Mid-Course Correction: A Strategy for Innovation, Research, Science and Technology

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INTRODUCTION

In September 2002, the Minister for Research, Science and Technology (RS&T) commissioned a rapid review of New Zealand's Science and Technology system by saying that he was looking for lateral, not radical thinking. He asked what could be done to build confidence, boost private sector investment and identify bottlenecks to improving the system.

New Zealand is not short of ideas. A series of reports on science and innovation has appeared in recent months. All agree that stronger government leadership and clarity is needed. This paper from the Royal Society highlights some of the emerging needs. In a few pages, it does not purport to be fully comprehensive or exhaustive in its coverage, nor does it reassess the evidence base commonly quoted in many other reports. This does not mean that there is no need for closer scrutiny and exposure of such "evidence to peer review. At the heart of the Society's proposed strategy are four major elements:

- **Vision**: New Zealand needs political leadership from the highest level, informed by expert knowledge and public processes, which produces a vision for future directions that are clearly expressed and broadly agreed to.
- **Focus**: New Zealand must further clarify the target areas that are to be given priority. Prioritisation is essential, as NZ has limited resources to carry out R&D at a globally competitive level. The process of prioritisation must be transparent and the reasons behind decisions exposed to public gaze, to check the validity of the arguments and achieve buy-in to the methods of achieving goals.
- **Commitment**: An innovative society is built on human capabilities and a willingness to provide the long-term support necessary to establish careers and infrastructure needs. In order to acquire and then harness those capabilities, New Zealand's strategy must encompass the time-scales associated with higher education and professional employment.
- **Investment**: Government must align investment more closely to the needs of the country.

This paper is organised under three headings:

1. The main drivers for sustainable economic growth, and RS&T's place among them.

2. New approaches, policies and instruments in support of economic growth and innovation and in the application of social and environmental knowledge in the service of sustainable economic growth and sustainable use of the natural environment

3. Incentives for effective public/private partnerships in support of growth and innovation

1. THE MAIN DRIVERS FOR SUSTAINABLE GROWTH

- **show political leadership at the highest level, informed by expert knowledge and public processes**
- **integrate government planning for sustainable stewardship of the environment, social well being, and economic growth arising out of new ideas, their successful application, and broad appreciation and management of risk**
- **create an entrepreneurially spirited, technologically literate, private sector**
- **maintain a formidable and world-class capability for scientific research**

We take the view that growth implies stewardship of our environmental, social and economic resources in such a way as to enhance the state of each, and the flow of services from each for the good of New Zealanders. While the research underpinning each of these areas is low in quantity it is high in quality. However, the uptake of research for value-added purposes remains catastrophically low in New Zealand.

The main driver for growth lies in the application of new ideas in the environmental, social and economic areas. New Zealand has established a Growth and Innovation Advisory Board (GIAB) to advise on economic matters, and has instituted task forces to define ways ahead in our Information and Communications Technology, Biotechnology and Industrial Design sectors. New Zealand also needs a Sustainable Development Advisory Board (SDAB) to work with GIAB and others to ensure the integration of environmental and social aims, and limitations to economic growth. Both of these bodies should report to the Prime Minister and interact with government ministries.

On the economic front, pushing solely from the research side will not bridge the divide between industry, public policy needs, and research. Currently, small companies simply cannot fund research except when they are effectively subsidized by the researcher. One driver that would reinforce New Zealand's science community more than any other would be the presence of an entrepreneurially spirited, technologically literate, private sector. A suite of policies and instruments is needed to create a

thirst in industry for innovation, enterprise growth, and aggressive exporting. One instrument would be funding for the short-term placement of our best technology graduates in leading-edge global technology companies to gain familiarity of their commercialisation processes. Of the 280,000 or so firms in New Zealand, only a few dozen currently export at any significant value, but several thousand could be described as export-ready, given the right conditions, which could include training and awareness programmes, grants programmes that reward innovation for export purposes, and targeted tax relief. The main thrust of New Zealand's industry policy should be aimed at these export-ready companies.

On the environmental front, New Zealand is in urgent need of improved knowledge and application of existing knowledge to environmental management. Understanding of the functioning of natural environments, environmental variability and its drivers, and knowledge of natural processes can be applied to improved renewable resource management, reduction of pollution, conservation of habitats, and in assessing risk that natural environmental variability can deliver to users of resources that are impacted by natural processes. Similarly, social science research not only assists in improving human health and welfare but also should make a large contribution to understanding the impacts on the economy of not formulating well-informed policy on areas such as the relationships between income, nutrition, early childhood rearing and effective teaching at pre- and primary school levels on the supply of skilled labour and reduction in numbers needing long term state support.

We stress that the greatest urgency lies in creating a well-educated work force and technologically literate, private sector. This will not be achieved with current policies; neither will it be achieved overnight. The implication is that a relentless emphasis on technology transfer by Crown Research Institutes will fall on stony ground, in New Zealand at least, for some years to come. In the Royal

Society's view, CRIs have a strong role to play, and need to concentrate more on underpinning capability development in readiness for increased industry maturity. In the meantime, CRIs' route for commercialisation may well lie with enterprises overseas. Put crudely, New Zealand has an under-demand for industrially-orientated research in the sense that it cannot yet use it domestically, and some CRIs must look overseas for markets. This involves partnering with other organisations and investors who recognise the skills and cost effectiveness that New Zealand has to offer to them. While these markets will contribute only marginally to New Zealand's short-term growth, they will allow New Zealand to build knowledge platforms as future springboards.

2. NEW APPROACHES, POLICIES AND INSTRUMENTS

- **train the S&T community in dialogue processes to engage in debate as part of society**
- **Ministerial policy units must include science advisers, and key science-using ministries should create chief scientific adviser positions**
- **create incentives for foreign direct investment, and research in export-oriented firms and start-ups**
- **improve evidence-based approaches to decision making on environmental and social issues**
- **improve the ability of environmental and social research to contribute to economic growth through risk assessment using knowledge obtained by these research sectors**
- **increase both basic and user-oriented research double funding in the Maori, Social sciences, and Excellence (Marsden) areas**
- **encourage industry applicants for the Research for Industry fund (require at least 50:50 leverage for the fund)**
- **nurture talented people, informed of workforce needs, with lower student debt, more stable and promising careers, and competitive pay**
- **reduce the 100% dependence of CRIs on contestable funding, fully fund their core activities with regular external review, and create a national fund to purchase/operate high value national S&T equipment and asset**

Science in Society

The science that confronts people in their daily lives generates real controversy and demands a more consultative approach to decisions. Science organisations must be enabled to provide scientists with encouragement, training and incentives to engage more regularly and effectively with the non-specialist public. Scientists must be able, as well as willing, communicators. The public must feel confident in what scientists are trying to do on their behalf. All sections of society should have the chance to understand and engage with it. It is now essential to fund and train the S&T community in dialogue processes to engage in debate as part of society.

As a corollary, policy analysts need to confront the fact that lack of transparent and open public processes leaves a number of stakeholders without a forum to express their views and to receive feedback concerning subjects such research in the service of sustainable resource use.

Science in Government Policy

Science is now an essential component of some of the biggest policy issues facing governments today, such as food safety, water quality and global climate, but government remains structured to emphasise

economic advice with little or no science input. Both scientists and economists should be able, and funded, to advise on what is known and what remains unknown or subject to risk, but neither discipline is well equipped to assess public reaction to risk.

Government (local and central combined) is responsible for approx 40% of GDP. Many extremely important areas of our national life are the direct responsibility of government operations. Yet changes in the structure and operations of government departments lack analysis of evidence, or sustained attention to outcome evaluation and feedback. For our national RS&T/Innovation strategy to succeed, ministries and agencies must engage with and implement evidence-based decision-making. Policy options should be based on good scientific evidence, but responsibility for policy must ultimately lie with governments, rather than with working scientists. To achieve this, ministerial policy units must include science advisers, and key science-using ministries should create chief scientific adviser positions.

Science in regional/local government also represents an important dimension. Councils have extensive influences over whether the constituent parts of New Zealand develop in an

environmentally sustainable way everything from regional planning and development of roads and public transport through to emergency management and coping with natural disasters. These groups need access to social and natural sciences advice but uptake, mechanisms, and ability to pay vary markedly across the country.

Industry Incentives

The Royal Society sees a need for new approaches in the Vote Economic Development to include incentives for foreign direct investment in order to create skilled employment opportunities for New Zealanders, which will increase industry awareness of overseas best practice, and have multiplier effects across all business. Tax incentives for research (especially targeted to companies intending to export) and for export-oriented clusters, would also put New Zealand on an equal footing with other countries. Government should also consider research grant and tax subsidies, focussing on start-up businesses and encouraging industrial R&D, that match those available to businesses elsewhere. There is also room for a pre-seed fund to address the "Innovation Progression Gap" the discontinuity in funding and commercialisation resource between research and market ready opportunities.

Aside from monetary incentives, the biggest single assistance for technology is information. The world's technical literature is spread over thousands of journals, and private researchers simply cannot afford e-

subscription to each one they need. New Zealand needs to provide affordable e-access to private subscribers.

Role of Environment Research

We see a need for Government and its advisers to form and present a clear view of the environmental research that it needs to achieve its goals. The role of institutions that fund, provide, and apply research, need to be clarified along with the role of the acquisition of basic, underpinning information. Quite often scientists get ahead of advisers and Government's preparedness to act, and this needs to be addressed. There also needs to be an appreciation at the highest levels of the contribution that research on environmental variability and biological processes has on the assessment of economic risk.

Role of Social Science Research

Government departments possess few or no means to carry out social science research that informs effective policy making. There is an important role for government to be clear about what research it needs, how it will be applied, and the appropriate institutions to carry out the various roles.

Research Incentives

It is essential that the aims above be supported by research, and the Royal Society argues strongly that the two ends of the spectrum user-oriented research and research which underpins and builds human capabilities must continue to be strengthened. Around the world, Government and private sector track record is less than perfect in picking science winners. Hence the need to ensure appropriate levels of underpinning science. International linkages and information flows are essential to New Zealand's scientists, and international exchange opportunities should be broadened. There is also a need for greater research emphasis on examining scientific and technological literacy in both compulsory and tertiary education.

Research for Industry

Technology New Zealand requires 50:50 joint funding, and the new consortia will aim for something similar, but new budget investment in these two areas amounted to about $10m, which will prise a matching $10M out of industry. The $100M Venture Investment Fund requires matching by $200M from the private sector, but will take time to build, and arguably, might raise some $50M extra private money per year. The Foundation's Research for Industry (RFI) fund currently has no firm rules on private sector contributions.

All the above totals to less than $100M of new private sector investment in R&D annually considerably short of the quantum leap of about $1B that New Zealand needs, if it hopes to reach the OECD average of 1.2% of GDP invested from industry. If Government's vision of returning to the top half of the OECD is to gain any ground at all, then every dollar from government's Research for Industry fund must lever at least a dollar from industry, and preferably two dollars. One way to encourage industry participation would be to make a portion of the fund available for industry lead applicants only. Even this will not be enough, and aggressive industry and fiscal policies will be needed to encourage the private sector to invest a further $600M.

Building Capability

Nurturing and challenging talented people are essential to achieving a knowledge society. The broad parameters to be addressed in any strategy to develop the best scientific talent include:

1. education and training not just in terms of volume but also matching supply with demand for a skilled workforce of scientists, technologists, technicians and support staffs

2. attracting sufficient students and apprentices into developing areas of science and technology

3. recruiting a skilled workforce from those recently trained in New Zealand and by migration

4. retaining a skilled workforce both New Zealand-trained and immigrant

5. negative factors affecting job security, training, recruitment, retention and attraction back to New Zealand including:

- provision of public processes that signal the reasons for policy, priority, and funding changes and their downstream impacts
- short duration of contracts for people starting careers in relation to the normally long duration before research outputs are achieved
- personal debt resulting from the student loan scheme
- the lack of early career support systems
- low pay

An urgent challenge is to re-stabilise the RS&T work force by favouring longer, rather than shorter, research contracts. Allied with this there must be a change to employment conditions so that when a problem is solved, staff are rewarded financially.

In building capabilities, three of the small Vote: RS&T funds should be doubled: $4.3M for social research, $4.5M for Maori research and $30M for excellence-based research. None of these funds is currently effective in building any enduring capacity or critical mass for research in these areas.

With industry unready to engage with the full force of CRIs, now is the time to strengthen their role in building capabilities. This will not be achieved by forcing a scramble for every contestable dollar, but by assuring a portion of stable funding to allow CRIs to develop promising ideas and promising people. The Royal Society supports the view that CRIs need a portion of funding to be supplied by their owner, the government. In some cases where true contestability cannot exist because of a limited range of providers, decisions on funding could be ceded back (with appropriate reporting mechanisms) from the Foundation for Research, Science and Technology to appropriate CRIs.

A particular application of this is in the funding of national collections and databases. Overall funding collections and associated databases must increase and support for collections of national significance, wherever they are held, should be negotiated with the relevant providers, with annual adjustments for inflation.

Lastly, New Zealand has also fallen behind the rest of the world in the area of very expensive items (greater than $1M) and increasingly equipment intensive science can no longer be carried out here. The provision of especially large items may need the formation of special inter-institutional consortia. Within the framework of an increasing national investment in RS&T, a case can be made for the formation of a large equipment seeding fund.

3. INCENTIVES FOR EFFECTIVE PUBLIC/PRIVATE PARTNERSHIPS

- **consolidate present "silo" funds for research into nationally available funds**
- **encourage industry direct application for Research for Industry funding**
- **use fiscal measures to encourage the development of new knowledge-based companies**
- **establish return provisions to allow researchers to return to research if they wish**
- **align R&D tax measures with international competitors**
- **encourage gifting and endowments through tax provisions**

Consolidate Silo Funding

New Zealand's science reforms have to a large extent made CRIs and universities competitors for funding and this has had the effect of driving

a wedge between them. For example, funding for Centres of Research Excellence (CoREs) is available to the tertiary sector only, while such centres are necessarily national in character. Similar effects can be found in other funds reserved for

universities or CRIs. They do not encourage collaboration in the national interest. New Zealand must find a research funding process that does not have this effect.

To achieve the highest possible returns on investment the various parts of the New Zealand innovation system must be closely integrated. Strengthening horizontal links between CRIs and universities would strengthen the national research network. The providers of knowledge, skills, human resources and capabilities must work closely together, and with those who benefit from them. The recent move to reduce the level of destructive competition for the small and (until recently) shrinking, pool of R&D funding is to be welcomed. Likewise the Government encouragement and support of closer links with industry and other users of R&D are to be applauded.

Build avenues for collaboration

New Zealand must encourage closer links between CRIs, industry and universities through joint R&D, and Technology Transfer projects to increase the effective pool of researchers available to work on a selected topic. Government must reduce the burgeoning costs (in resources, time and morale) of compliance and accountability in New Zealand that are alienating our current science and technology providers, deterring recruitment to science and technology and potentially stifling innovation.

A stronger and more deliberate focus is needed on educating the research and the industry communities on the principles of commercialising research. Measures might include encouraging industry direct application for Research for Industry funding, and consolidating a number of small funds reserved for CRIs or universities.

Consortia should be more actively encouraged, strong leadership on consortia areas of endeavour should be given at Cabinet level, and disincentives to joining consortia, which may exist at industry level, should be removed. We propose that new funding be found, and/or reserved in roughly equal proportions if necessary from Vote RS&T, Vote Economic Development, and Vote Education. Funding should allow consortia to be built from best performing components across the national research and innovation system. Initial fund investment of, say, $10m per year from each of the three Votes, could be followed by new tranches each year of $5m each until the total fund reached a total of $90m per year after five years (eventually to be matched or exceeded by private sector funding).

Support might also be given to companies installing pilot plants close to research institutions. The Royal Society recognises that, where government regulation is involved, the relationship between some researchers and "end userscan be adversarial. Care is needed in bringing such groups together.

Encourage Knowledge Companies

Encourage the development of new companies exploiting high-tech products that might be spin-offs from universities or CRIs through appropriate fiscal policies and support that will minimise the risks of start-up and growth. Measures might include targeted tax relief; direct grants; business assistance through serviced incubators; service provision; and assistance with intellectual property protection. Institutions should also be covered to establish return-provisions to allow university or CRI staff time to establish a spin-off company at minimal risk to their future (e.g. up to six years to establish a business, within which time scientists can return to a similar position to the one they left). Government should also consider further grant and tax subsidies which focus on start-up businesses and encourage industrial R&D, that match those available to businesses elsewhere. Lastly it is now becoming urgent to remove tax disincentives to R&D activities and to alter tax provisions to encourage gifting and endowments.