Powering Innovation

Improving access to and uptake of R&D in the high value manufacturing and services sector

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Overview

The high value manufacturing and services sector is key to New Zealand's economic future, but is currently under-developed

Rapid development of the high value manufacturing and services sector (HVMSS) has the potential to generate a step change in the economic growth and social wellbeing of New Zealand. The country already has examples of highly successful firms in this space and the number is growing. The traditional contribution of our food and fibre based sectors will remain critically important for our future, but international experience shows that growth of the HVMSS offers a pathway to higher productivity and a means to reverse our relative decline in living standards. This sector can also increase the diversity and overall value of our exports and contribute to the growth of new skills and capabilities nationally.

However, there is evidence that the New Zealand HVMSS is under-developed, and could contribute substantially more to the economy than it currently does, particularly through growth in high productivity advanced technology industries.

Notably, there is a relatively low level of investment in research and development (R&D) by New Zealand business (0.54% of gross domestic product (GDP) in 2010, compared with the Organisation for Economic Co-operation and Development (OECD) average of approximately 1.5%); similarly there is a relatively low level of overall expenditure on R&D as a percentage of GDP (1.30% in 2010, compared with the OECD average of 2.33%). These ratios are considerably less than those in other economies similar to that in New Zealand.[1]

The Minister of Science and Innovation requested a review by an independent Panel

Upon the Minister's request, the Ministry of Science and Innovation (MSI) assembled an independent panel to advise how the Government can better facilitate the development and growth of the HVMSS through enhancing the level of access to and uptake of research and development (R&D) services. This includes lifting the number and quality of successful commercialisation ventures from university and Crown Research Institute (CRI) research.

The Panel members were Professor John Raine (Chair), Professor Mina Teicher and Phil O'Reilly.

The scope of the review included:

- Firms across a range of advanced technologies, which in this report and its recommendations refer to technologies including biotechnology, processing, electronics and embedded systems, mechatronics and robotics, sensing and scanning

[1] Statistics New Zealand Research and Development Survey: 2010 (available at www.stats.govt.nz).

devices, advanced materials and manufacturing technology (including plastics), marine technology, medical technologies, pharmaceuticals, agri-technologies, digital technologies and information and communication technology (ICT)).

- The application of technology developments to the more traditional manufacturing sector including, for example, meat processing, wool processing and related agri-tech activities.
- The role of public research organisations involved in this sector.
- Actions that can be taken to address the opportunity for the HVMSS to increase New Zealand's GDP and labour productivity.

Specifically, the Panel was asked to:

- Analyse the primary barriers to technology and knowledge transfer from research organisations to the HVMSS in New Zealand and provide options to overcome those barriers.
- Provide an analysis of overseas models for assisting and driving growth in the HVMSS that have the most relevance to New Zealand, analyse the key lessons and practices from these models and explore what their implications would be for the roles, responsibilities and funding structures of key research institutions in the sector.
- Provide options for the roles, functions and funding of research organisations in the sector.

The full terms of reference for the review are available at http://www.msi.govt.nz/sites/all/files/u4/TORHiTechReview2.pdf.

The Panel consulted widely with representative individuals and organisations key to the HVMSS, including: providers of R&D (CRIs, universities, polytechnic institutes and independent research organisations); research consortia and associations (such as the Heavy Engineering Research Association (HERA)); commentators; angel investors; companies in the sector; and representatives of industry sector bodies.

This overview report is accompanied by a full report. The reader is invited to read the full report to better capture the scope of potential actions for enabling change in the HVMSS. The full report provides more comprehensive discussion, and includes:

- An overview of New Zealand's innovation system
- An analysis of barriers to access to and uptake of R&D by the HVMSS, supporting the associated recommendations
- Appendices providing information on New Zealand's research and commercialisation organisations
- Appendices that give more detailed information from the submissions to the review and from research on the innovation systems in other countries.

The full report is available at www.msi.govt.nz/hvmreview

This review report proposes new initiatives to grow the High Value Manufacturing and Services Sector

Recent efforts to grow the HVMSS include the introduction of new Technology New Zealand (TechNZ) mechanisms aimed at accelerating the expansion of small- to medium-sized enterprises (SMEs) and larger companies. The intended National Network of Commercialisation Centres (NNCC), and actions recommended by the Crown Research Institute Taskforce will also influence R&D engagement and new technology uptake by companies in the HVMSS. The recommendations in this report offer additional mechanisms by which the Government can accelerate the process of growth of the HVMSS and further drive the New Zealand economy.

The Panel also notes that earlier well-researched reports, notably those of IPENZ and the New Zealand Institute,[2] present recommendations in the subject area for this review. The Panel hopes that this report reinforces previously recommended actions and proposes new initiatives that will, if adopted, place New Zealand on a path of much more rapid growth and development in its HVMSS.

Innovation is an ecosystem with interactions at many levels

This report focuses on science and technology-based innovation. However, growth of an innovation culture also involves broader questions around the breadth and depth of secondary and tertiary education, entrepreneurship education, the development of a more science-aware society across all professional disciplines and the creative connection of talented minds across discipline boundaries. A future innovation culture in New Zealand will be characterised by a vibrant design and creative arts community, and by the innovative contributions of professionals in business, law, the humanities and social sciences. These important broader influences, and that of the challenge of long-term sustainability of our society, were acknowledged by the Panel as it focused on the more confined scope of this review.

New Zealand's innovation ecosystem has been shaped over the years by government, the domestic and global economic climates and other factors, rather than having been led by a long-term, well understood and widely supported national innovation strategy.

The innovation ecosystem is often seen narrowly as a "pipeline" or "food chain", in other words a linear commercialisation model that goes from idea to full market establishment with stages in research, proof-of-principle development, prototype, product beta-testing in trial markets and market launch. This scenario may be true for "technology push" projects that emerge from publically funded research organisations, but, innovation typically paints a much more complex picture. It commonly begins not with a discovery but with the identification of a market need that triggers industry-led innovation, which represents the large bulk of science and technology innovation in New Zealand.

[2] Institution of Professional Engineers New Zealand: *Catalysing Economic Growth: Boosting Innovation Expertise in the Private Sector*, 2011 (available at www.ipenz.org.nz), and New Zealand Institute: *Standing on the Shoulders of Science: Getting More Value from the Innovation Ecosystem*, 2009; *A Goal is Not a Strategy: Focusing Efforts to Improve New Zealand's Prosperity*, 2010*;* and *Plugging the Gap: An Internationalisation Strategy*, 2010 (available at www.nzinstitute.org.nz).

It may also begin with lateral thinking that takes an existing technology and puts it in a new application or applies a technology to different markets. Innovation also emerges from partnerships between R&D institutions and industry, where work on a project produces spin-off ideas that produce new and often unexpected developments.

In reality, the innovation ecosystem has interactions at many levels and may involve iterative organic processes rather than a simple linear model. It is important that, between investments from the Government and the private sector, all innovation pathways and stages of the commercialisation process are funded, but based on sound market-led decision making.

The primary R&D organisations in New Zealand are its eight universities (Auckland, AUT, Canterbury, Lincoln, Massey, Otago, Victoria and Waikato) and eight CRIs (AgResearch, Plant and Food Research, Environmental Science and Research (ESR), Scion, GNS Science, Industrial Research Limited (IRL), Landcare Research and the National Institute of Water and Atmospheric Research (NIWA)). In addition, there are a number of industry-supported private sector research associations and organisations that draw upon government funds for specific types of research. The polytechnics, particularly the Metro Group, also have the capacity to offer technology development services to industry.

There is significant room for development of New Zealand's HVMSS

New Zealand industry is characterised by a relatively large number of very small companies in the SME sector, many with little or no history of engagement in R&D. This factor limits their capacity to implement new products and processes that are generated through research. However, contrary to popular perception, New Zealand has a slightly lower proportion of employees in SMEs, with 19 or fewer employees, than the OECD average (Figure 1). New Zealand has a similar proportion of people employed in large firms (250 or more employees) to the OECD average, although the number of very large firms in New Zealand is less than the OECD average. Low productivity in New Zealand does not seem to relate to its high proportion of small companies. Denmark, for example, has similar proportions of SMEs but a much more productive economy measured as GDP per capita (Figure 2).

Unlike other sectors important to the economy, such as agriculture, the HVMSS is exceptionally diverse and fragmented: it is composed of a large number of technology sub-sectors that are not unified by an overarching national strategy or vision.

The landscape of R&D capability across the sector is by no means uniform. In this sector, small technology start-ups, such as those that spin-out of university research, may be R&D intensive to the exclusion of other skills that are necessary for successful entrepreneurial or international growth. Large companies, such as Fisher & Paykel Healthcare and Rakon, have embedded in-house R&D capability but have difficulty meeting the demand for additional skilled professionals for specialist research needs.

Despite these characteristics, the New Zealand HVMSS includes many firms that have achieved global leadership positions in specialist niche markets and there is evidence that this group is expanding. For example, of the 116 firms where joint MSI and New Zealand Trade and

Enterprise (NZTE) service plans were completed, for 2008–09 total turnover increased by 14.4% to $11.15Bn, and total exports increased by 18.9% to $7.83Bn.

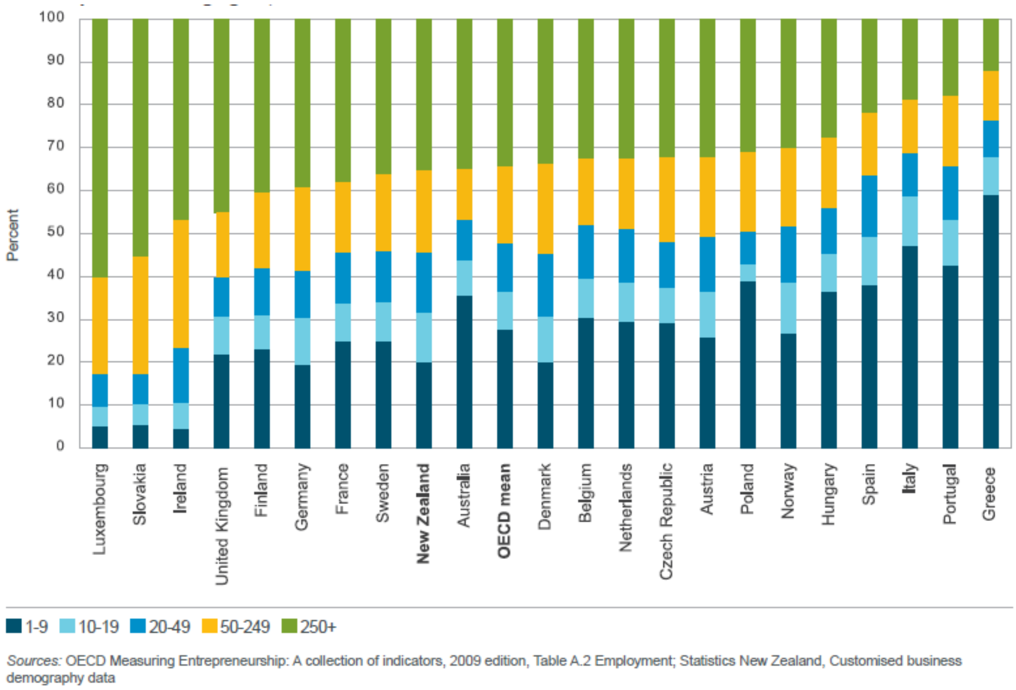

Figure 1: Number employed by size class of business as a percentage of the total number of persons engaged (Source: 2011 Economic Development Indicators, Statistics New Zealand)

However, there is significant room for further development. While a substantial number of companies are involved in advanced technology business exports, the bulk of export earnings come from relatively few. For example, in the year ending March 2010, the top 100 TIN100 companies[3] had combined revenues of $6.7Bn, of which $4.9Bn were exports involving 24,000 staff. The next 100 companies had total revenues of $508M and employed 2,900 staff.

Because of its location, and long-term focus and dependence on primary industries, New Zealand has developed an advantage over other countries in some fields. While the country should, without doubt, continue frontier research in agriculture, oceanography, water, aquaculture, geology, bio-ecology and veterinary science, it should not allow the focus on these areas of expertise to become a barrier to success in other areas, for example, in sciences that do not need major (or costly) equipment investment but that have the potential to deliver advanced technology products.

New Zealand's macroeconomic environment has been identified in a range of studies as not being as supportive as it could be to investment in the private sector and innovation.[4] Specific actions taken to develop the HVMSS must be accompanied by ongoing changes to the macroeconomic environment to support innovation.

[3] TIN100, Industry Analysis, New Zealand, 2010, Sixth Edition.

[4] University of Canterbury: *Innovation in New Zealand: Issues of Firm Size, Local Market Size and Economic Geography*, Hong Shangqin, Philip McCann and Les Oxley, 2009 (available at www.econ.canterbury.ac.nz/RePEc/cbt/econwp/0904.pdf); Ministry of Research, Science and Technology: *Becoming More Globally Competitive*, Peter Morten,2006 (available at www.morst.govt.nz/publications/a-z/b/becoming-more-globally-competitive/).

OECD data shows a clear link between investment in R&D and GDP growth

It has been noted that New Zealand falls well short of the average OECD total R&D expenditure as a percentage of GDP. In 2010, New Zealand invested the following amounts in research and development.[5]

Business	$1013M	0.54% GDP
Government (excluding higher education)	$ 629M	0.34% GDP
Higher Education Sector	$ 802M	0.43% GDP
Totals:	**$2444M**	**1.30% GDP**[6]

The link between investment in R&D and GDP growth is clearly seen in OECD data. The *OECD Science, Technology and Industry Outlook 2000*[7] contains a comprehensive summary of the empirical links between innovation and economic performance. Based on a large number of studies evaluating the rates of return on R&D investments, it finds the direct (private) rates of return are typically between 10% and 20%, making investments in R&D ultimately a profitable undertaking. Rates of return typically show considerable differences across sectors, with R&D in research-intensive sectors having higher returns.[8]

A comparison of GDP per capita versus national R&D expenditure (GERD) per capita, over time in US dollar equivalents (Purchasing Power Parity US dollars), for New Zealand and various other countries, confirms that increased investment in R&D does correlate to increased GDP (Figure 2). Although this correlation may be one of diminishing incremental return over time, this return is worth seeking, in terms of the expected absolute GDP per capita growth achieved.[9] There is clearly an opportunity for New Zealand to lift its HVMSS performance by moving closer to OECD average R&D investment levels.

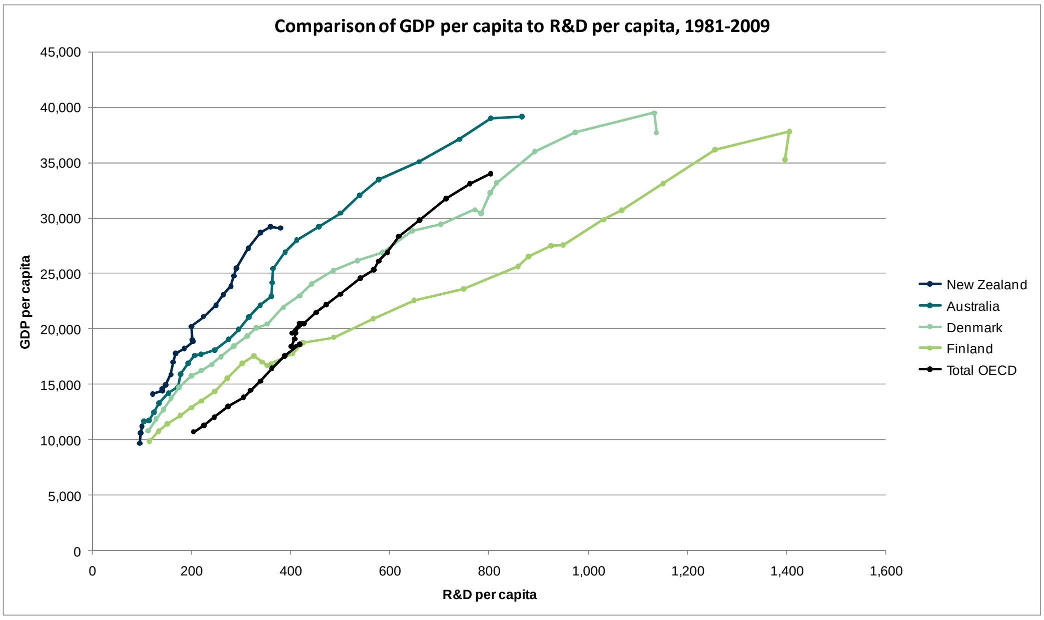

Figure 2: How New Zealand GDP per capita compares

5 Statistics New Zealand Research and Development Survey: 2010 (available at www.stats.govt.nz).
6 Due to rounding, some figures may not add to stated totals.
7 *OECD Main Science and Technology Indicators 2010–12*, February 2011; Statistics New Zealand; Ministry of Science and Innovation.
8 *OECD Science, Technology and Industry Outlook 2000* (available at www.oecd.org).
9 *OECD Main Science and Technology Indicators 2010–12* (2011); Statistics New Zealand; Ministry of Science and Innovation.

There are a number of barriers to access and uptake of R&D in New Zealand

An important step in the Review was to identify what barriers currently stand in the way of growth of an R &D culture in industry, along with enhanced knowledge transfer to industry from research organisations.

From the submissions to this review, generic barriers were identified in four thematic areas: **Structure/Infrastructure, Capability**, **Investment** and **Culture**.

There is a lack of connectivity within the sector

Many submissions to the Panel highlighted structural and infrastructural barriers, including:

- Fragmentation, and limitations in depth and relevance of research capability in research organisations servicing the needs of the HVMSS, manifested as a lack of available researchers to develop technologies needed by the company.
- Geographical spread of companies and research organisations, and therefore a lack of, or poorly developed, sector "clusters".
- A lack of advanced technology manufacturing infrastructure to develop technologies.
- Sub-optimal networking and collaboration between organisations (including between research organisations throughout the country).
- The need for greater critical mass and scale in commercial research services and research commercialisation units attached to research organisations.

One industry research association submitted that "*publicly funded research organisations... are not generally linked to a particular niche manufacturing sector or particular companies. Therefore there is little networking and/or interaction and companies do not identify with those organisations as being 'their' research providers*."

Of the industry-focused CRIs, IRL is most directly involved with the HVMSS. However, because of the diversity and fragmented nature of the sector, IRL has a very diverse portfolio of activities that probably lack the depth to be as effective as they need to be in supporting advanced technology innovation. The IRL submission to the Panel noted that the "What's Your Problem New Zealand?" programme was heavily oversubscribed. This is symptomatic of the present inability of IRL to fully engage with industry as broadly and deeply as it could.

IRL has spun out companies from its basic research. However, the abandonment of BioPharm in 2006 and the slow path to market of HTS 110[10] indicate that there are opportunities for improving commercial outcomes from this CRI. IRL has been hindered by a lack of breadth and depth of science and engineering capability to fully engage with the wide range of industries in the HVMSS. There is an opportunity for IRL to become more market driven and better aligned with short- and long-term industry needs, particularly through much greater engineering engagement in product and process development projects with industry.

[10] HTS 110 was launched to commercialise IRL's high-temperature superconducting technology. A part of this entity was recently bought by the New Zealand-based company Scott Technology.

There are significant capability issues

The second key group of barriers identified in responses fell under the general category of capability. This is primarily focused around access to and mobility of knowledge, and attraction and retention of talent. In the area of research commercialisation, international comparisons show that New Zealand appears to perform well per dollar of research funding spent.[11] However, a number of factors have worked against the institutional commercialisation system being able to deliver as effectively as it could.

Barriers identified included:

- A lack of access to knowledge by industry, and transfer of knowledge from the R&D sector to industry. This often links to a lack of experience in using R&D and of understanding of what R&D can do for an organisation – this absence of an R&D culture across many SMEs shows as a persisting cut-and-try "do it yourself" approach. This in turn links to a commonly risk averse attitude in New Zealand companies, and a focus on short-term cash flow and survival.
- Low mobility of R&D staff between universities, CRIs and industry, attributable to staff performance incentives not being aligned to industry R&D engagement. In this regard, incentives in the TEC Performance Based Research Fund were mentioned as a barrier by a number of respondents to the Review. Related to this is the relative lack of incentives for university (or CRI) staff to engage in IP commercialisation.
- In regard to attraction and retention of skills:
  - A shortage of professional skills in a number of areas in business and advanced technology. For example, it is estimated that New Zealand needs 2,000 – 2,750 new engineering graduates each year, but in 2008 there were only 1,500[12]. This shortage stems from cultural and education system issues in New Zealand – there is a need to motivate more young people to retain science and mathematics at secondary school and to pursue science and technology education at tertiary level.
  - For larger companies with internalised R&D functions, difficulty in attracting university graduates, or graduates with the required capabilities.
  - Difficulty for universities in attracting top academics from the international market, and reducing teaching contact hours to free up more staff time for research and/or industry or community engagement.
- Consequences of the difference in alignment of university, CRI and company cultures and drivers such as:
  - A lack of industry presences in university and CRI specialist research centres
  - Tensions around IP ownership frustrating some commercialisation processes, and concerns that leakage of IP will occur from research organisations under contract to industry.

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[11] See www.universitiesnz.ac.nz/files/u2/NZVCC_Uni_ResearchFIN_1C59D.pdf and www.otago.ac.nz/entrepreneurship/docs/Qual%20report_31%20August%202010.pdf.

[12] Institution of Professional Engineers New Zealand: *National Engineering Education Plan*, 2010, Prepared for the Tertiary Education Commission by the NEEP Project Governing Group (available at www.ipenz.org.nz).

- Limited capability to take projects through the early commercialisation stage, or not being able to find the right business or commercialisation partner.
- Few industry partnerships with R&D companies overseas, and a lack of government initiatives and schemes that promote the engagement of New Zealand researchers in the international arena and encourage collaboration.

Investment or funding was mentioned as a barrier in every submission

Funding barriers relate not only to availability of investment funds but also, and very importantly, to how the investment of government and private sector funds is prioritised. Barriers mentioned included:

- A lack of integration in the HVMSS sector, and of identified niche areas and focus on unique products and processes to improve international competitive advantage.
- Low level of R&D investment by government, and structure of government funding.
- Under-investment by the private sector, and a lack of risk capital for R&D led innovation, especially for small companies, to take projects from idea to commercialisation and complete the value chain.
- A lack of integration among the public sector resources, a large number of intermediary organisations (such as NZTE, TechNZ, Business New Zealand, EDAs, Chambers of Commerce and so on) and high turnover of staff in these organisations. This linked to a lack of alignment around investment decisions that support companies or industry sectors.
- Overseas ownership leading to use of New Zealand operation for manufacturing only and therefore an absence of drive for innovation.

Cultural barriers are both national and organisational

Finally, a group of barriers was classified as “cultural”. These also link to capability in particular, but included those relating to New Zealand’s national culture and the perceived lack of and need for a national innovation strategy. Cultural barriers also included differences in organisational culture, for example, between research organisations and business, challenges around relationships, management of intellectual property (IP) and barriers that have their genesis in business culture. These barriers tend to affect the innovation system capability and long-term strategic direction. Because an innovation culture is nurtured by potential actions under each of Structure/Infrastructure, Capability and Investment, culture-related recommendations appear under these three headings and under a fourth “The Big Picture - How to Make an Even Greater Impact”, which focuses primarily on long-term strategic issues and out-of-scope recommendations.

In making its recommendations, the Panel drew on lessons from overseas

The Panel reviewed innovation strategies in a number of countries and regions throughout the world where there are good examples of growth being driven from the HVMSS and how improvement has been achieved in access to and uptake of R&D. These included the Nordic countries (particularly Norway, Denmark and Finland), Taiwan, Singapore, Israel and the Australian state of Queensland, who have programmes, institutions and policies that are worthy of study and consideration. These small to medium size jurisdictions are also working to grow innovative business sectors. Notably:

- Finland, for example, has adopted a centralised and coordinated approach to the development of their innovation ecosystem, with the establishment of an overarching Research and Innovation Council which is chaired by their Prime Minister. Finland is set to significantly overhaul its science and education system. Among other things, its Strategic Centres of Excellence (SHOKs), set up in the early 2000s as public–private partnerships, will be reviewed by 2013. The activities of the SHOKs are expected to be strengthened and funding expanded. In addition, the Research and Innovation Council of Finland has identified actions to develop their innovation system, for example, *"structures will be reformed and organisational, operational and regional fragmentation will be reduced".* Strategic development policies have been developed to improve the flexibility of organisations, raise their profile and integrate complementary organisations.
- Denmark, a country respected for its innovative approach to R&D, has an elegant innovation policy. Many of the tools within it already exist in New Zealand and would benefit from expansion or enhancement. Denmark has had success with R&D institutions working closely with industry. An international review of the Danish GTS Institute System in 2009 found that "*while the GTS system has done well in meeting its target groups' national and even international needs for technological services…the world is changing around it, so GTS must adapt as needs evolve"*.[13]
- Finland, Denmark and Queensland have introduced support schemes, analogous to New Zealand's Technology Fellowship scheme, which place researchers in industry. The outcomes of such initiatives can be outstanding, such as the "Industrial PhD Programme" funded by the Danish Council for Technology and Innovation.
- Queensland's Smart Futures Commercialisation Fellowships are aimed at "researchers-in-residence", and seek to improve industry uptake of new technologies and cross-pollination of ideas by placing a researcher in-house. The fellowships
  - include grants of up to $100,000 per year
  - are available to industry and businesses to engage an innovation-focused researcher (PhD or equivalent) for a minimum of six months and maximum of two years on either a full-time or part-time arrangement
  - must be matched by a sponsor cash contribution of 1:1

[13] Danish Ministry of Science, Technology and Innovation: *A Step Beyond: International Evaluation of the GTS Institute System in Denmark*, 2009, p 48 (available at www.teknologiportalen.dk/NR/rdonlyres/43A17153-8159-4FD5-83BB-67D33F650897/3647/AStepBeyond_web_2.pdf), ISBN: 987-87-923-7280-2.

- researchers must be retained and sponsored for the term of the fellowship by a Queensland-based SME.

  Reciprocal fellowships, which bring industry staff into universities or research institutes, are also available.

- Finland has identified that it under-utilises schemes such as sabbaticals for researchers to work in companies and tailored postgraduate and research programmes at its higher education institutes. One of its strategic development policies is that incentives for business cooperation are created for higher education institutions.[14]

- ITRI in Taiwan encourages staff to cycle through and gain experience and then move into industry. Professional development of staff is part of the institute's culture, and it is expected that staff will leave ITRI and join (or form) a company.

New Zealand may be able to incorporate into policy aspects of findings of other countries who are also currently reviewing their innovation systems. The Panel was aware that adopting portions of a particular country's innovation strategy does not, however, guarantee success.

Apart from industry-linked R&D funding, New Zealand has some examples on the home front of schemes to lift industry capability that have worked well and which could be adapted to enhance R&D uptake in the HVMSS. For example, NZTE's "Better by Design" business mentoring programme is based on the idea "*Design unlocks better business – better thinking, better approaches, and better customer connections*". This has helped New Zealand companies increase their international competitiveness by integrating design principles right across their business. By using an analogous approach to development of an R&D culture, companies in the HVMSS should be able to enhance their prospects for growth.

An in-depth commentary on features of the innovation systems in other countries that were studied is included in the Panel's full report.

The Panel took a holistic view of the innovation system

MSI does not have policy and operational oversight of the entire New Zealand innovation system. For example, universities and polytechnics are partially funded by the Tertiary Education Commission (TEC), and other research organisations are funded by industry. In order to make effective change to the innovation system, all of these institutions need to be engaged in the change process. Therefore, the Panel has, in taking a holistic view of the innovation system, made some recommendations that are technically outside the scope of the report. These are intended to engage other players in potential changes that, collectively, could power the innovation system further and faster, thereby benefitting the economy of New Zealand.

Overall, the Panel believes that adoption of the recommendations that follow could lead to an exciting transformation in New Zealand's advanced technologies industry sector.

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[14] Research and Innovation Council of Finland: *Research and Innovation Policy Guidelines for 2011–2015*, 2010, (available at www.minedu.fi/export/sites/default/OPM/Tiede/tutkimus-_ja_innovaationeuvosto/tiedotteet/RIC_press_2010.12.21_Linjaus.pdf), ISBN: 978-952-485-998-1 (pdf).

The Panel's recommendations aim to drive connectivity, enhance the innovation culture, and catalyse innovation

The Panel's full recommendations are provided on pages 13 to 26 of this report.

The Panel recommends changes that relate to roles, responsibilities and structures of key research institutions in the HVMSS, notably a significant restructuring of IRL and the establishment of a new organisation that focuses primarily on industry demand-driven development projects while retaining IRL's established strengths. The Panel recommends the new institution be based in Auckland, Wellington and Christchurch and exist on a scale appropriate to the needs of the sector, now and in the future. To move away from research institute connotations, the Panel has suggested that this new organisation be called Advanced Technology New Zealand (ATNZ). The Panel also recommends changes or incentives to enhance knowledge access and R&D activity in the HVMSS. Other key recommendations relate to providing incentives for mobility of R&D capability between research institutions and industry, enhancing R&D access for market-led product and business developments, and enhancing commercialisation activity from research institutions.

The Panel recommends setting a national innovation strategy, including top level political leadership of an enduring innovation agenda through the establishment of a new Science and Innovation Council. International experience is that the development of the innovation system requires the highest levels of government support. The Panel recommends that the new Science and Innovation Council be led from a very senior ministerial level in Government. Recommendations also include potential changes in the education sector that are seen as essential in growing innovation capability that will underpin a national innovation culture.

Progressive increases in Government investment in R&D are recommended over an extended period, ideally to bring New Zealand's overall R&D investment at least up to the OECD average, underpinned by a continued commitment to basic research. The key aim of such changes is to better leverage the Government's investment in R&D with investment from the private sector. The report recommends an increased focus on the Physical Sciences and Engineering, while recognising that a successful innovation system depends also on science-aware graduates in Business, Creative Arts, Design, the Humanities, Law and the Social Sciences.

Concluding Comment

The recommendations in this report are a call to action that the Panel sees as essential to achieve out-performance in the national innovation system, and growth in access to and uptake of R&D in the HVMSS. These recommendations sit in a wider macroeconomic context and there are ongoing imperatives on the Government to address factors such as incentives to develop a strong savings and investment culture in New Zealand, broader and deeper capital markets, and creation of a more attractive environment for foreign direct investment. Such developments will be essential if the desired growth in private sector engagement and investment in R&D is to be fully realised.

Recommendations

Structure / Infrastructure – driving connectivity

<u>Recommendation 1</u>
Develop a strategic and structured approach for connectivity between research and development providers and the high value manufacturing and services sector

<u>Recommendation 1.1</u> IRL should evolve into a new "Platform for Industry" organisation, as "Advanced Technology New Zealand" (ATNZ), which would focus primarily on industry demand-led research and development contract work and would deliver expertise across a selected range of advanced technology platforms

(i) Assuming its new form, ATNZ would extend its industry development project support activities and downsize its basic research projects.

(ii) Consideration should be given to moving selected research platforms from IRL to one or more universities or, possibly, to other CRIs.

(iii) The significant majority of the professional staff should be engineers and those with applied science skills, including those in new and emerging areas of interest to business.

(iv) Two additional sites for ATNZ should be established, one in Christchurch and one in Auckland. The relative size and scope of these sites would be based on the likely demand and industry sectors in these locations. The universities in each of the three cities where ATNZ is located would collaborate on this initiative and help, where needed, in the transition and establishment phase by facilitating such aspects as joint appointments and possibly with temporary physical facilities. (Detailed recommendations on roles and funding appear as Recommendations 19 and 20 in Chapter 4.)

<u>Recommendation 1.2</u> Government should give consideration to combination, rationalisation or coordination of related research themes, operating structures or other business arrangements for closely related research organisations. This should be done where it would enable these organisations to exchange knowledge, better allocate funds for incoming projects, use human resources more effectively and run commercialisation units that have more scale and effectiveness.

<u>Recommendation 1.3</u> In certain sectors (for example, agri-technology and other service sectors) where many small- to medium-sized enterprises (SMEs) are generically similar, the Panel recommends developing an industry engagement strategy for more effective outreach by CRIs, and other research institutes and associations to ensure better uptake of technologies. These activities (for example, industry sector advisor programmes) could take place in cooperation with industry bodies.

Recommendation 1.4 The establishment of further university–CRI–industry research consortia should be explored in advanced technology sub-sectors, with matching funding by government and industry. Each consortium should include at least two research organisations and two industries submitting a joint proposal under a competitive process, on a project initiated by the industry partners. The associated IP commercialisation framework would be designed to incentivise industry to participate.

Capability and Commercialisation – Enhancing the Innovation Culture

Connectivity, Staff Mobility and IP Benefits

Recommendation 2

Enhance connectivity between research organisations, tertiary education institutions and industry, through more flexible arrangements for employment, IP rights and benefits, and incentives for staff mobility and engagement in commercialisation. Promote R&D awareness and knowledge access schemes.

Universities

Recommendation 2.1 Introduce more flexible university employment and IP benefits incentives to encourage staff, subject to meeting agreed teaching and research duties, to:

(i) Undertake paid consultancy work with business and industry.

(ii) Take on joint appointments or substantial secondary paid employment with business and industry at a level that enables New Zealand to match overseas income levels for sought-after academics.

(iii) Facilitate leave of absence for working in industry for periods of up to two years.

(iv) Engage in commercialisation and industry relationships, by adopting a more flexible and generous policy towards the percentage of the researcher share in the commercialisation revenues and ensuring that full national and international patents are given credit for academic promotion. In some cases, a researcher share of IP benefits of 50% or higher may be justified.

Related incentives are recommended for the polytechnic sector where a staff member has technological knowledge that is in demand from industry partners.

CRIs

Recommendation 2.2 Introduce incentives for CRI staff to:

(i) Move into industry after a period of employment in the CRI sector to transfer R&D capability to advanced technology industries.

(ii) Engage with commercialisation, by adopting a standard policy that allows a share of IP benefits in the form of a performance bonus or royalty share to researchers who are actively involved in successful commercialisation initiatives.

More Flexible Approaches to IP Rights

Recommendation 2.3 To maximise the potential for successful new technology innovations, develop more flexible approaches to IP rights under which university or CRI IP or specialist knowledge may more easily be transferred to an industry partner or to a spin-out venture funded by external investors. Seek more flexible share-of-benefits arrangements that may not necessarily be equity or royalty arrangements, but could be success-based funding of staff positions or of student scholarships with or without an equity or royalty component. Look for long-term partnerships to achieve long-term benefits.

R&D Awareness and Knowledge Access

Recommendation 2.4 To enable MSI to introduce R&D awareness to and gain engagement from industry sectors, and improved access to knowledge:

(i) Create an R&D analogue of the NZTE Better by Design programme, which helps New Zealand companies increase their international competitiveness by integrating design principles across their business.

(ii) Promote the existing TechNZ Global Expert scheme and link this to the networking and industry advisory capability embedded in the proposed ATNZ (see Recommendation 1.1).

Increasing Commercialisation from Universities and CRIs

Recommendation 3

Individual commercialisation units should continue to develop or increase capability both through embedded skills and through networked activity, to deliver high quality screening of IP opportunities and increased good quality commercialisation deal flow nationally.

Recommendation 3.1 Build on current networks of commercialisation units to link all universities and CRIs, and create the planned National Network of Commercialisation Centres (NNCC). This network should also enhance linkages to industry partners.

Recommendation 3.2 Provide an NNCC coordination office that would deliver support to the networked commercialisation offices by facilitating administrative services, database management and connections to wider investor and technical expert networks. This would include:

(i) Networking to Economic Development Agencies (EDAs), angel and venture capital investor groups, technical experts, national and international IP lawyers and other businesses.

(ii) Creation and management of databases for technical expertise, investor contacts and so on.

(iii) Connection through the ATNZ hubs (see Chapter 4) to businesses and industries needing commercialisation advice.
(iv) Assistance for individual research organisation units to obtain expert input to IP commercialisation decisions or to connect to similar technologies under commercialisation in a different organisation in New Zealand or overseas.
(v) Encourage and support networking activity and the operation of regional cross-sector groups in each of Auckland, Wellington and Christchurch.
(vi) Administrative support for network operations such as meetings, travel, database maintenance, Pre-seed Accelerator Fund (PSAF) contract expenditure monitoring and reporting.

<u>Recommendation 3.3</u> University and CRI commercialisation units should develop or increase embedded capability to deliver high quality screening of IP opportunities and increased deal flow, through:

(i) Appointment of directors with international business experience, and business development managers with the necessary technology backgrounds to identify and effectively screen commercialisation opportunities, existing competition and prospective connections to similar technologies and strategic partners in New Zealand or overseas.
(ii) Governance or advisory boards that bring to the commercialisation decision process a wide range of knowledge of, and expertise in, international markets.
(iii) An actively managed database of accessible technical and business experts across a range of technologies who can be summoned to give additional advice on potential technology opportunities.
(iv) The services of the best (international) patent lawyers, aggregating demand if possible across several institutions and/or commercialisation centres to obtain services at lower cost.

<u>Recommendation 3.4</u> In addition to the enhanced access to investors enabled through the NNCC, university and CRI commercialisation units should enhance their linkages to angel investors and investor syndicates and seek to establish serial successful commercialisation venture partnerships.

International Recruitment of Skills

<u>Recommendation 4</u>

Implement a study to determine where the professional skills gaps are in the New Zealand research organisations and advanced technology industries. Then launch an international talent attraction campaign including repatriating talented New Zealanders through a dynamic "Bring Back our Brains" programme. The programme would aim to attract top scientists, engineers and business people who are working overseas, but also to create a "buzz" in New Zealand during the process. Implement this programme by expanding the existing Royal Society of New Zealand Rutherford Foundation initiatives, using a talented and creative advertising firm, and encouraging the universities, CRIs and industry partners to run talent search campaigns at the same time.

(i) For universities: the programme would include creating new paid positions for or co-funded by the Government for three years (including a start-up research grant) and subsequently paid for by the university.

(ii) For the private sector: introduce the programme to create new positions co-funded by the Government and the company for the purposes of a new R&D programme within the company. This could take place as a part of current TechNZ funding, for a defined period, for example, three years.

Enlarging the Talent Pipeline

Recommendation 5
In order to meet the demand for skills that are and will be required by New Zealand's high value manufacturing and services sector, current education policy settings and initiatives should be revisited.

Recommendation 5.1 Review policy on tertiary education tuition subsidy limits, which has led to capping of enrolled student places, with the aim of enabling universities to enrol students in the areas of Sciences and Engineering that are in demand, without penalising other disciplines.

Recommendation 5.2 Reinforce initiatives to engage under-represented groups in the science innovation system through secondary and tertiary education (for example, women remain under-represented among engineering graduates and Māori and Pasifika are under-represented more generally in the science disciplines).

International Collaboration and Agreements

Recommendation 6
The Panel recommends that New Zealand should research and subsequently increase the number of international research and development collaboration agreements in strategic areas for the HVMSS, in both large research infrastructure and areas of basic and applied research that support capability development in this country. R&D collaborative agreements between specific companies and overseas partners should also be encouraged.

Recommendation 6.1 Pursue targeted bi-national and company-to-company agreements in science and technology areas that support the HVMSS. Bi-national agreements for co-funded research projects could be pursued with countries where there are existing (largely unfunded) cooperation agreements such as China, Japan, Korea, France, Germany and the United States of America, but also others such as Australia, Taiwan, Israel and Singapore. This should include continuing negotiation for improved access to international organisations like the European Commission Framework Programme for Research and Technological Development.

Recommendation 6.2 the Panel recommends continued and new membership in mega-research infrastructure projects in order to participate in advanced international scientific research that requires shared infrastructure investment. Examples of existing participation include the Australian Synchrotron project and the European Organization for Nuclear Research (CERN) Large Hadron Collider. Priorities for such memberships should be reviewed every five years.

Raising Awareness in Business

Recommendation 7

Increase visibility and awareness of technology developments and the value of innovation and the successes achieved by the sector through networking and promotional events.

Recommendation 7.1 The formerly TEC-funded Priorities for Focus (PFF) technology showcase events currently hosted by university research, and commercialisation offices should be extended to continually increase mutual awareness of R&D capability and innovation opportunities between the university, polytechnic, CRI and industry sectors.

Recommendation 7.2 In the case of CRIs, tertiary education institutions and other research organisations, the senior organisational leadership should increase the promotion of and publicity for successful business–industry partnerships and technology commercialisation from research, to motivate their organisations to move towards a more outward-looking innovation culture.

Investment to Catalyse Innovation

Prioritising and Driving Value from Government Investment

Recommendation 8

While maintaining sufficient investment capability to foster serendipitous discovery and innovation, MSI should select a number of advanced technology platforms as a focus for TechNZ funding of R&D. In order to achieve scale in particular industries, New Zealand should concentrate on niche areas, for example, biotechnology, processing, electronics and embedded systems, mechatronics and robotics, sensing and scanning devices, medical technologies, advanced materials and manufacturing technologies (including plastics), pharmaceuticals (only to early IP licence stage), agri-technologies, digital and ICT technologies. The basic research focuses of Recommendation 14.1 would service these platforms.

Recommendation 9

The investment in TechNZ grants, including Technology Development Grants and Technology Transfer Vouchers and the Pre-seed Accelerator Fund, should be increased as programmes become established and industry demand increases. Such grants should continue on a partner co-funding basis. In future policy design, the Government should consider models

that provide for repayment of a proportion of a grant where the funded project has led to commercial success, to allow for reinvestment back into the TechNZ investment fund.

Recommendation 10

Maximise early stage international market intelligence input into technology development funding. MSI should continue and enhance its collaboration with NZTE to provide better market information, in parallel with MSI, early in the investment process. This will inject additional high quality market input into the decision process around development support for advanced technology projects at as early a stage as possible.

Recommendation 11

Continue the move towards collaborative investment in large research infrastructure, as exemplified by the planned investment in High Performance Computing. New high-cost physical and/or communications infrastructure that is required for clusters of industries and university research groups should be established on a cooperative basis and located to best serve the community of researchers (in universities, CRIs and industry) and on the basis of co-funding where appropriate by partner industries.

Recommendation 12

Leveraging private sector investment is a key factor and important for all government investment in private companies, but consideration of a graduated scale of co-funding may provide an incentive for engagement of new players.

Recommendation 12.1 Industry co-funding should continue to be used for all government investment in private companies, with the level of the matching customised for each programme of support. To engage new participants in schemes such as the Technology Transfer Voucher, a graduated scale of co-funding should be explored, which could provide, for example, a more substantial government funding component for small companies on their initial project engagement.

Recommendation 12.2 Government should continue to collect and use for future investment decisions statistics on commercial success of companies that have received government funding. Among other things, this can be used as a public relations factor – to attract more private funding to R&D and to assist future government funding allocations.

The Big Picture – How to Make an Even Greater Impact

Oversight and Leadership

Recommendation 13
Form a Science and Innovation Council, led from a very senior ministerial level in Government, with representatives from the university, public and private research organisations and from industry. Members should represent a wide range of science and technology themes, including the social sciences. The role of the Science and Innovation Council should be to establish a national innovation strategy and advise on science and innovation policy and priorities.

Reinforcing the Basic Research Platform

Recommendation 14
The Panel recommends that New Zealand maintain its commitment to basic and applied research through MSI and other government science funding, but, as funding increases allow, give more emphasis to engineering and the physical sciences.

Recommendation 14.1 Along with investments in life sciences, New Zealand should prioritise areas of research in engineering and the physical sciences that are essential for innovation in advanced technology, including computer science, mathematics, neural-computation, mechatronics, robotics, smart devices and embedded systems, information and communications technologies and media. New Zealand should prioritise areas of the sciences where it is capable of playing a leading role given its capital and capability base and where there is the potential to deliver advanced technology products. For example, the application of computer science and mathematics in neural-computation or mobile health products, media and cyber security, are areas that offer the potential for high value exports. Advanced research in, for example, agriculture, oceanography, water, aquaculture, geology and forestry and bio-ecology, should continue at both the basic and applied levels. Among other factors, these are essential to ensuring long-term sustainability of our living environment.

Funding support would be through:

- individual grants and scholarships
- collaboration grants (for researchers from different universities, CRIs)
- interdisciplinary and emerging technologies grants (for cross-disciplinary research)
- Centres of Research Excellence (CoREs).

Recommendation 14.2 Maintain, in real terms, the existing level of funding for basic and applied research through MSI and other government science funding agencies. This funding should be part of a wider long-term agenda to increase funding levels into the tertiary education and CRI sectors to provide world-class facilities and enable the appointment and retention of top staff from the international talent pool.

Education – Creating the Next Generation of Innovators

Recommendation 15

Introduce initiatives to produce a new generation of young people inspired to move into creative and entrepreneurial careers in the Sciences and Engineering.

Recommendation 15.1 In order to begin filling the funnel at an early age, launch a major national campaign encouraging young people to choose science and engineering career paths. This campaign should include success stories of start-ups in the media, science programmes on television, school advisors connecting science education with technology advances, sustainability and nature conservation, presentations in schools, and, for example, role models presenting to groups of science-gifted girls, Māori and Pasifika. It should include social media campaigns as well as traditional media. Growth in numbers of graduates ultimately moving into careers in the sciences and engineering must be balanced by many choosing careers in business, design and the creative arts to ensure that a vibrant innovation culture continues to evolve.

Recommendation 15.2 Establish new government funds for PhD scholarships in the priority areas of Applied Sciences and Engineering (see also Recommendation 15.3) for R&D capability building. These scholarships should be larger than the usual type of university PhD stipend. They should be prestigious and competitive.

Recommendation 15.3 Increase funding into the existing MSI capability-building schemes (such as the current Technology Fellowships) to enhance the level of knowledge transfer into industry sectors and capability building through:

(i) Industry-based and co-funded Masters and PhD programmes in applied science and engineering. Universities would build partnership programmes with industries in their region. Students would spend the bulk of their time in the company under joint supervision of the university and the industry partner. A flexible approach to IP rights should go hand-in-hand with this scheme, with agreement at the commencement of projects on the allocation of financial benefits that would follow successful commercialisation.

(ii) Industry co-funded employment of graduates in science and engineering. This is a partnership scheme in which recent graduates or postgraduate students work on an industry-based problem where the supervising academic and industry partners give joint oversight to the project-based employee.

Recommendation 15.4 Develop a new generation of graduates with international business skills that address the shortage identified by various commentators[15] by ensuring that New Zealand has a premier international business school, probably based in Auckland. This should evolve through enhancement of present programmes at one of the existing business

[15] New Zealand Institute: *Standing on the Shoulders of Science: Getting More Value from the Innovation Ecosystem*, 2009; *A Goal is Not a Strategy: Focusing Efforts to Improve New Zealand's Prosperity*, 2010; and *Plugging the Gap: An Internationalisation Strategy*, 2010 (available at www.nzinstitute.org.nz).

schools or as a collaborative venture across two or more. Student international business entrepreneurship projects would be integral to the academic programme. It should involve successful New Zealand international business entrepreneurs in guest teaching, mentoring and sponsorship of academic positions and scholarships in the school.

Academia Engagement with Business and Industry

Recommendation 16 [16]

If the TEC Performance-Based Research Fund (PBRF) continues in (or close to) its present form after the 2012 PBRF Quality Evaluation, introduce a separate but similarly performance-based fund that:

- **(i) Recognises excellence in innovative work in the areas of applied sciences, architecture, design, engineering and technology.**
- **(ii) Would likely be linked to business and industry co-funding for postgraduate students and/or partnered projects.**

Making and Incentivising Investment in Advanced Technology Businesses

Recommendation 17

The Panel recommends that the New Zealand Government should take proactive steps to lift the level of local and foreign investment in the New Zealand HVMSS.

Recommendation 17.1: The Government should "court" multinational companies to establish local industry collaborations and establish R&D facilities in New Zealand. Ideally, such initiatives should be led from the highest political level (in some countries this has been the Prime Minister) and should include incentives for foreign direct investment.

Recommendation 17.2: The Government should take steps to attract international venture capital to invest in new start-up companies, and other foreign direct investment into established industries, by raising ongoing awareness of the opportunities in New Zealand and considering other incentives.

Recommendation 17.3: The Government should encourage the investment of a small proportion (for example, 1%) of the New Zealand Superannuation Fund and Accident Compensation Corporation Fund in advanced technology companies in New Zealand.

The Goal of Increased Investment – Both Private and Public

Recommendation 18

Set a target of matching OECD average public sector investment in R&D within 10 years and using increased investment to leverage private sector investment. This recommendation

[16] **Note:** As Principal Moderator for the 2012 PBRF Quality Evaluation and potentially involved in the 2018 PBRF Quality Evaluation design, the Panel Chair felt it necessary to stand aside from this recommendation.

addresses the country's long-term investment in R&D and should be the subject of a follow-up project.

Recommendation 18.1 Increase public funding by 2.5% per annum or more in real terms over a 10-year period to place public investment in research and innovation at least at the OECD average level. The Panel believes the eventual target should be above the OECD average in order to drive performance in the innovation sector.

Recommendation 18.2 Use the increased public funding to leverage significantly increased innovation investment from the private sector. The target for the private sector investment increase should be much higher. It is instructive to note that for the private sector to lift its investment to the OECD average in 10 years would require a 30% per annum increase.

Roles and Funding of ATNZ – the Future of Industrial Research Limited

Recommendation 19 ATNZ Business Model: Operating Structure and Roles

The Panel recommends that the ATNZ should have an operating structure and roles as follows:

(i) ATNZ would be a Crown-owned company, operating on the basis of reinvestment of any operating surpluses and driven by industry needs rather than blue-skies research.

(ii) The emphasis for ATNZ would be on "development" rather than "research" but it would retain some embedded science and engineering research capability and would link strongly to universities and other research organisations as well as to industry.

(iii) ATNZ science and engineering staff would be engaged primarily in market-led industry projects in both technology and market identification and characterisation roles.

(iv) ATNZ would be geographically located at key sites in Auckland and Christchurch, but with continuation and transition to the new focus at the Wellington Gracefield site. Establishment of the two new sites would begin as soon as possible.

(v) Ideally, the ATNZ sites will be collocated with technology start-up companies and, possibly, specialist technology research centres.

(vi) ATNZ would be framed around a series of advanced technology platforms that relate to its industry sector focus which are not covered by sector-specific CRIs.

(vii) Technology platforms for ATNZ could include:
- Microelectronics and embedded software systems (a generic field covering medical technologies, electronics, mechatronic devices and others)
- IT & Telecommunications
- Electro-optics

– Alternative energy systems
– Advanced materials and nanotechnology (including plastics)
– Advanced manufacturing technology
– Marine technology
– Future: Nano-bioelectronics.

(viii) At the time of the creation of ATNZ, consideration should be given to moving selected research platforms from IRL to one or more universities or to other CRIs.

(ix) Some R&D specialisations that currently exist in other CRIs could be considered for transfer to ATNZ, or vice versa, if this contributes to creating relevant critical mass of related R&D activity.

(x) ATNZ would provide a location for shared use of high technology R&D equipment and IT services.

(xi) ATNZ would offer a portal for information or specialised knowledge enquiries from the industry sector, also providing connections into more sector-specific research institutions and associations.

(xii) The ATNZ sites would offer a hub for industry–institute (including CRIs)–academia networking, joint project activity and for connection with other R&D service providers such as specialist research centres, the NNCC, incubators, research associations and private research laboratories.

(xiii) ATNZ would aim to create an internal culture that encouraged the mobility of staff to feed talent into industry sectors. Most scientists and engineers would be expected to remain in ATNZ for not longer than 10 years and would be subject to incentives to move into industries.

(xiv) The ATNZ should work in association with the Metro Group[17] of polytechnics, to provide staff consultancy to industry on product and/or process development and on production problem-solving projects on a subsidised basis. For example, projects could be effectively co-funded through a partial in-kind contribution of staff and student time.

<u>Recommendation 20</u> ATNZ Business Model: Governance and Investment

The Panel recommends that the ATNZ should operate under the following governance and funding framework:

(i) ATNZ would have an independent Governance Board appointed by the relevant Ministers with a majority of business appointees (including the Chair). The Board would include representatives from the applied science/engineering research sector as well as international members.

[17] The Metro Group consists of: Christchurch Polytechnic Institute of Technology, Manukau Institute of Technology, Otago Polytechnic, Unitec Institute of Technology, Waikato Institute of Technology and Wellington Institute of Technology.

(ii) ATNZ would receive core government funding but would be tasked with leveraging government funding with at least equal funding from industry-linked contracts. It is expected that the level of industry contribution to project funding would range from half to two-thirds of the total contract value.

(iii) The future size of ATNZ would depend on the available investment envelope and industry demand and co-investment but the Panel foresees an effective target size of between 600 and 1,000 professional full-time equivalent (FTE) staff (current IRL staff 320) across the three sites. The significant majority of the professional staff should be engineers and those with applied science skills including those in new and emerging areas of interest to business.

(iv) ATNZ and its industry partners should be able to use project funding flexibly across project costs, including labour, financial and legal services, equipment and consumables, subject to meeting independent external audit requirements.

(v) Among key performance indicators for ATNZ, the following, if able to be clearly linked to ATNZ interventions, would help show that ATNZ was succeeding in its partnerships with industry:

- Revenue growth and export market development of project partner companies.
- Employment growth in existing companies or in new companies that are created through ATNZ–industry partnerships.
- The number of new product launches as a result of project partnerships with existing partner companies.
- The amount of new foreign investment secured by companies as a result of project

Seven priority actions will set the stage for constructive change

All of the Panel's foregoing recommendations are considered important to give an integrated suite of actions that would drive change across different groups and sectors that contribute to New Zealand's innovation system. In the following, the Panel has set down what it sees as priority actions that set the stage for constructive change.

Priority 1

1. Commence the reshaping of IRL as ATNZ. (Recommendations 1.1, 19 and 20).
2. Set up dialogue within government on reviewing the policy on tertiary tuition subsidy limits, in relation to meeting industry demand for graduates in areas of the Sciences and Engineering. (Recommendation 5.1).
3. Proceed with the National Network of Commercialisation Centres, concurrently promoting stronger commercialisation units in the research organisations. (Recommendation 3).

Priority 2

4. Set up a joint MSI–MoE Innovation Task Force with universities, CRIs, polytechnics and industry representatives to work towards:
    - More flexible employment and performance incentive arrangements to enhance R&D collaboration, staff mobility and knowledge transfer.
    - More open IP management strategies to better support national economic development. (Recommendation 2)
5. While remaining open to serendipitous advanced technology opportunities, determine priority investment areas based on the NZTE market input and identified advanced technology platforms for industry, and focus new investment more heavily in these areas, increasing investments in partner co-funded grant schemes such as Technology Development Grants, Technology Transfer Vouchers, Pre-Seed Accelerator Fund, Global Expert, and Technology Fellowships in the priority areas as budget allows. (Recommendations 8, 9, 10 and 15.3)

Long-term Strategic Priorities

6. Form a Science and Innovation Council, led from a very senior ministerial level in Government, and develop a long-term science and technology investment strategy. (Recommendations 13 and 18)
7. Working across MSI, MoE, MED, implement:
    - A campaign to attract international and New Zealand-citizen talent from overseas to New Zealand to fill essential capability gaps.
    - A major "young brains into science and engineering" campaign, supported by scholarships.

    (Recommendations 4, 15.1 and 15.2)

Appendix: Independent Panel Members

Professor John Raine (Chair) is the Head of the School of Engineering and Pro Vice Chancellor – Innovation and Enterprise at the Auckland University of Technology. John has had long term involvement in setting up university commercialisation operations, and was co-founder of WhisperTech Ltd, the Canterbury Innovation Incubator and the HITLabNZ. He has been a member of the MED Design Task Force, and the Governance Boards of the MacDiarmid Institute for Advanced Materials and Nanotechnology, and of IPENZ. He is currently chairs REANNZ Ltd, the Crown owned Company managing the KAREN advanced broadband network, and is Principal Moderator for the 2012 TEC Performance Based Research Fund Quality Evaluation.

Professor Mina Teicher is the Director of Emmy Noether Research Institute for Mathematics at Bar-Ilan University. Mina has previously held post of Chief Scientist at the Ministry of Science Culture and Sport and Director General at the Ministry of Science and Technology with the Israel government. Mina is currently a member of the Uniservices Stage Gate Investment Management Committee. Mina is widely credited for the development of the innovation sector in Israel.

Phil O'Reilly is the Chief Executive of Business NZ, New Zealand's largest business advocacy group, representing thousands of businesses of all sizes. Phil chairs the Capitalising on Research and Development Action Group (CRAG) and the Government's Green Growth Advisory Group. Phil is a member of the MSI Innovation Board and was previously a member of the Board of the Foundation for Research Science and Technology. He is also a member of the Council of the Royal Society of New Zealand. Internationally, Phil represents New Zealand employers at the International Labour Organisation (ILO) and is a Board Member of the Business & Industry Advisory Council to the OECD.