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**Science New Zealand**

**Submission to the New Zealand Productivity  
Commission enquiry: New Models of Tertiary  
Education**

**Submitter Information**

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## Science New Zealand Inc

Science New Zealand comprises the seven Crown Research Institutes as members, with Callaghan Innovation as an associate member. The Board of Science New Zealand comprises the CEOs of the Crown Research Institutes. Multiple groups drawn from the members work across the membership on areas such as human resources, Maori relationships, marketing & communications, procurement, and science strategy. Some of these groups also incorporate other Crown entities. The groups provide a community of practice and also a forum for collaboration and strategic overview.

The purpose of Science New Zealand is to foster appreciation of the value of science and technology in creating economic, environmental and social wealth for New Zealand and to provide a vehicle for cooperation and coordination amongst and between CRIs and other members. This includes providing policy, organisational, relationship and advocacy support for CRIs in their collective championing of the economic transformation of New Zealand.

The Crown Research Institutes are: AgResearch, ESR, GNS Science, Landcare Research, NIWA, Plant & Food Research, and Scion. Together they provide science research that helps both protect and grow the national wealth and wellbeing, supporting the production of goods and services and enhancing productivity from across the primary sector through to advanced manufacturing and new materials.

The CRIs employ more than 3,500 FTEs, comprising the majority of publicly-funded science researchers in their areas (excluding health and ICT, which are largely the domain of universities). The CRIs are in some 50 locations around New Zealand, of which 20 sites are shared with other CRIs and/or institutions including universities. The total revenue exceeds \$650 million, the bulk of which comes from commercial and government contracts. The CRIs and tertiary institutes – predominantly universities - contract to each other on various programmes and activity so as to maximise specialist knowledge or infrastructure.

CRIs have for many years rated first or second in the OECD amongst government-owned research institutes in attracting private sector commissions. The CRIs have benefited from rising levels of business sector investment in New Zealand and are the largest providers of science research, in our disciplines, to New Zealand businesses.

# Response from Science New Zealand to the February 2016 issues paper from the Productivity Commission: 'New Models of Tertiary Education'

## Introduction

The Productivity Commission has been asked to explore the big trends affecting the tertiary education system, consider how innovative “new models” can help the system respond positively to them, and consider system and institutional settings that encourage or inhibit new models.

“New models” are defined as new and improved ways of achieving an end, such as improved ways of facilitating learning or better ways of delivering tertiary education.

The Science New Zealand response provides observations to help inform the Commission as it prepares a second Report, and refers to only some of the 78 questions set out by the Commission. The response focusses on the productivity benefits to New Zealand which do, or should, arise from the tertiary education system (including its connectedness to CRIs).

## Underpinning ideas:

- The tertiary education system in New Zealand is, as the Report indicates, very different in significant ways from systems elsewhere. Few, if any, other systems have all of its universities ranked in the top 500 of the world with each having at least one subject in the top 100;
- The types of institution in New Zealand are also very different from those overseas, even if carrying similar names. New Zealand’s universities are relatively similar to each other, but have few direct comparators overseas.
- Science New Zealand supports the concept that universities have a broad value to our society, providing economic and social benefits to individuals and the community.
- The tertiary education system is part of a wider national research and innovation system which has developed to meet New Zealand’s needs.
- Tertiary education is not a stand-alone element where change or drivers and incentives have little to no impact on those beyond the circle. As such, the Commission needs to bear in mind:
  - o changes to the tertiary education system should not compromise the separate and distinctive roles of universities and CRIs. Both major sets of entities have been creating greater overall benefit for New Zealand from working together whilst respecting those different roles, purposes and cultures.
  - o TEIs, industry/sectors, and the CRIs are in a trilateral relationship in the New Zealand RS&T context. Each leg is able to develop the most effective relationship with the others, appropriate to the situation. While there are issues arising from the necessarily different structures each has in achieving their core purpose, there is not a need to intervene in how the parties manage their engagement.
  - o A closer study of the CRI/university engagements may well provide useful models for others engaged with TEIs. The diversity encourages innovation which rigid regulation would prevent.

### **Science New Zealand interest**

Science New Zealand has a keen interest in the inquiry. CRIs partner with tertiary institutes in research, staffing and infrastructure; and are also significant employers of graduates - particularly in STEM (science, technology, engineering and maths).

In addition to these direct interests, CRIs also have a stake in greater STEM literacy in the wider society. Tertiary education is a vital element in helping shape the paradigms of the nation's future leaders in both the public and private sectors.

### **Research and Teaching: getting the balance right and addressing value**

The Report refers primarily to teaching and less so to research. The Report Questions touching on research (Q10-13) are in regard to the effects of research on the institution's teaching.

The issue of the value (or otherwise) of the research itself – either to the global community or the New Zealand community - produced by tertiary education is not addressed. Yet that would seem to be an important element of the purpose of being productive.

Thus it would be useful to see more discussion on Box 3, page 28: – *Perspectives on the purpose of tertiary education* where The Treasury's view of the five main functions of tertiary education (1987) is outlined, as is its 2008 comment on the wider importance of skills.

### **Universities as training centres: improving the nation's productivity base**

Science New Zealand strongly supports the view that tertiary institutions and particularly universities have a wider role than simply being training centres for employers. It is, however, an important function, and one of concern to CRIs. Associated with this is the question of "Which employment market – New Zealand or globally?" In other words, how closely should some or all of our tertiary institutions serve New Zealand's national needs for capability development?

There is need for further discussion on how best to balance the individual's right to choose an area of study, and the national capability needs. The report notes that immigration is a larger supplier of skills to the labour market than tertiary education (page 44). This however poses its own issues, as we note below, in ensuring locally-relevant knowledge.

The Productivity Commission's further Report should open up this discussion for wider social input. As for Crown Research Institutes, all have sought to partner with their university colleagues to take practical steps in addressing the questions raised.

### **CRIs as employers**

The Crown Research Institutes employ the majority of publicly-funded science researchers in their areas (excluding health and ICT which are largely the domain of universities), on an FTE basis.

CRIs are put forward by university recruiters as likely future employers for students, particularly at PhD level or above.

The environment in which CRIs operate is dynamic, and thus CRIs are constantly recruiting as people leave and as new skills are required to meet the core purpose of the CRI.

CRIs recruit between 67 to 77 people at PhD level annually (2011-2015 figures). Between 40 and 57 per cent of these are recruited from abroad; with between 4 to 11 of these percentage points being people with a New Zealand degree. So just over one-third to a half of PhD level recruits have no New Zealand training. CRIs report that 38-44 per cent of those recruited in the previous year could not have been recruited in New Zealand.

Recruiting globally brings in new skills and ways of thinking and creates global networks. It is also an endorsement of the quality of work being produced from CRIs, and that CRIs provide an attractive work environment.

The question is, how sustainable is this level of recruitment, given that the global 'talent war' is becoming ever more heated – already, some positions can take over a year to fill.

### **Meeting CRI requirements as employers**

CRIs have expressed concern to New Zealand's universities that too few people are graduating in areas relevant to CRIs, and / or with the New Zealand-relevant knowledge.

There is no concern with the quality of the education and training received by graduates from New Zealand universities. The concern is with the quantity of graduates in some areas which are vital to New Zealand's economic well-being, and with the applicability of their education and training to CRI requirements.

CRIs are focused on issues relevant to New Zealand. Thus they value staff who have New Zealand-relevant knowledge – for example, of New Zealand's flora and fauna (both native and introduced), sectoral histories and current structures, and social environment.

It is possible for students to leave a New Zealand university with little training in matters important to New Zealand's needs. This is not a matter of academic quality which, as international and PBRF rankings indicate, is very high. Rather it reflects the incentives upon universities. The university, the department and the individual are rewarded for advancing global knowledge: publications in high-impact journals are essential indicators in that process; and work has a higher chance of publication in those journals if it is globally interesting as well as being excellent. Global recruitment also helps with rankings as it shows international connectivity.

Those are good things. However, an issue arises if the academic workforce trains candidates using, for example, North American species rather than New Zealand species because the academic is more familiar with the former because their training and/or research interests lie outside New Zealand; or takes lesser interest in New Zealand-relevant issues because New Zealand issues are of lesser interest to high impact journals.

(Clearly, there are many examples of New Zealand based researchers, working on New Zealand issues, being published in high-impact journals. The point is that researchers focused on New Zealand issues are less likely to achieve this, no matter how excellent. That is one reason why New Zealand journals were established and maintained).

The CRIs recognise that the tertiary education model means institutions are agnostic about the issue (although many individuals in the system are not). As shown by the business model of New Zealand universities (*Fig 7, page 11*), institutional survival depends upon being well ranked in global surveys. This drives recruitment of the highest quality staff globally, publishing in high impact journals, and selecting research areas or topics which enable that. These are appropriate responses to the current business model.

For CRIs, however, the apparent low 'local knowledge' factor in the graduate cohort over several years has been deeply concerning. This led CRIs to propose some practical solutions to their university counterparts which built upon the distinctive roles of the two types of institution and created greater overall national benefit.

### **CRI and university engagement: education**

In response, CRIs offered to complement the universities research-led teaching with CRIs expertise in areas relevant to New Zealand. It is notable that the CRI and university publication quality is on a par for field-weighted citation indices; and that senior CRI staff on university rolls are typically A-graded for PBRF purposes.

The result is that now:

- i) CRIs make a considerable contribution to the education of Masters and PhD students (NZQF levels 9 and 10). In 2015, CRIs were involved in the supervision of 645 tertiary students: 441 PhD candidates and 204 Masters students. In 2011, the total was 514, and it has been growing steadily;
- ii) CRIs partner in graduate schools in conjunction with universities and in specialist courses or programmes;
- i) CRI staff hold academic positions, primarily at Professorial or Associate Professorial level. This may be as part time-employees directly paid by the university; or via their CRI employer. The minimum number of hours is 0.2 as this enables the staff member's entire publication record to be counted for PBRF purposes.

### **CRI and university engagement: tech transfer and commercialisation skills, leading to innovation**

The mentoring and co-supervision engagement ensures that a considerable number of students in relevant degree areas coming from New Zealand's universities have contact with CRIs. In addition, CRIs provide internships and work experience.

These multi-level interactions enable students to enter into a commercial or near-commercial environment whilst at university. CRIs business model requires bidding into contestable funds, working with individual businesses and sector groups, and with local and central government. This requires corporate disciplines which train students for later work in a CRI or in the private sector.

The engagement of CRIs with tertiary providers provides a different perspective for the student on the purpose of knowledge acquisition and the value of its application to industry, sectors and policy problems, not least in the New Zealand context. This is beneficial to students and to tertiary colleagues, and also enlivens the thinking within the CRIs.

Importantly, it improves research translation. The student develops an understanding and then familiarity and confidence with the process of taking research outcomes through to tangible applications. Even if that individual does not travel the whole route, they see the process in operation, and this can open new ways of thinking about their research and its use. It fosters a sense of the possibilities arising from collaboration between researchers and industry or entrepreneurs. Innovation – with definable social, environmental and economic benefits - happens when the fruits of knowledge are applied.

### **CRIs and universities: commercial arrangements**

#### **i) Cross-subsidisation of research with teaching income**

CRIs are interested in the question of cross-subsidisation (Q13). New Zealand's RS&T "market" is highly competitive both in bidding for contestable funds from the government, and in commercial contracts. Cross-subsidisation of commercial research contracts from Vote Education resources may impact on CRI competitiveness as well as potentially lowering educational outcomes for students. The universities tax-free status and different financial performance requirements exacerbates the impact on non-university providers.

#### **ii) Supervision costs**

The arrangements covering supervision are agreed between institutions and student. The financial impacts (on both CRIs and tertiary institutions) and impacts on the educational outcomes for the students should be included in the study.

The matter of financial compensation or payment between a university and a CRI for mentoring and co-supervision of students is challenging. At present, CRIs consider that this is best addressed by one-on-one negotiation between CRIs and university where the individual circumstances of the student or wider relationship can be taken into account.

However, it is clear that CRIs do contribute a significant resource which is necessarily constrained, and cannot subsidise the activity despite the national benefit being achieved.

*Q75 (Do regulatory or funding settings encourage or discourage providers from engaging in joint ventures? If so, how?)* addresses the funding system which requires a single provider to "own" and receive payment for each enrolment, even if there is considerable collaboration with another provider. Further work is needed to ascertain if it could be beneficial to the national interest for CRIs to "own" the enrolment where the majority of the supervision and placement is within the CRI.

#### **iii) Differing business models**

CRIs and universities are increasingly working together. Their distinctive purpose and roles are complementary, underpinned by very different missions and cultures. Consequently, their business models are also distinctively different, which can complicate matters both at the institutional and staff levels.

CRI's each have an explicit Statement of Core Purpose setting out their raison d'etre and operate under a different legislative construct than universities.

Universities have tax-free status, and have to aim only for a surplus on revenue (CRIs are required to achieve a return on equity to demonstrate financial viability, and preferably to return a dividend to the shareholder). There are different methods in allocating overheads (a critical element in costing research bids) because of differences in how the two sets of institutions are able to monitor staff time and resource use; and different work requirements and expectations which shape how rewards from IP development is allocated to staff.

The gains from working together where the incentives are right and there are mutual benefits to be realised by the parties and for their clients means that a variety of different approaches have developed. The Lincoln hub is just one example of this.

Having a variety of approaches developed between institutions creates room for innovation and trial, and avoids rigid regulation which is unlikely to suit all occasions and situations.

### **CRI and non-Scientist training**

In addition to PhD-trained staff members, CRIs have considerable interest in recruiting top-quality technicians with relevant technical skills. These are very valuable people whose skills complement that of scientists and who are essential to effective research with high productivity.

The discontinuation of the NZCE disrupted a traditional career path which is not adequately replaced by MSc study.

The national education system has to be responsive to nationally identified needs. It is not clear where such needs are identified and then incentivised to occur.

### **CRI and tertiaries engagement: general**

CRIs and universities are working increasingly closely on a variety of endeavours at both institution to institution and staff to staff level. These include areas such as use of infrastructure, student learning, and of course research and publications. This is mutually beneficial to both sets of institutions and, importantly, to New Zealand.

Concern is often expressed about the level of translation of research outputs from TEIs into societal benefits, particularly economic benefits.

CRIs have the nation's highest level of business sector engagement. The engagement is particularly strong in some of the most significant export earning sectors of the economy, as well as in environmental areas (which of course underpin many of those sectors), and related social research areas.

In these areas, CRIs are the principal place of engagement between industry and research – whether the research is directly from the CRI or from TEIs. CRIs contract or partner in other



ways with a TEI. The CRI operates as the principal provider of services to the client, including being a trusted agent to identify other sources of knowledge from within New Zealand or globally, which can assist the client to either identify an opportunity or resolve a problem.

This mediating role arises from the CRIs customer intimacy with the sector. It optimizes the roles, resources and networks of both CRIs and TEIs to benefit the client.

A close collaborative culture between CRIs and TEIs does not, and should not, preclude competition in these sectors between the two types of institution, in terms of seeking contracts or in intellectual contest.

It would be easy for reviewers looking solely at the TEI scene without this wider context to assert that the TEIs had a relative deficiency of engagement with these sectors, and make recommendations based on this view.

In practice, the close linkages between CRIs and TEIs ensure sectors receive access to all of the national and global knowledge base. Further, the growing number of students being mentored or co-supervised by CRIs ensures that research training and research outputs by students and early career researchers are integrated with the sector.

### **Distinctive roles, purpose and cultures of CRIs and universities**

There is national benefit in maintaining the unique and distinctive roles, purposes and cultures of CRIs and universities.

Universities distinctive role is set out in the Education Act. Being critic and conscience of society is one, important, element of that. Being free to choose what to research and teach is another. This freedom is supported by NZQF focus on quality assurance which is not linked to specific New Zealand needs.

Unlike tertiary education providers, CRIs are bound by Parliament to undertake research of benefit to New Zealand, and to do so whilst pursuing excellence, operating in accord with social responsibility, promoting and disseminating that knowledge to New Zealand, and maintaining financial viability. CRIs are strategy-driven research organisations.

CRIs have a direct relationship with the Crown as owner, as well as the funder and policy maker. CRIs have to obtain shareholder Ministers' approval on their Statement of Corporate Intent, and Ministers' issue an annual Letter of Expectation to guide alignment with the national investment programme.

CRIs have a STEM focus, supported by social sciences. In most TEIs, however, STEM is a minority activity. The TEI business model rewards acquisition of humanities students as they have a lower cost. The Government is to be congratulated for increasing the subsidy for STEM students, and for acknowledging that recruitment into STEM subjects is affected by perceptions and guidance from parents, teachers and other advisers in secondary school or even lower school levels.

**National capability development: non-science careers**

The Report (page 34) identifies that a well-educated population may be poorly matched to employer demand. This may be re-phrased as *New Zealand is developing a population of well-educated people, but not necessarily a well-educated population.*

Levels of STEM education have been fluctuating for some years, although recent signs indicate a rise. High levels of STEM skills in a population are critical components in productivity growth.

New Zealand has a national objective of increasing business investment in RS&T. Science New Zealand supports this objective for several reasons, not least because this increases the level of innovation in the wider economy and this is linked with a wealthier and healthier society. STEM providers, such as CRIs, will benefit from demand for specialised research.

It is the experience of Science New Zealand members that having a high level of STEM knowledge in management and boardrooms increases the willingness of organisations to consider investment into STEM.

Research in New Zealand (2006) indicates that just one-quarter of science PhD students carry through to become permanent research staff (whether at a university or elsewhere).

More attention needs to be paid to the other 75 per cent, in particular equipping them to better understand and use the transferable skills they have acquired along with their content knowledge. While universities have begun offering courses in entrepreneurship, this form of work is likely to be a route for a minority of those who do not become career researchers.

Training in STEM, including through to PhD level, should heed the lessons from the faculties promoting study in law or commerce. Neither an LL.B nor a B.Com is regarded as inevitably leading to a legal or accountancy career, but both are valued in business and other circles for the skills and thinking processes they inculcate.

Similarly, a STEM degree should be promoted for the skills and thinking such study hones, rather than presented as primarily a vocational pathway to becoming a scientist. This approach may encourage those students who enjoy science at school to continue with it at tertiary level, and thus increase the cohort both of researchers and of the science-literate in other areas of the economy and society.

It may also help address the disparity in foundation degrees held by senior management in New Zealand and those in other countries. Surveys indicate that 25 to 30 per cent of New Zealand boards and management are likely to have an accounting degree, whereas 20 to 23 per cent of the CEOs of the S&P Top 500 companies in the 2005-7 period held a STEM degree.