RESOURCES BASED VIEW, AGGLOMERATION, AND CLUSTER FORMATION MODELS TO ASSESS INNOVATION AND TECHNOLOGY TRANSFER IN NEW ZEALAND

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ABSTRACT

Using a resource-based view, we assessed the innovation and technology transfer system in New Zealand to explore the role of innovation, as well as the strategies, structures and performance of New Zealand university and research institute technology transfer offices. While we found a broad consensus about the potential of innovation to spur economic development, we also found a wide diversity of opinion about how New Zealand should organize, coordinate and measure the progress of the national technology transfer system. We conclude that executives face high transaction costs in accessing innovation from universities and research institutes. Our findings also suggest that public-sector managers face difficult strategic choices in measuring the effectiveness of technology transfer offices.

INTRODUCTION

Spurred by advances in information technology, life sciences, and globalization of capital markets, the potential for translating technological invention into commercial innovation for new business creation has never been greater (Ahn and Meeks, 2007; MoRST, 2008; NZVCA, 2007; Angra, et al., 2008). In the quest for global competitive advantage and increased standards of living, government policies have sought to enhance competitiveness by investing in basic research and early stage product development to enhance investment readiness (Moore, 2002), as well as increase entrepreneurial growth to spur economic growth (Shane, 2002). Such policies have taken many forms including research and development tax credits, grants to universities and research institutes, matching angel and venture capital funds, and incubators to spur entrepreneurial activity (Da Rin, et al., 2006; Keuschnigg and Nielsen, 2001, 2003; Porter, 1990, 1998, 2000; Solow, 1956, 1957).

Using a resource-based view, we used a mixed-method approach to assess the innovation and technology transfer system in New Zealand to explore the following questions: What is the role of innovation in university and research institute technology transfer? What is the right strategy and focus for technology transfer efforts? What is the right structure to efficiently evaluate and execute technology transfer transactions? What is the right ecosystem to support technology transfer?

A RESOURCE-BASED VIEW OF BUILDING TECHNOLOGY TRANSFER CAPACITY

In a seminal article introducing the resource-based view of the firm, Barney (1991) suggested that firms gain competitive advantage from having resources that provide them with unique sources of competitive advantage. These resources may fall into a variety of categories, including physical, financial, human, and organizational; and confer competitive advantages based on the value, rareness, uniqueness (inimitability), and embeddedness in the organization fabric. The difficulty other firms experience in imitating these successful firms’ resources is explained by the amount of time it takes to create and develop them (often decades), as well as the difficulty (in the case of embeddedness) others experience in identifying them as sources of competitive advantage. Barney makes the case that the more rare, unique, and embedded the resource, the greater the source of competitive advantage, so long as those resources fit the environment in
Makadok (2001) connects resources to the term “capabilities,” defining a capability as “a special type of resource - specifically, an organizationally-embedded, non-transferable firm-specific resource whose purpose is to improve the productivity of the other resources possessed by the firm” (2001: 389). He concluded that capabilities can’t be bought; rather, they must be built. Further, these internal capabilities, combined with external partnerships, may be seen as a flexible innovation system (Su, 2009).

In the context of this study, capabilities to be explored include the importance of innovation to economic development, as well as the role, structure, business models, metrics and performance of the technology transfer in spurring the New Zealand economy.

**NEW ZEALAND GOVERNMENT STRATEGIES FOR GROWTH AND INNOVATION**

While each country develops a national innovation system within its own context, the early stage of technology-based industry development usually requires public support and coordination (Porter, 1990; Tan, et al., 2006). Recognizing the transformational potential of a knowledge based economy, the New Zealand government has mobilized across national and regional agencies, as well as academia and research institutes, to accelerate Intellectual Property (IP) driven growth. The seminal report entitled *Growing an Innovative New Zealand* (Clark, 2002) articulated the government’s aim of “building an economy that was both inclusive and innovative” and provided a framework for achieving economic goals which is known as the Growth and Innovation Framework (GIF).

GIF provided a framework that directed investment priorities including: (1) Developing, attracting and retaining people with exceptional skills and talent; (2) Increasing global connectedness to overcome the tyranny of distance; and (3) Focusing innovation initiatives in areas which can have maximum impact, particularly biotechnology, information and communication technologies (ICT), and the creative industries such as design and film production. Other recurring themes were to focus the tertiary sector on high quality and relevant teaching and research, as well as to recognize excellence within the system and strengthen the overall skill base in New Zealand. Mechanisms for this purpose have included funding centres of excellence, fostering better linkages between tertiary education providers, industry and communities, and the development of mentoring frameworks. In addition, a range of national and regional government agencies such as MoRST (Ministry of Research, Science and Technology), FRST (Foundation for Research, Science and Technology), TEC (Tertiary Education Commission), and NZTE (New Zealand Trade and Enterprise), as well as Regional Economic Development Agencies (REDA) such as Grow Wellington, have interpreted these investment priorities into program initiatives.
MoRST and FRST are central actors in the New Zealand national innovation system

MoRST (Ministry of Research, Science and Technology) is a New Zealand government department which develops innovation policies, and manages the government’s investment in research, science and technology. MoRST sets the priorities for approximately $650 million in annual funding and evaluates the efficacy of investments (MoRST, 2008). For example, MoRST issued the Biotechnology Roadmap in 2007 to outline the role of biotechnology and to set investment guidelines in the industry sector (MoRST, 2007).

FRST (Foundation for Research, Science and Technology) was established in 1990 by an Act of Parliament to invest in research, science and technology on behalf of MoRST. FRST invests in several hundred research projects annually aligned with the aforementioned policy framework of information technology, biotechnology, and creative industries (FRST, 2008).

Three other important entities supporting commercial innovation in New Zealand are reviewed briefly below. First, as the tertiary education sector is responsible for approximately two-thirds of research publications in New Zealand and is critical for intellectual property development (MRST, 2006), the Tertiary Education Commission (TEC) is responsible for leading the government’s relationship with the education sector. Specifically, the TEC outlines its role as: “… allocating more then NZ$3 billion annually to tertiary education organizations, building the capability and capacity of higher education and training to contribute to national economic and social goals” (TEC, 2008). Second, as global alliances are critical in building a value-added and internationally connected economy, New Zealand Trade and Enterprise (NZTE) was established in 2003 as the government’s national economic development agency with a focus on boosting export earnings, strengthening regional economies, and delivering economic development assistance to both industries and individual businesses (NZTE, 2008). Third, several regional initiatives are also emerging such as Grow Wellington’s focus on building Centres of Excellence (COE) coordinated among the nine Councils of the Greater Wellington Region. Grow Wellington helps firms to coordinate national resources for specific needs and enables venture development through networks such as the
Creative HQ business incubator and Angel HQ investment fund to enable private sector investment in start-ups (Grow Wellington, 2008).

**Crown Research Institutes and Universities as Sources of Innovation and Technology Transfer**

Crown Research Institutes (CRI) are quasi-public companies established to undertake scientific research and related activities in accordance with the Crown Research Institutes Act of 1992. The nine CRIs are owned and monitored by the Government of New Zealand, while also having accountable and independent boards. CRIs may consequently be defined as being driven by a mix of private and public objectives, including technology transfer and commercialization (see Table 1) (CCMAU, 2008; Statistics New Zealand, 2007).

The overall goal and rationale of these various supporting strategies, funding mechanisms, and institutions is to foster better linkages between tertiary education providers, CRIs, industry, and communities towards building a critical mass of value-added private sector activity resulting in sustainable economic growth.

Second, all eight universities in New Zealand – University of Auckland, Auckland University of Technology, University of Canterbury, University of Otago, University of Waikato, Victoria University of Wellington, Lincoln University and Massey University - have a varying focus in developing intellectual property for technology transfer and commercialization. They have established entities to offer assistance to link their academics and researchers with like-minded academics and researchers from other institutions and with companies (see Table 1).

Commercial exploitation of discoveries has increased in importance since the emphasis in government funding for universities has shifted from reward based on number of full-time students to quality of research generated from the university. The primary goal of this government-inspired Performance-Based Research Fund (PBRF) is to reward and recognize the quality and quantity of research generated, as well as to encourage more research (TEC, 2009).

**METHODOLOGY**

To assess the innovation and technology transfer system in New Zealand, we employed a triangulated design (Jick, 1979; Sackett and Larson, 1990; Scandura and Williams, 2000; Yin, 1984), which uses multiple approaches to investigate the research question (Jick, 1979; Scandura and Williams, 2000) to increase the rigor and relevance of the study. In this study, triangulation involves interviews, multiple product case studies (Eisenhardt and Graebner, 2007), and an online survey.

Based on over forty open-ended interviews and discussions expert participants in technology transfer offices, as well as key stakeholders in the New Zealand innovation system, we coded their responses and insights into an online questionnaire which was reviewed by a panel of experts for validity, redundancy and accuracy (Yin, 1984). We also developed specific case studies based on technology transfers from Crown Research Institutes and universities in agriculture and food, biotechnology, information technology, and manufacturing.

Based on this model, we distributed a survey to members of technology transfer offices at all eight universities and nine Crown Research Institutes in New Zealand, as well as key stakeholders in the innovation ecosystem to include but not limited to NZ Institute, NZ Institutes of Technology and Polytechnics (NZ ITP), Science NZ, New Zealand Venture Capital Association (NZVCA), FRST (Foundation of Research, Science and Technology), MoRST (Ministry of Research, Science and Technology), TEC (Tertiary Education Commission), NZTE (New Zealand Trade and Enterprise) during the April-June 2009 study period. We received 305 responses from key decision-makers and influencers of innovation in NZ comprising: researcher scientists (43%), entrepreneurs and management executives (17%), Crown Research Institute Technology Transfer staff (7%), government officials (e.g., FRST, MoRST, TEC, NZTE) (7%), investors (e.g., Angel, Venture Capital) (6%), university-based Technology Transfer Office staff (6%), key support professionals (e.g., patent attorney, accountant, lawyer, headhunter) (4%), and other professionals in the national innovation system (e.g., company directors) (11%). Study participants averaged over 10 years of experience in their roles, with 0-5 years (15%), greater than 5-10 years (15%), and other categories.
years (18%), greater than 10-20 years (25%), and greater than 20 years (42%). The next section reviews the results of interviews, case studies, and survey respectively.

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<th>Institution</th>
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<tr>
<td>University of Auckland</td>
<td>Auckland UniServices Limited (UniServices) is a wholly-owned company of the University of Auckland. UniServices’ mission is to apply the research and expertise of the University to client needs and business opportunities, enabling organisations based on new knowledge to grow, expand the University's research capability and benefit the broader community.</td>
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<tr>
<td>University of Otago</td>
<td>A wholly-owned subsidiary of the University of Otago, Otago Innovation Limited is charged with exclusive responsibility for the commercialisation of Intellectual Property arising from research within the University.</td>
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<tr>
<td>Waikato University</td>
<td>A wholly-owned subsidiary of the University of Waikato, WaikatoLink was founded to maximise the economic potential of the University's Intellectual Property (IP) and to bridge the gap between academic research and the realisation of technology potential.</td>
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<tr>
<td>Lincoln University</td>
<td>Lincoln’s Research and Commercialisation Office aims to assist the University to become New Zealand's premier national research education provider for the sustainable management of natural resources to enhance environmental, social and economic viability in the global environment of the 21st century.</td>
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<tr>
<td>Victoria University</td>
<td>VictoriaLink Ltd (Vicilink) helps staff and students turn world-class research at Victoria University into commercial opportunities. Vicilink is a technology transfer company like those attached to leading universities all over the world; committed to identifying commercial prospects, building new businesses, and connecting accomplished academics with the industries craving their expertise.</td>
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<tr>
<td>Canterbury University</td>
<td>Research and Innovation (R&amp;I) is to provide end-to-end services which facilitate and support all stages of research and innovation development, from initial funding through to commercialisation, where appropriate.</td>
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<td>Massey University</td>
<td>Massey is committed to a high deal flow strategy that aims to deliver a higher volume of commercial outcomes but with the university having a smaller stake and lower risk exposure. To achieve this Massey partners with preferred commercialisation partners (the Bio Commerce Centre and Enterprise Centre) to undertake IP evaluation and deal brokering.</td>
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<tr>
<td>AUT (Auckland University of Technology)</td>
<td>Business Innovation Centre (BIC) offers a unique collaborative environment and is focused on the transformation of innovative ideas into business reality. These ideas encompass the continuum from pure technology research to established technology businesses.</td>
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<td>AgResearch Ltd (AgResearch)</td>
<td>AgResearch’s mission is to seek areas of common interest and opportunities for investment and cooperation where pooling of resources promises faster and better results than would occur otherwise. AgResearch also aims to support pastoral farming that is not just highly profitable but sustainable - where for a given unit of effort more economic value is created yet with a smaller environmental footprint.</td>
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<tr>
<td>Industrial Research Ltd (IRL)</td>
<td>IRL is a world-class research enterprise focused on helping you win in the marketplace through the application of scientific and engineering excellence.</td>
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<tr>
<td>Institute of Environmental Science &amp; Research Ltd (ESR)</td>
<td>ESR is a government-owned crown research institute which provides operational science and research services which underpin New Zealand's health and justice systems.</td>
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<tr>
<td>Institute of Geological &amp; Nuclear Sciences Ltd (GNS Science)</td>
<td>GNS Science is a research institute owned by the New Zealand Government. Their purpose of understanding earth systems and technologies to transform this knowledge into economic, environmental, and social benefits for New Zealand.</td>
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<tr>
<td>Landcare New Zealand Ltd (Landcare Research)</td>
<td>Landcare Research is New Zealand’s foremost environmental organisation specialising in sustainable management of land resources; optimising primary production, enhancing biodiversity, increasing the resource efficiency of businesses, and conserving and restoring the natural assets of our communities.</td>
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<tr>
<td>National Institute of Water &amp; Atmospheric Research Ltd (NIWA)</td>
<td>NIWA’s mission is to conduct leading environmental science to enable the sustainable management of natural resources for New Zealand and the planet.</td>
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<tr>
<td>New Zealand Forest Research Institute Ltd - trading as Scion</td>
<td>Scion is a Crown Research Institute dedicated to building a stronger bio-based economy for New Zealand.</td>
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<tr>
<td>The New Zealand Institute for Plant &amp; Food Research Ltd (Plant &amp; Food Research)</td>
<td>Plant &amp; Food Research is a New Zealand-based science company. Their goal to underpin the growth of plant and marine-based industry in New Zealand and offshore through the successful application and commercialisation of research-based innovation.</td>
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RESULTS

The results of our study of the innovation and technology transfer system in New Zealand may be grouped into the importance and role of innovation and allocation of innovation resources, as well as the strategy, structure, metrics and performance of technology transfer offices (TTO) in NZ.

Importance and Role of Innovation in NZ

First, to ground our study we asked participants: “How important is technology transfer from NZ publicly-funded universities/research institutes to economic development, wealth creation, and competitiveness?” In this case, an overwhelming 89% responded that innovation was “important/very important” to economic growth, with 10% rated innovation as “somewhat important”.

Next, respondents reinforced the importance of innovation in terms of prioritizing overall impact measures, noting the following improvements were “important/very important”: customer satisfaction (93%), revenue growth (94%), return on investment (94%), and increased profit margins (86%). In contrast, only 54% of participants noted that social benefits were seen as “important/very important” as a measure of innovation.

While respondents appeared confident about the importance of innovation, a large number expressed concern about the environment in which it was conducted, with recurrent concerns which included:

- Lack of support resources: “I believe that most innovation and technology transfer in New Zealand, particularly in a university setting is managed without adequate resources”;
- Risk averse: “A lack of job opportunities when ventures fail means a very risk adverse [sic] culture”;
- A want of capital and management: “Good ideas based on niches but poor access to capital and management expertise”, and “our researchers are world class (if they stay) but management often misguided and inept”;
- Incentives need modification: “Amend the PBRF to allow credit for research that is successfully commercialised”;
- Industry links need improvement: “We are not good at getting alongside industry”;
- Isolated market position: “Small market, limited pools of investors for initial funding, and the tyranny of distance”; and
- Limitations imposed by limited market and labour-market size: “Small pockets of great skill but too small to be effective”, and “…extremely small number of firms able to develop and maintain the major structural shifts required for effective new product development”.

Allocation of Innovation Resources in NZ

Next, another critical step in assessing the innovation system is the allocation of resources. A resource based in building an industrial cluster, for example, suggests preferentially allocating resources to enhance capacity building and strengthen competitiveness in a narrow set of key industry sectors. To explore this issue, we asked participants: “Should publicly-funded, university/research institute funds be preferentially allocated to key industry sectors in NZ (e.g., agriculture, information technology, biotechnology)”? In this case, however, respondents were evenly divided on the question of preferentially allocating resources into key industry sectors, with 47% preferring total academic freedom and 53% preferring a focus investment.

Most respondent’s comments, however, dealt with research investment in niches:

- “Agricultural and practical focus - exploiting 80 benefit for 20 effort concept - exploiting niches”;
- “Better funding of research projects aligned with industry needs”;
- “A much more realistic and hard-nosed view of where we have competitive advantage (both commercial and R&D) and focus on building scale around niches”; and
- “More consortium led industry driven research in areas where critical mass might be reached”.

Among 53% who preferred to allocate resources preferentially to specific sectors, those respondents strongly suggested investing in agriculture and food sector which was seen as world class - as opposed to emergent industries such as biotechnology and ICT (information and communications technology) (see Figure 2). In this regard typical responses included:
• “Focus on the areas we are really good: AgBio, Food, some electronics and manufacturing (very specific areas), Biotech, but largely non-medical”;
• “Most successful innovations are involved in Agriculture and Food”.

A number of respondents were motivated to comment on the need for co-operation: “We operate in a small local population so should encourage collaborative, cooperative approaches between organisations and companies to compete effectively at international level”, and “Development of a more cooperative inter-institution environment to replace competitive model that hinders collaboration between research organisations”.

**Figure 2: Ranking of Industry Sector Priorities and Competitiveness in New Zealand**

Structure, Evaluation, Metrics and Performance of Technology Transfer Offices in New Zealand

The second part of the survey focused specifically on the structure, evaluation, metrics and performance of technology transfer offices in New Zealand. First, to explore the structure of technology transfer offices (TTO) we asked: “Should Technology Transfer Offices operate for-profit, non-profit, or a mix of both?” In this case, respondents were decidedly mixed with 19% calling for TTOs to be primarily non-profit service providers focused on advancing research for public benefit (e.g., advancing basic science, education, social impact, service provider of grants, contract research); 14% of participants called for TTOs to be for-profit entities seeking to maximize the commercial value of research (e.g., licensing, spinoffs); and 67% of respondents called for TTOs be a mix of both public benefit and for-profit (i.e., evaluate case-by-case). Respondents generally held views that supported TTOs and the need to provide them with adequate resources:

• Provide resource to assist building capability in TTO’s as distinct from incubators to prevent competition. Take a national rather than regional approach

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most innovation and technology transfer in New Zealand, particularly in a university setting is managed without adequate resources. This is can be determined by the lack of interest and knowledge of technology transfer/commercialisation from senior university management …”.

To further explore the structure of TTOs, we asked: “All things being equal, technology transfer offices should prioritize their business models?” In this case, respondents preferred TTOs to focus on creating new ventures (e.g., spin offs) in NZ and preferentially licensing technologies to existing NZ firms, versus an exclusive profit-maximizing focus on licensing technologies to the highest bidder, regardless of firm country of origin. As such, respondents were consistent in preferring to help local firms versus solely maximizing profits by selling IP (intellectual property) to an international firm.

Some respondents identified a perceived lack of training and experience among some TTO staff, with comments such as:
- “Tech transfer office staff are not skilled to find and commercialise IP.”;
- “slow, lack of agility in the commercialisation enterprises”;
- “Recruit people who have been there done that. Currently the staff are simply just too inexperienced to know how to really evaluate an idea and commercialise it appropriately”; and
- “Innovation and quality of discovery are first rate in NZ but technology transfer leaves something to be desired”.

Figure 3: Business Model Priorities for Technology Transfer in NZ

Next, we assessed the evaluation approaches and sources of advice used by commercializing researchers in performing due diligence on technology transfer opportunities. Figure 4 shows that several sources are used and, despite the reservations identified earlier about TTOs, the responses appear to suggest that, as internal staff, they remain a preferred source of advice.
Further, we assessed the tools used to evaluate technology transfer opportunities by asking respondents: “What are the top tools your organisation uses to evaluate technology transfer opportunities?” Perhaps reflecting the wide range of objectives and sources of input, respondents also used a wide range of tools with “market analysis” the only widely used approach, with a number of analytical approaches such as internal rate of return, net present value or discounted cash flow, breakeven analysis, or simulations “seldom” employed. Next, an important aspect of which raised considerable controversy in our study was how to measure success in TTO activities: “How should we keep score? Please rank the following metrics for Technology Transfer Offices in terms of value to NZ.” In alignment with government policies to focus on exports (NZTE, 2008), respondents ranked “increased exports” as the highest priority for measuring the effectiveness of TTOs. Also, consistent with previous answers respondents rated “profitability of the TTO” and “licensing to international firms” as low priorities – see Figure 5.

Figure 5: Ranking of Metrics in Terms of Value-Added for New Zealand
Finally, we assessed the participants' perceptions of performance by asking: “How effective are the following NZ universities and Crown Research Institutes at commercialisation?” Among the university rankings, we found that the University of Auckland was perceived to be significantly superior in commercialisation effectiveness. 73% of respondents noted the University of Auckland as “innovative/highly innovative”, and they were four-fold more “highly innovative” than the average university. Waikato University and Otago University were found to be moderately innovative, and the remaining five universities—Massey, AUT, Canterbury, Victoria and Lincoln - were found to be low to moderate in innovation effectiveness (Figure 6).

Specific observations included:

- “If you look at your engineering universities (Auckland, Canterbury) you will find the most curious, innovative, and talented people thinking about what society needs now and in the future”;
- “A great deal of effort and expectation, but very little real value. NZ needs to look to overseas models where effectiveness and new ideas are developed from the research to the commercial application”; and
- “Commercialisation offices are very variable. UniServices and AUT are very good. Others need upgrading”.

In overall terms, participants considered that Crown Research Institutes were less effective innovators than universities. However, there was wide diversity as respondents rated IRL (Industrial Research Limited) to be twice as “highly innovative” than the average CRI, although only 52% perceived them to be “innovative/highly innovative.” Respondents also rated Landcare Research New Zealand Ltd (Landcare Research), Institute of Environmental Science & Research Ltd (ESR), and Institute of Geological & Nuclear Sciences Ltd (GNS Science) as significantly poor innovators in terms of commercialization performance (Figure 7).

On CRIs, respondents said:

- “Learn from the successes of Auckland UniServices and IRL”; and
- “CRIs need stronger/bigger commercialisation teams to take ideas through proof-of-concept to prototype level”.

Some further views on technology transfer that were raised by respondents include:

- Re-structure technology transfer nationally: “Create one national tech transfer office”;
- Look to teams rather than projects: “Fund key teams, not projects with uncertain commercial outcomes”;
- Remedy lack of resourcing in technology transfer by providing “Funding specifically for tech transfer”; and
- Bureaucratic complexity: “Simplify the hoops you have to jump though to get stuff out of CRI in particular. We considered 3 projects over 5 years and all were just too difficult to get through the paper war before actually talking to someone who might have the key knowledge we were looking for”.
Figures 6 & 7: Ranking Commercialisation Effectiveness Universities and Crown Research Institutes

**Effectiveness of NZ Universities at Commercialisation**

- University of Auckland: 25% Not Innovative, 48% Somewhat Innovative, 28% Innovative, 8% Highly Innovative
- Waikato University: 17% Not Innovative, 57% Somewhat Innovative, 27% Innovative, 8% Highly Innovative
- University of Otago: 37% Not Innovative, 37% Somewhat Innovative, 47% Innovative, 9% Highly Innovative
- Massey University: 13% Not Innovative, 50% Somewhat Innovative, 32% Innovative, 5% Highly Innovative
- AUT (Auckland University of Technology): 15% Not Innovative, 68% Somewhat Innovative, 27% Innovative, 2% Highly Innovative
- Canterbury University: 10% Not Innovative, 85% Somewhat Innovative, 32% Innovative, 3% Highly Innovative
- Victoria University: 17% Not Innovative, 80% Somewhat Innovative, 33% Innovative, 3% Highly Innovative
- Lincoln University: 18% Not Innovative, 85% Somewhat Innovative, 25% Innovative, 3% Highly Innovative

**Effectiveness of Crown Research Institutes**

- Inherintal Research Ltd (IRL): 1% Not Innovative, 41% Somewhat Innovative, 38% Innovative, 14% Highly Innovative
- AgResearch Ltd (AgResearch): 3% Not Innovative, 34% Somewhat Innovative, 51% Innovative, 10% Highly Innovative
- The New Zealand Institute for Plant & Food Research Ltd (Plant & Food Research): 8% Not Innovative, 41% Somewhat Innovative, 44% Innovative, 7% Highly Innovative
- New Zealand Forest Research Institute Ltd - (Meninge in Scion): 1% Not Innovative, 47% Somewhat Innovative, 50% Innovative, 2% Highly Innovative
- National Institute of Water & Atmospheric Research Ltd (NIWA): 22% Not Innovative, 51% Somewhat Innovative, 22% Innovative, 5% Highly Innovative
- Landcare Research New Zealand Ltd (Landcare Research): 31% Not Innovative, 91% Somewhat Innovative, 18% Innovative, 3% Highly Innovative
- Institute of Environmental Science & Research Ltd (ESR): 28% Not Innovative, 58% Somewhat Innovative, 20% Innovative, 6% Highly Innovative
- Institute of Geological & Nuclear Sciences Ltd (GNS Science): 36% Not Innovative, 55% Somewhat Innovative, 18% Innovative, 3% Highly Innovative
CONCLUSIONS

This study indicates that there is a broad consensus in the research, science and technology community in New Zealand about the potential of innovation to spur economic development, as well as address a wide range of pressing environmental and social issues. In addition, there was strong agreement that technology transfer of intellectual property from universities and Crown Research Institutes (CRIs), which represented two-thirds of scientific publications and patents, to local private companies was a critical success factor for achieving global competitiveness. Further, there was significant agreement that the progress and impact of advances in innovation should be validated by external, "customer facing" and "value-added" measures (e.g., customer satisfaction, revenue growth, return on investment, and increased profit margins).

While there was a broad consensus on the potential for innovation, there was a wide diversity of opinion in how New Zealand should organize, coordinate and measure the progress of the national technology transfer system to enhance innovation and economic growth. Using a resource-based view, we assessed the innovation and technology transfer system in New Zealand to explore the following questions: What is the role of innovation in university and research institute technology transfer? What is the right strategy and focus for technology transfer efforts? What is the right structure to evaluate and execute technology transfer transactions efficiently? What is the right ecosystem to support technology transfer? We used a multi-method methodology including cases studies, interviews and an online survey to assess drivers, obstacles and performance of the NZ technology transfer system.

We found, for example, respondents were evenly divided on the question of preferentially allocating resources into key industry sectors, with half preferring total academic freedom and the other half preferring a focused investment. This is a central strategic question as it has been suggested that the preferential building of resources and capabilities in a narrow set of key sectors may be important in developing national competitiveness in a global context (de la Mothe, 1999, de la Mothe and Mallory, 2006). In addition, among those who prefer allocating resources to a specific sector, half of those participants prefer to further invest in low growth primary industries (e.g., agriculture and food) versus transformative, high growth industries (e.g., biotechnology, clean technology, information technology).

Perhaps as a result of a wide diversity opinions regarding strategy for the national innovation system, we should not be surprised to find an equally diverse set of perspectives on how technology transfer offices (TTO) in New Zealand should be structured, evaluated, and measured. For example, the majority of respondents felt that TTOs should be structured as both a for-profit commercialization arm and as a non-profit service provider, which is exceedingly difficult to operationalise (i.e., difficult to be strategic about a case-by-case approach).

In addition, requiring TTOs to give priority to local firms rather than maximizing their profitability runs the risk of diverting TTOs from establishing important international linkages, and thus reducing overall national economic benefit. We also found that a wide variety of informal and formal approaches were used by participants to assess technology transfer opportunities (e.g., advisory, analytical tools such as internal rate of return); as well as a broad diversity of measures of success (e.g., increased exports, number of jobs created, licenses to NZ firms, number of patents and scientific publications).

Finally, the assessment of performance between universities and CRIs revealed significant performance differences and encouraging trends by leaders - University of Auckland and Industrial Research Ltd - which may serve as important benchmarks to elevate performance levels for innovation and commercialisation within New Zealand.

From here we would like to extend our study by conducting cross-sectional analyses (e.g., by participant type, objectives, performance), as well as by longitudinally assessing the extent to which the general economic environment (e.g., recession or growth periods) affects the approaches used in technology transfer. We would also like to conduct a comparative study of best practices and competencies of international technology transfer initiatives by benchmarking the activities of New Zealand and Australian research organisations against the practices used by successful institutions such MIT and Stanford (in the USA) and the University of Waterloo (in Canada).
In sum, our study shows that the resource-based view of the firm (Barney, 1991) can be extended to the context of technology transfer offices and that this theory provides a useful lens for examining the capabilities required to translate scientific ideas into commercialisable innovations which can, in turn, help improve a country’s international competitiveness. For commercialisation practitioners, the findings suggest that a significant commitment is required to improve the resources and capabilities needed to bridge the divide between scientific insight and successful commercial innovation.

Further, we conclude that industrial firms face high transactions costs (i.e., time, effort) in accessing innovations from universities and CRIs effectively. This is compounded by the broad range of objectives, approaches and measures under which different TTOs operate.

For policy makers, our findings suggest that a uniform approach to measuring commercialisation effectiveness would help universities and CRIs to align missions and strategies (e.g. by making clear links between for-profit or non-profit objectives, processes and performance measures), would encourage industry to collaborate more closely with research institutions, and would help reduce transactions costs and enhance commercialisation effectiveness. Further, consideration should be given to direct Government support to help co-ordinate and resource the commercialisation of innovations.

As such, we hope that our study leads to a positive and constructive debate on mobilising the national innovation system in New Zealand, and is a useful tool for both policy makers and technology transfer office managers who are charged with helping to transform the intellectual property associated with nascent technologies developed by universities and CRIs into successful products and services.

REFERENCES


