivity side, funding and initiatives build science and technology capability as well as partnerships between industry, academia and government. Victoria's Boosting Highly Innovative SMEs programme – which is modelled on the US Small Business Innovation Research programme – supports SME innovation and stimulates government procurement of innovative and local content. Broadband infrastructure is also a priority, with $20 million of additional funding to roll out over 1,000 kilometres of fibre in under-served parts of Victoria. ICT use by government, businesses and individuals is likely to be accelerated by such funding.

As part of the 2011-2012 Victorian Budget, the Coalition Government announced a $7.9 million package to build on industrial strengths and facilitate linkages between innovation actors. The package included the establishment of an Office of the Lead Scientist, the Victorian Biotechnology Advisory Council, the Industry Sustainability Working Committee and collaborative networks for technology transfer.

Melbourne is home to INNOVIC – the Victorian Innovation Centre – which is one of six state-based innovation centres set up in the 1980s to support the practical development of innovation, educate and assist innovators and small businesses, and develop and commercialise viable new products and technologies. INNOVIC provides a range of government-funded innovation services, including commercialisation seminars, introductions and referrals to a network of commercialisation stakeholders, networking events, opportunity pitches and innovation prizes. INNOVIC also offers a strategic planning and marketing consultancy, a grant-match service, patent searches, market research and business planning.

Lessons to be learned from Melbourne's innovation system:

- new funding focused on innovation to meet regional challenges
- building linkages and partnerships between business, research/education and government
- innovation infrastructure includes hard infrastructure like broadband which facilitates innovation

- a “portal” for government-funded innovation support and information.

11.4.4. Copenhagen[55]

Denmark’s capital region, Copenhagen, is home to a third of Denmark’s population and shares a number of similarities with Auckland. These include its proportion of the national population, its modest international services and international business links, and the fact that it is not considered a major airline hub.

The Copenhagen region’s innovation scorecard is the strongest of the comparator regions chosen. However, by OECD standards, Copenhagen has relatively average innovation capacity and continues to have a shortage of skilled workers (OECD, 2009a). While public investment in education has been high, it has not resulted in a skilled workforce. Their challenges include difficulties in mobilising young people; school leavers with limited foundation skills; falling completion rates across secondary, tertiary and vocational education; a culture of delaying tertiary study and entering the labour market; and underutilisation and attraction of skilled immigrants.

According to the European Commission, Denmark’s regional innovation system is “still mostly untested” (European Commission, 2008, p. 21). The OECD (2009a) recommends interventions in four main areas to improve the performance of the Copenhagen region: skills availability, innovation and research, infrastructure and governance. While efforts at the national level have been made to tackle the shortage of skills, the OECD suggests that stakeholders in the Copenhagen region could do more. For example, they could provide on-the-job training for immigrants to encourage their integration into the job market, they could attract foreign firms and international events, the University of Copenhagen could play a greater role in attracting foreign students and research projects, and they could facilitate networks between business and academia. While Copenhagen has many technology transfer offices, incubators, private research and technology organisations, and science and technology parks, they appear to have had limited success in forging better linkages. For Copenhagen, the core issue is not the lack of hard innovation infrastructure but rather the soft infrastructure, such as cooperation and networks between industry and education.

[55] This section relies heavily on the OECD’s (2009a) *OECD territorial reviews: Copenhagen, Denmark,* and the European Commission’s (2008a) *INNO-Policy TrendChart - policy trends and appraisal report: Denmark*.

Regional pilots have been established to foster collaboration between universities, non-innovative SMEs and their GTS institutes. GTS institutes are private, non-profit, independent consulting firms which develop and sell technological services to firms and the public sector. Innovation agents are employed by the GTS network to identify and channel SMEs through the innovation support system. More broadly, initiatives include marketing and creating a single access point for the innovation system, including the GTS network, and an increased focus for collaboration between industry and the arts, building on Denmark's strong base in design. In Copenhagen one of the major projects is the Copenhagen Institute of Interactive Design, a new institute that combines education, research and consultancy and brings together academia, industry and international partners.

Copenhagen's main assets, like Auckland's, are its quality of living and public services. However, for innovation – particularly the movement of goods and services, and the attraction of global talent – there is a need to address transport infrastructure, the cost of housing, cultural amenities, crime levels and air quality. To maintain and improve growth and innovation, Copenhagen should continue to work on these areas.

Lessons to be learned from Denmark and Copenhagen:

- skills must be continually assessed and shortages addressed
- focus on high-tech sectors should not come at the expense of the manufacturing and SME base
- business R&D is high in Copenhagen and there are some linkages between industry and researchers, but there is also a need to support user-driven innovation. Innovation intermediaries such as incubators and STPs do not guarantee linkages between industry and academia are created. The relationships and networks still need to be fostered
- infrastructure supports skills attraction and innovation.

When Auckland's regional innovation performance is compared with city-regions elsewhere in the world, it is clear that Auckland still has some way to go. Auckland's performance within the innovation institutions and linkages dimension is particularly weak. Business and public R&D is low, with weak connections between business,

education and other innovation actors. While all parts of the Auckland innovation system need to be addressed, it is recommended that interventions should focus on boosting the capacity and capability of firms, innovation support agencies, and education and research institutes as well as their ability to work with each other.

The actions recommended are consistent with the types of interventions developed and implemented in the comparator regions examined as well as exemplar regions like Munich, Boston and Edinburgh.[56] Of course, it should be noted that transferring programmes, policies and initiatives from one region to another is not always effective due to different conditions and the ability to implement (or the efficacy of implementing) a programme in exactly the same way. However, the recommendations in this review are a good starting point.

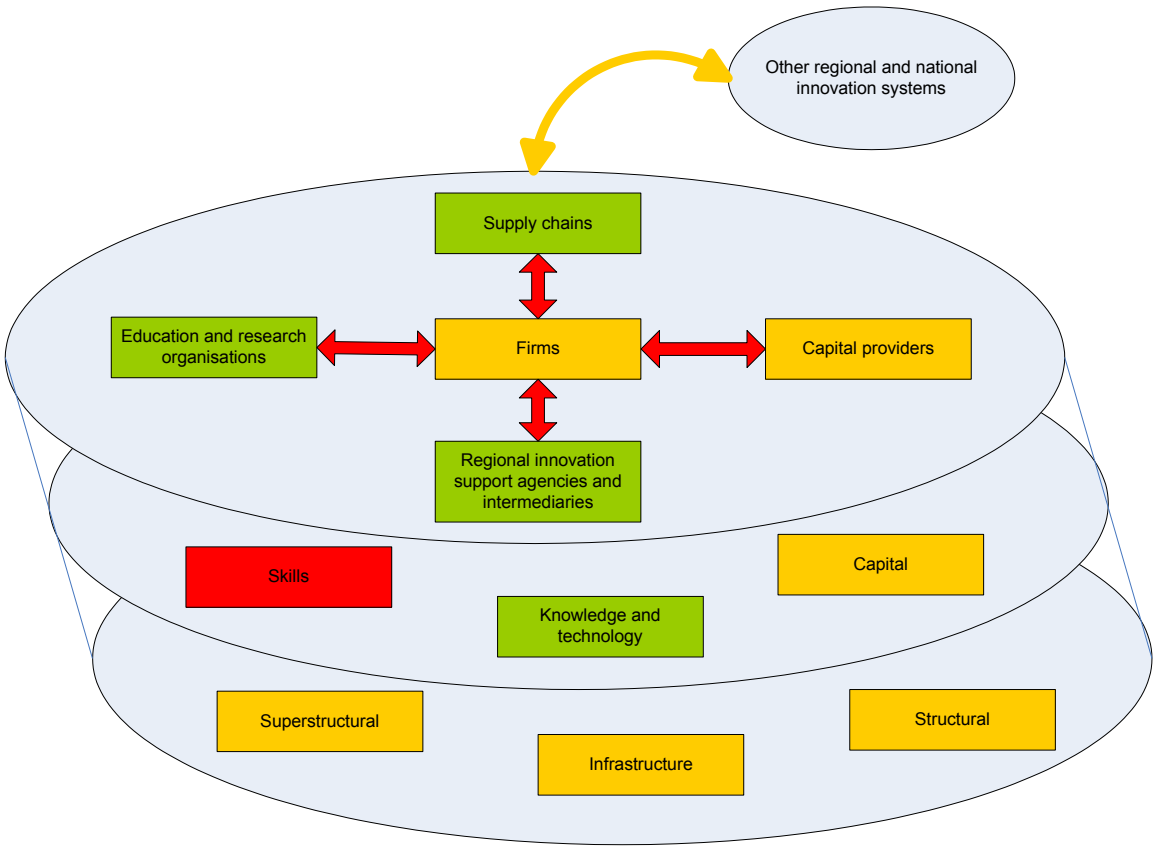
[56] These examples rely heavily on the "Ideopolis" concept and subsequent case studies developed by The Work Foundation for various industry groups, delivery agencies, universities, councils and economic development agencies in the UK (The Work Foundation, 2006).

12. Conclusion

It is often perceived that Auckland and New Zealand are innovative places with innovative people and firms. The Auckland region has unique qualities which impact on the way innovation occurs, such as its geographical spread, the critical mass of education and research organisations, and the types of firms that locate there. However, innovation performance has always lagged behind other places that Auckland and New Zealand typically benchmark themselves against.

This paper shows that Auckland is a weak to moderate performer internationally, akin to other regions which are only just entering the knowledge economy and use new technology rather than produce it. This indicates that while Auckland may have a sufficient base of people and an institutional framework on which a vibrant innovation system can be built, there are difficulties in other parts of the system – namely innovation inputs, the innovation actors and the linkages within the system (Figure*Figure 20*). The challenge is in commercialising knowledge with input from the private sector.

Figure 20: Auckland's regional innovation system, indicating areas of strength and weakness



For *Figure 20*, green indicates relatively strong performance, orange signals an average performance or some cause for concern, while red means that Auckland has performed poorly.

Reasons previously given for New Zealand's innovation performance have included the paltry amounts spent on research and development (particularly in the private sector), weak capital markets and a lack of focus on science and technology education. Using a regional innovation systems framework, the review delved deeper into the reasons underlying Auckland's performance, focusing on the actors, the conditions under which they operated and their relationships within the system. A systems approach is sensitive to the notion that business innovation does not generally occur in isolation. It is a social process of knowledge and technology transfer and commercialisation, where many actors play different parts and operate within many dimensions – for example, organisational, business environment, spatial, regulatory and political frameworks.

The review draws on existing data and research on Auckland as well as interviews, workshops and focus groups with over 80 businesses and 40 government, education and industry organisations. The sectors studied in depth were advanced materials, marine, digital content, financial and insurance services, and food and beverage processing, with additional assessments of the tourism and medical technologies sectors. Sectors were selected based on size, underlying capability strength in Auckland, growth rate, export orientation and national significance.

While there appears to be a lot of innovation activity occurring in most of the Auckland businesses interviewed, innovation was often hidden, informal, relied largely on internal resources, and typically focused on incremental rather than radical improvement. There was little in the way of a systematic approach to managing innovation. Often, when innovation did occur, it was not obvious or necessarily considered by the firm as "innovation". Rather, it was a part of their everyday business activity. These findings raise the issue about whether there is a better way of assessing and promoting innovation, given that it is often hidden and not explicitly recognised by firms.

Small firms were largely focused on their current projects/orders and did not have the time or resources to devote to thinking beyond this. In most firms, the primary innovation focus was on products. Process, organisational and market innovation were not as common.

There was little in the way of a systematic approach to managing innovation. However, not surprisingly, the sophistication of innovation processes tended to increase with firm size. Large firms tended to be more deliberate in their approach to innovation, with dedicated staff and allocated budgets (although this was often referred to as design and marketing).

The different nature, structure and maturity of the sectors also appeared to influence the sophistication of innovation management. For example, the marine sector in Auckland appeared to be more advanced in its ability and processes for innovation due to the relatively larger size of its businesses, the industry's maturity, the history of innovating through the America's Cup and international yachting events, and its ability to be more collectively organised. This is contrasted with the digital content sector which is small, relatively young, traditionally domestically competitive rather than collaborative, and has few large-scale leading firms. While firms in the finance and insurance services sector are generally larger and use innovation management techniques, the sector is dominated by multinational firms where there is little scope for local innovation in products, processes, or management systems.

The review showed that businesses were, on the whole, very inward in their focus. They did not take the opportunity to tap into the resources the regional innovation system had on offer. Firms in their supply chains, competitors, customers/consumers and other firms in their industry were generally not considered as key sources or partners for innovation. Similarly, the Auckland region has a strong support system for innovation, including business and innovation consultants, market research firms, and government agencies which provide funding and advice to firms for innovative activity. However, firms found them difficult to access or were not even aware of their services. Innovative firms also tended to fund innovation from internal sources – such as cash flow and retained earnings – as a first preference. Most crucially, while firms recognise Auckland's academic and research institutions and

organisations as sources of future employees, they make very little use of the great depth and breadth of research skills and knowledge for innovation.

There are, of course, exceptions to these general observations. For example, digital content firms paid particular attention to customer needs (which drove innovation) and their suppliers (such as hardware and software providers) acted as conduits to firms for knowledge and international connections. Also, the Auckland boatbuilding sector is characterised by SMEs who specialise in parts of the boatbuilding process so collaboration in the supply chain is required to produce the end product. The food and beverage processing sector also showed extensive integration along the supply chain, with a high degree of collaboration between suppliers and customers.

In the business and innovation support sector, what was particularly stark was the lack of articulated and clear strategies for growth and innovation, and many businesses lacked these as well. Without these strategies, there was no vision of where the industries were heading, what is required to achieve growth, and therefore there was a lack of coordination in organising their resources. For example, the marine sector had identified a number of infrastructure needs (e.g. berthage, refit space and facilities) which will require coordinated effort from the industry and local government to address. The digital content sector consists of many small firms, with large peaks and troughs in workflow and therefore irregular revenue and labour requirements. Firms in the sector could consider collaborating to smooth these cycles and create scale to enable them to secure larger international projects as well as to pool resources for R&D investment, market research, skill development and promotion. Overall, little thought was given to identifying the collective growth needs of industries at a regional level, such as in infrastructure, skills and R&D, which often require coordinated investment from multiple government (central, regional and local) agencies and businesses.

Various private sector providers also offer innovation support, such as business management services, market research services, scientific research, consulting engineering services and technical services. Many Auckland businesses mentioned the importance of market research and consumer testing, particularly those in food and beverage processing and finance and insurance services. While market research services are available, businesses (food and beverage processing SMEs in

particular) considered there to be barriers to access, both in terms of the cost of market data and reports, and the lack of skills to analyse and interpret the information so that they could benefit from it.

The picture regarding availability of capital and funding provision in the region for innovation was more mixed. Few firms turned to equity to fund innovation, with the large majority relying on their own internal sources and bank debt. Given that the firms appeared to focus mainly on incremental innovation, there is a question as to whether funding would be a constraint for the development of more significant or radical innovation. At a regional level, the lack of equity capital has been cited many times as an inhibitor of growth and innovation by firms. The shallowness of the market is in part due to reluctance from firms to use equity, few experienced investors, and the attractiveness, and therefore capability, of firms.

There are real R&D strengths in the work of universities and CRIs in the Auckland region which are relevant for industry. However, the interviews highlighted the lack of connectedness between firms and the education and research organisations as the greatest weakness in the regional innovation system. A few companies did have reasonably strong relationships with individuals in research organisations but these were exceptions.

While firms were well aware of the education and training role of the universities, industry training organisations, and institutes of technology and polytechnics located in the region, they were less aware of their research and typically did not know what research was being undertaken or how to access R&D that would be relevant to their business. This was particularly acute for digital content, financial services and tourism sector firms which believed that training was unsuited to sector needs and/or had little connection with education and research institutions on R&D matters. Most firms in most sectors were relatively ignorant of the role of CRIs, although food and beverage firms – especially those in the primary producer segment – had a good appreciation of the role of Plant and Food Research.

The primary factors underlying the difficulties research and industry have in engaging with each are related to incentives and timeframes. Researchers' motivations are often governed by public funding requirements (for example, PBRF which focuses on

research publications) and work within characteristically long timeframes, often on basic research. Conversely, the R&D problems from industry that typically present at the door of a laboratory are often comparatively straightforward with results required within commercial timeframes (hours to weeks rather than months to years). Co-investing in strategic research is also seen as both costly and risky for industry. Further, many firms are often not sufficiently resourced to commit to and engage in projects. Institutional memory for the less successful research and industry collaborations also runs deep. All of these affect the willingness of firms to undertake collaborative work with research organisations.

There is certainly capability within the actors in the innovation system – the firms, research and education organisations, capital providers and innovation support agencies – however, they are working in isolation of each other. The solutions for improving the functioning and performance of each of the actors often rely on them working with another actor or with multiple actors. For example, improving investor capability may require the development of support programmes by regional innovation agencies as well as input from firms and industry. Relationships between firms within some sectors, and relationships between actors, have soured in the past due to mistrust and intense competition. While in some cases competition can enhance innovation by driving firms to strive for even better products, services and processes, on the whole more can be achieved in Auckland by firms and organisations working together and competing internationally, rather than competing with the firm next door.

A number of recommendations have been made throughout this paper on how to strengthen the linkages within sectors as well as between actors. Given that the linkages between firms and the education and research organisations were the weakest in the system, those recommendations are of priority. These include firm-based incentives to engage with research and education organisations – for example, ensuring good implementation at the regional level of the new technology transfer vouchers, promoting the role of “translators” to go-between research and industry, and forming and maintaining sessions between research providers and industry to discuss and work on solutions to their innovation problems.

It was also clear that different sectors have different innovation challenges. For example, the financial and insurance services sector in Auckland is constrained by international parent relationships and the fast-replication of new products and services. However, their approach to innovation management is generally good practice. The tourism sector consists of many SMEs and a diverse range of sub-sectors which can be hard to engage in industry-wide initiatives. They also have little capacity and capability to devote to innovation. In reviewing business innovation performance in Auckland, what was particularly apparent was the lack of sectoral mobilisation on tackling barriers to innovation. Few industries had a clear vision of growth and plans/actions for how to achieve that. Instead, proposals to improve industry opportunities are relayed to potential partners (often local, regional and central governments) in an ad hoc fashion with little evidence of the benefits that will accrue. Further, sectors generally did not think spatially about where expertise across New Zealand is placed and how these could be linked better to maximise innovation and market opportunities.

Some sectors have begun to think more strategically about growth and innovation. For example, the marine sector in Auckland is beginning to come to an industry-wide position on its future and a coordinated, industry-led action plan to chart its development. It also aims to address complementarities with the sector in Tauranga and Northland, in particular, as well as alignment of hard and soft infrastructure developments in line with the future vision. More of this needs to occur.

The systems framework used in this paper has shown how important it is to view innovation in a holistic way. Knowledge and technology were considered to be a strength of the region; however, other inputs or resources Auckland provides, as well as the framework conditions, are sufficient but there is much room for improvement. For example, Auckland's culture was viewed as both a spur and barrier to innovation. Business, and business success, is not always viewed positively by the general public in New Zealand, although this may occur to a lesser extent in Auckland due to its history as a business-oriented city and region. There is also a widely-held view that New Zealanders are innovative. Instead while there is certainly innovation in Auckland, the notion of widespread innovation and innovative people is not born out of fact or reflected in innovation performance. In reality, there appears to be a

predisposition towards inventiveness, creativity and incremental change, rather than innovation *per se*. The commercialisation aspect of innovation seems to where the weakness lies.

While the existence of the belief that the region and nation is innovative is not necessarily a bad thing, it can potentially be an obstacle to improving innovation performance as it may be viewed that there is nothing to fix. Therefore, most of the culture-related recommendations focus on promotion – promoting innovation generally (what it is and what it is not), promoting innovative products and ways of working in the region, and profiling success stories, innovation events and innovation awards.

General infrastructure was regarded as acceptable but the review identified some key areas for improvement from an innovation perspective. Transport and broadband infrastructure have already been identified at the national level as issues to resolve. Regional and central government should continue to invest in them. Other hard infrastructure has also been identified by industry as a barrier to innovation for some sectors. Examples include infrastructure for clusters; turn-around space for manoeuvring into berths, refit space, heavy duty haul-out facilities and access to larger cranes for the marine sector; flexible and cost-effective commercial scale food and beverage pilot facilities for the food and beverage sector; improved studio infrastructure to host more and larger budget productions for the digital content sector; and networked innovation hubs to link district health boards, primary health organisations and health technologies firms. Further investment in sector-specific infrastructure should be dependent on feasibility and their fit with sector action plans discussed previously.

Of concern is the breadth and depth of skills for innovation in the region. While trade skills and unskilled labour were relatively accessible to firms in Auckland, more highly skilled occupations were harder to fill as science, technology and engineering skills were in high demand. The supply of skills in these areas is hampered by a number of factors ranging from career promotion (too little) to pay rates in other countries (too attractive). The ability to recruit skills from overseas is also hindered by these same factors – lower pay rights but relatively higher costs of living. At the same time, it was also identified that Auckland may not be utilising the migrants that are already

here to their full innovation capacity. For some sectors there were concerns that graduates were not prepared well for entry into the workforce, which has led to more industry involvement in training. It should also be recognised that firms also have a responsibility to train and develop their own employees and it will be rare that a graduate will work at the same level as others who have been in the job much longer.

A number of different approaches will likely be needed to improve the stock of high technology and knowledge-intensive skills in Auckland. Skills action plans for key sectors of strength in Auckland, in concert with sector strategies, are required. These should identify skills gaps, both current and future-focused, and the actions needed to fill those gaps. Promotion of careers in high-demand/high-skill areas are also needed as well as assessments of whether incentives (such as scholarships and subsidies) within tertiary education and research should be considered.

Competency at the foundation skill level is also an area of weakness. Many people in the Auckland region are not able to contribute to innovation in a meaningful way due to low levels of language, literacy and numeracy. Targeting interventions towards communities that are most affected by low foundation skills are likely to reap the largest benefits for Auckland. Programmes to improve participation in education, training, literacy and numeracy programmes, and apprenticeships for Māori and Pacific Island peoples are recommended. Workplace foundation skills could also be raised through better matching of workplaces to assistance and training, and general awareness-raising of the links between skills, productivity and innovation.

Strong leadership and management skills were consistently found to be critical to successful innovation and the development of a culture of innovation in firms. Approach to business and general business growth goals also impact on innovation. Many SMEs were not interested in growing the business, developing new or better products, or reaching new customers or markets. Some were more reactive in business and focused on securing short-term opportunities rather than building on longer-term growth. Clearly such approaches to strategy and leadership will constrain innovation. Further, strong commercial skills – preferably gained by working in large, international or multinational organisations – were desired by firms and considered to be scarce in New Zealand. Some managers were promoted from

technical positions but were not necessarily skilled in business and people management.

Encouragingly, there are many avenues available in the region for improving management capability including formal degrees, mentoring and workshops. However, they do not appear to have significantly improved the stock of managers in Auckland over time. More tailored approaches to management capability support that utilise more experiential approaches to capability development may need to be instituted.

Innovation is occurring in Auckland but there is potential for it to improve more. The information gathered, and the innovation indicators and benchmarking with other regions suggest that the greatest weakness in the system is the lack of connection between firms, and between firms and research and education providers. As such, most of the recommendations outlined in this paper are targeted at enhancing the linkages within and between these groups.

However, actions which focus purely on this part of the system are only part of the answer. As outlined, innovation occurs within a system and all parts need to work in concert with one another. Therefore, other recommendations are directed at all the other parts of the system – from enhancing foundation skills of individuals in the region to improved hard and soft infrastructure in Auckland. Ensuring all parts of a system are operating to their potential is a hard task, as it requires all the actors in the system to come together to recognise the importance of innovation, establish the actions needed to enhance it, and for those actions to then be implemented. This paper is the first step in the right direction. It is now the role of industry, research, education, regional and central government to act on the proposed recommendations. However, there is no “quick fix”. The road to improved innovation performance will not be a short one. Nevertheless, working on Auckland’s regional innovation system will pay good dividends – for Auckland and for New Zealand.

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Appendix 1: Method

The review incorporates a number of approaches to populate the regional innovation system framework. It has been informed by a literature review, innovation indicator development and data collection to benchmark the Auckland regional innovation system internationally, and studies in a number of critical sectors in Auckland. Given that the innovation issues encountered do differ by sector, and therefore the interventions that are likely to be successful differ, particular attention is paid to sector assessment within the overall regional innovation system framework.

12.1.1. Literature review

A literature review informed the development of the framework, as well as the assessment of the region. Key inputs included:

- the OECD's review of New Zealand's innovation policy (and background documents prepared for the national innovation systems project)
- papers prepared as part of the Auckland regional economic development strategy
- the Auckland Sustainable Cities Programme
- the International Review of the Auckland Metro-Region
- feasibility and sector studies in support of innovation concepts in Auckland
- the Auckland Policy Office's Auckland research programme.

12.1.2. Indicators

The indicators were guided by national level science and technology policy indicators used internationally, available innovation scoreboards, diagnostic methods for innovation systems applied to French regions (Prager, 2007) as well as a regional typology developed for EU regions (UK Technopolis, 2006).

We relied on data from a variety of sources including Statistics New Zealand (particularly the Business Operations Survey), EuroStat and OECD.Stat.

12.1.3. Sector studies

Based on sector size, underlying capability strength in Auckland, sector growth rate, export orientation and national significance, the sectors studied in-depth were advanced materials, marine, digital content, food and beverage processing, and

financial and insurance services. These sector studies were completed in conjunction with Deloitte and their sub-contractors. For each sector there were a range of interviews (10 firms and 10 supporting organisation per sector) and focus groups with representatives from each sector (four per sector with 4-5 attendees). Firms were selected based on areas of growth within the sectors and range (for example, size, exporting status, R&D intensity, international parent entity connections and location). Interviewees at the firm level were usually groups of chief executives, managing directors, product and marketing executives, sales managers, technicians, engineers and innovation specialists. Supporting organisation interviewees were from economic development agencies, research institutes, training organisations, universities, technology transfer offices and/or major suppliers/customers/distributors. Focus group attendees were usually part of the firms' value chains or sector representatives. A larger workshop per sector was also held to present and discuss the initial findings. Workshop attendees included industry associations, economic development agencies, government officials from multiple departments and firms. The approach means that a balanced view was obtained of innovation in each sector. Over 80 businesses and 40 industry, education and government organisations took part in this component of the review.

The data collection for the advanced materials, marine and digital content sector studies occurred over November 2007 to April 2008, while the food and beverage processing, and financial and insurance services studies occurred over September to November 2008. It should be noted that some of this data was collected during a time of turbulence in international financial markets with New Zealand's economy entering a recession. It is believed that these conditions have not affected the findings. In fact they advance the importance of innovation to economic growth and that in recessionary times there is even more of an imperative to strengthen a region's innovation system.

The interviews were conducted with a structured interview schedule designed to elicit:

- whether firms have a systematic approach to innovation

- whether there is an understanding or awareness of the role that other "actors" within the innovation system can play to improve innovation, and if so, how these linkages operated
- whether, and how, the environment for regional innovation could be improved.

For supporting organisations, interviews focused on:

- their role in, and contribution to, the regional innovation system
- where relevant, their perceptions and knowledge of innovative activity at the industry, sector or institutional level
- their linkages with firms and industry, and other innovation system "actors" in Auckland and New Zealand
- whether, and how, the environment for regional innovation could be improved.

Assessments of the health technologies and tourism sectors were also completed, relying in the main on available reports and journal articles and other work that occurred in parallel to this review on the feasibility of innovation concepts in the health sector.

12.1.4. Limitations

The interviews conducted rely on self-reported instances of innovation within the firm, and the processes and relationships involved in bringing ideas to fruition, including those that were less successful. The methods used also require reliance on memory of events in the past, and represent the perspective of one part of the firm.

However, the use of qualitative methods, supplemented with available reports and data, and interviews with individuals in different parts of the regional innovation system go some way towards enhancing the reliability and validity of information.

Innovation data at the regional level was particularly weak, which constrains useful comparisons with other regions as well as the monitoring of Auckland's performance over time. Comparisons with other nations and regions as well as the regions selected for comparison are also constrained by data availability for those countries and regions. One of the recommendations of this review is to collect data on regional innovation system performance and make it available at the regional (and local) level.

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Ministry of Economic Development

Stephen Knuckey

Jason Le Vaillant

David Waite

Tariq Ashraf

Justine Cummings

Cally Ward

Rachel McCurdy

Emilia Mazur

Bryan Chapple

Brad Ward

Peter Winsley

Andrew McCallum

Consultants

Anne French – Knowledge Matrix

Matt McKendry – Deloitte

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Delwyn Corin

Craig Fredrickson

Carole Canler

Alison Reid

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Hamish Hill

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Adam McElroy

Hans Frauenlob

Janet Nieborg

Tom Dawson

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International peer review panel

Paul Benneworth – Senior Researcher, Centre for Higher Education Policy Studies, University of Twente, The Netherlands

Greg Clark – Chair of the OECD Forum of Development Agencies and Investment Strategies; Advisor on City and Regional Development for the UK Government;

Senior Fellow, Urban Land Institute, Europe; Lead Advisor, British Council OPENCities Programme

Don Scott-Kemmis – Senior Fellow, Australian Centre for Innovation (ACIIC), Faculty of Engineering University of Sydney; and Associate Professor, Faculty of Business, University of Technology, Sydney

Philip Shapira – Professor of Innovation, Management and Policy, Manchester Institute of Innovation Research, Manchester Business School, University of Manchester; and Professor, School of Public Policy, Georgia Institute of Technology, Atlanta

Participants

Film Auckland
Media Design School
New Zealand Trade and Enterprise
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Health technologies report

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