THE RESEARCH WORKFORCE OF AOTEAROA NEW ZEALAND

Research Community Workshop

Briefing Paper and Workshop Outcomes

30 November 2020

ROYAL SOCIETY TE APĀRANGI

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Preface

This paper sets out to stimulate new thinking about the overall research workforce of Aotearoa New Zealand and the associated research labour market for progression into long-term employment. It is divided into five parts. The first three consider a long-term trajectory of the workforce, setting aside the impacts of COVID-19. In the fourth section, those impacts are briefly considered. The final part sets out the outcomes from the workshop.

Part A analyses the research workforce using available data relevant to progression into long-term employment, setting out evidence that suggests there are significant issues needing attention. Taken as a whole, the evidence suggests that the research labour market, and in particular that for those holding doctoral qualifications, is not functioning well – there is a persistent oversupply relative to demand in long-term roles for the types of roles for which graduates have been prepared and wish to pursue. This has established what is sometimes called a "precariat" – a group of people competing for a small pool of temporary research roles for extended periods, especially in their early career.

Part B identifies some factors that may be influencing the research labour market – these include a number of operational settings within the public research and postgraduate funding systems.

Part C then sets out a number of possible changes or new initiatives that might be expected to improve the performance of the research labour market so that those highly-achieving students who undertake higher level qualifications suited to their own interests and aspirations, also develop wider skills which place them on viable career pathways towards long term employment without extended time within the precariat.

As stated above, **Part D** briefly considers potential impacts of COVID-19.

Part E distills the briefing paper elements for which there was broad agreement at the workshop, as well as discussion outcomes. It includes other elements from table discussions and some new material to construct an interpretive narrative that can be read without reference to Parts A-D.

It is acknowledged that there is significant and growing evidence that recognition and career progression of female researchers, Māori and Pacific researchers, and perhaps other researchers of non-European ethnicities in at least some employment contexts may not be equitable. This paper does not set out to examine such career progression issues arising within long-term employment, focussing instead on factors affecting the initial attainment of long-term employment. This in no way suggests that one or other issue is more important. Both need consideration.

Part A
Wāhanga Tuatahi

Situation Analysis

1. Characterisation of the Research Workforce

In the 2018 Research, Science and Innovation System Performance report[1] the headcount of researchers was shown to have grown from about 20,000 in 2004 to about 31,000 in 2016. Excluding the 13,000 post-graduate students, the headcount of researchers was about 18,000 in 2016.

Data from the same report for 2014 and 2016 suggest there were 12,000 full-time equivalent (FTE) researchers - just over 3000 FTE researchers employed in universities (noting that only a portion of academic staff time will have been allocated to research, about 2000 FTE researchers in government, and a number approaching 7000 FTE in business. In addition, there were technicians and support staff.

1.1 Universities

In the 2018 Performance Based Research Fund Quality Evaluation, the total active university-based researchers totalled 6870 FTE (of a total of 7470 FTE across all institution types) – this counts fully academic staff time. In contrast, in 2003 there were 4460 FTE evaluated as research active across all institution types. Research inactive university academic staff are now very few, and the cohort of PBRF-eligible research-active staff in research roles in universities is now of appreciable size.

The number of fulltime equivalent academic staff in New Zealand universities at tutor/lecturer level or above has remained almost constant for the last 15 years – between 2002 and 2016 it was 5700±200[2]. However, there has been an increasing headcount of academic staff at tutor/lecturer level and above due to increasing part-time employment (Figure 1). Above that level the headcount rose from 6310 in 2012 to 6780 in 2019[3] but the FTEs only changed from 5805 to 5865. "Other academic staff/tutorial assistants" rose from 2490 to 3455, but it is likely many of the assistants were also studying for PhDs.

The headcount of research staff[4] (which includes research-only staff, research fellows, post-doctoral research fellows and other research support staff) rose from 2230 in 2012 to 3560 in 2019 (whereas the FTEs rose less from 1675 to 2330). The bulk of this group are below 40 years of age. The proportion of these who actually undertake research rather than support it (e.g. technicians), and the proportion who hold PhDs or other higher degrees are not recorded in the dataset.

Overall, in 2019, the headcount of university-based researchers was of the order of 10,300. The vast majority of these would be expected to hold PhDs.

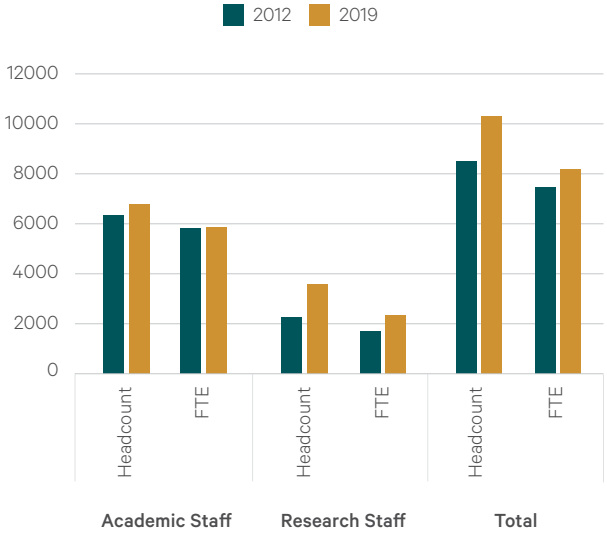

FIGURE 1 – University-based researchers (academic staff at tutor/lecturer level and above)

[1] Research, Science and Innovation System Performance report, Ministry of Business, Innovation and Employment, 2018 **https://www.mbie.govt.nz/assets/7693f53535/research-science-and-innovation-system-performance-report-2018.pdf**

[2] Data obtainable from www.educationcounts.govt.nz , RSP tables

[3] Data obtained from the information supplied to the Ministry of Education by tertiary education providers via the Workforce Questionnaire.

[4] Data obtained from the information supplied to the Ministry of Education by tertiary education providers via the Workforce Questionnaire.

1.2 Crown Research Institutes (CRIs)

The bulk of the just under 2000 FTE researchers employed by Government in 2016 (as set out in the 2018 Research, Science and Innovation System Performance report) will be in CRIs. Over the last decade, CRI staff numbers have not changed significantly. The 2020 staff headcount at CRIs is just under 4000, about half of whom are researchers. Within that researcher cohort, the majority will hold PhDs, but there is a significant group who do not.

1.3 Independent Research Organisations (IROs)

There are three larger (>100 staff) independent research organisations (Cawthron Institute, Malaghan Institute and Building Research Association of New Zealand - BRANZ, plus several medium (>50 staff), and a number of smaller organisations, some supported by levies, some operating as commercial entities, and some the result of government initiatives such as the regional research institute initiatives. There has been growth in the research capacity in IROs over the last decade.

The 2020 headcount of researchers across IROs is likely to be of the order of 1000. Some IROs, e.g. those undertaking medical research are more likely to employ PhDs than some others whose focus is more on industry development.

1.4 Business

The total business R&D workforce is significant in size. There are some companies with clearly identifiable R&D teams, e.g. Fonterra, F&P Healthcare, but also many other companies which have small numbers of R&D workers. Commercial R&D usually has a greater focus on development than research, so the R&D workforce will be much more mixed in the qualifications held than the three groupings above.

1.5 Consistency with Census Data

The research workforce can be visualised as a sub-set of those holding higher degrees. The 1996 Census showed that approximately 74,000 out of 2.786m (2.7%) people of working age held a higher degree (Level 8 or above), yet by 2018 this had grown to about 360,000 of a work-age population of 3.78m (9.5%).

Doctorates were first distinguished from other higher qualifications in the 2006 Census which recorded 16,800 (0.53% of work-age population), but the number steadily grew, up to 22,300 in 2013 and then to 29,800 (0.79%) in 2018. This rise reflects both increased graduation rates and any increase attributable to migration. There has been a net rise of over 1000 PhD graduates per annum in the work-age workforce in this country in recent years. Because there will be a significant group of PhD holders exiting the work-age population each year (likely to be several hundred), the total new entrants to the category will be significantly higher than the net rise.

Detailed data for Census 2018 were not available at time of writing, but in Census 2013 there were two dominant employment roles - 13,000 doctorate holders classified themselves as practising professionals and about 3000 classified themselves as managers or administrators. There were 14,000 declaring as paid employees, 1000 who were employers and 2000 self-employed. In terms of industry, there were three dominant groups – education (6300), professional services (3500) and the health and social assistance sectors (3300). Next highest was 1000 in public administration.

These data are consistent with there being over 10,000 doctorates in the research (including higher education) workforce, but this is only one-third of the doctorates of work-age.

Consistent with the 1996 and 2001 censuses in which unemployment amongst those holding a higher degree was very low, in 2006 of the 16,700 doctorates in New Zealand only 225 (1.3%) declared as unemployed and in total 85% were employed (the difference of about 14% is primarily people not seeking employment). As Figure 2 shows, in 2013, of 22,300 there were almost 3900 (17%) listing as unemployed, and those degree holders in employment were down to 81%. In 2018, 77% were in employment so those unemployed or not seeking work had risen to 23%.

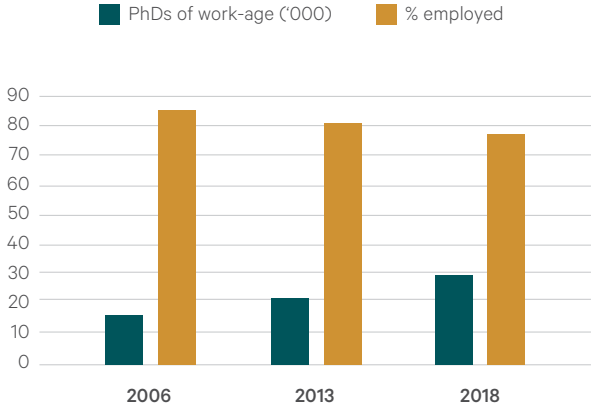

FIGURE 2 – Census data: Holders of PhDs of work-age and their employment.

1.6 Characterisation of the Research Workforce

Although the available published data are not on a consistent basis, the overall research workforce in 2020 can be characterised with reasonable certainty as follows:

- A headcount of at least 18,000 and possibly as many as 20,000 researchers (excluding post-graduate students), of whom well over half hold PhDs,
- At least 10,000 of these being in universities, the vast majority holding PhDs,
- Of the order of 3000 in CRIs and IROs, the majority but far from all holding PhDs,
- At least 5000 in business, with a highly varied qualification mix.

Of the likely 30,000 or so PhD holders in the work-age population, about one third have employment as researchers. However, the research workforce is a minor employer of the totality of those holding higher degrees.

2. Supply and Demand in the Research Labour Market

2.1 Supply of PhD Holders

In section 1, it was shown that only a small fraction of those holding higher degrees are in the research workforce. The higher degree targeted at developing graduates capable of independent research is the PhD, meaning those graduates are most likely to seek roles in the research workforce. Census data show that a net increase of over 1000 doctorates a year in the work-age population was occurring from 2013. The entry rate was probably significantly higher to offset those exiting the work-age population.

In 1998 there were 400 doctoral completions in New Zealand universities, but by 2013 this had risen to an average of about 1400 per year[5] (Figure 3). For the last ten years there has been gender equity in the graduating cohort overall, but a growing female dominance amongst domestic graduates (55-60%). Of the domestic graduates, in recent years there have been about 71% NZ European, 9% Māori, 4% Pacific, 17% Asian, with the balance being other or unknown.

International completion grew from less than 50, to roughly match domestic completions from 2015. This followed a fees policy change so that those international students pay domestic fees. Domestic graduations had grown more slowly – up 47% at a time when the general increase in working age population was over 20% so the real growth in domestic PhD graduations was of the order of 25% across the two decades.

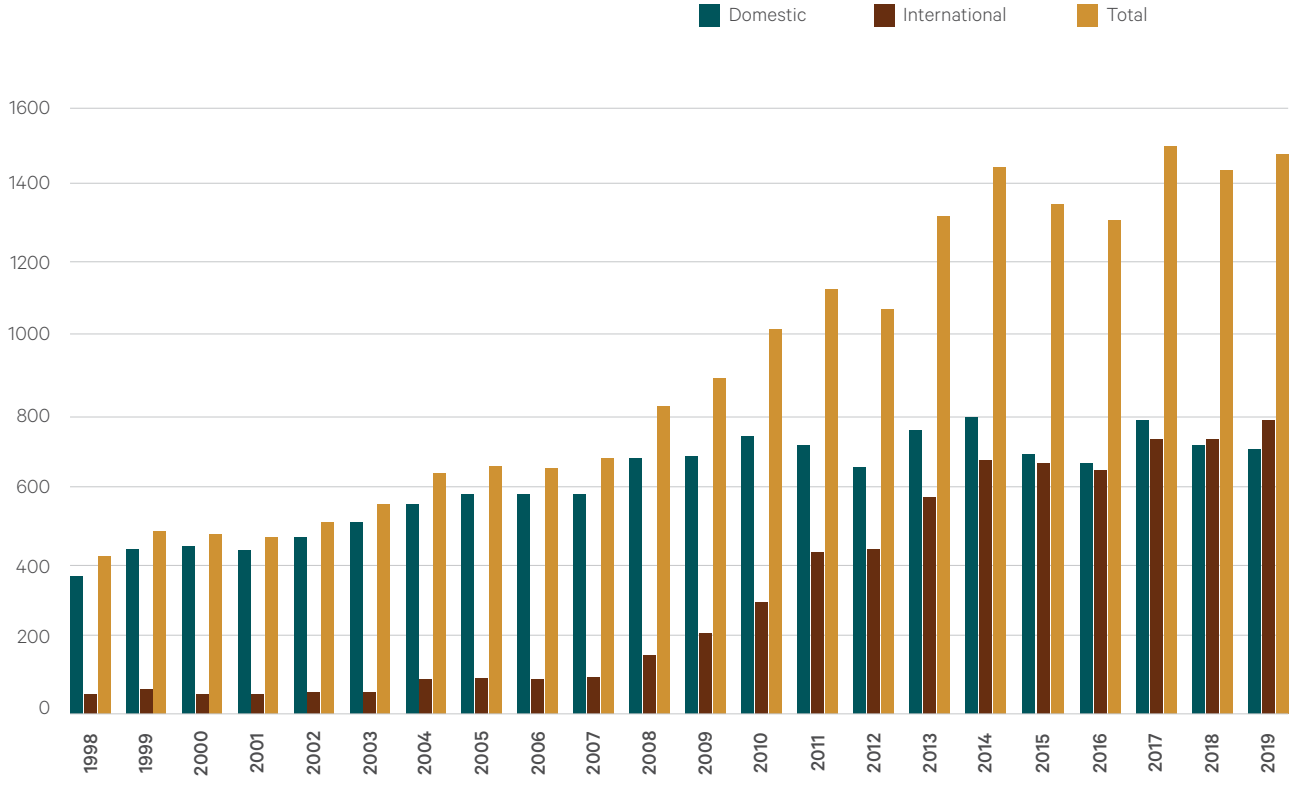

FIGURE 3 – PhD graduations in New Zealand 1998-2019.

[5] Data obtainable from **www.educationcounts.govt.nz**, RSP tables

Whilst many international students leave New Zealand, others seek to become permanent residents and to obtain employment here. In a major study, the Ministry of Education examined destinations and earnings of international graduates in 2012/2013[6]. The snapshot was taken using employment and earnings data for PhD graduates in the previous eight years. Of the cohort of international PhD graduates within one year of graduating, 35% overall, but 45% of those classified as "young", were in employment in New Zealand, but this dropped to about 20% in later years. The proportion who had returned overseas rose equivalently. Whether this rise was through inability to obtain employment in New Zealand or other reasons is not known. There seems no specific reason why the observed behaviour of international students at the time of the snapshot would not have continued. Thus, retention of international PhD students is probably a significant but minority contributor to the net rise in work-age PhD holders in this country.

There is also the role of migration of those already holding doctorates. Total net inward migration to New Zealand was high through the period 2013 to 2018 but has since reduced. Doctorate graduates can come in when they have a job (and that job may be existing or new), but some also enter as partners of job holders, but the extent of this latter is not known.

Overall, it is likely that the net rise in doctorates available to work in New Zealand will continue to increase steadily, but whether this will still be at the rate of well over 1000/year occurring between 2013 and 2018 is not known.

2.2 Supply of PhD Holders

Figure 4 shows summary data from **www.educationcounts.govt.nz** for all doctorate completions, including international students. The largest numbers are in natural and physical sciences and society and culture. The numbers in health and engineering and related technologies are significant. It is instructive to look inside the detailed year by year data (not shown) at the balance of international and domestic students over the last ten years in the major fields (noting that the data do fluctuate significantly from year to year so only broad trends can be discerned and these trends may not be evident in Figure 4):

- In natural and physical sciences, the domestic completions dropped slightly from 190 to 150, whilst international completions grew from 70 to 210. Within the domestic cohort, biological sciences held up best (and as will be shown later this sub-cohort is female-dominant).
- In information technology, the domestic completions held steady at about 30, whilst international completions doubled to be slightly higher than domestic completions.
- In engineering and related technologies, domestic completions held relatively steady at about 75 (2011 was a low year), whereas international completions grew rapidly from about 35 to 140.
- In agricultural, environmental and related studies the domestic cohort remained steady at an average of 10-15 whilst the international cohort grew from 10 to 25.
- In health, the domestic cohort grew from just over 100 to about 125, whilst the international cohort grew from 20 to about 80.
- In management and commerce, the domestic cohort dropped from about 60 to 50, whereas the international cohort rose from about 20 to 60.
- In society and culture, the domestic cohort rose slowly from of the order of 175 to closer to 200, whereas the international cohort went from 40ish to close to 100.

Unsurprisingly, growth in international completions was strong in those disciplines often seen as contributing directly to economic development in the private sector, whereas domestic completions dropped back a little in those disciplines. Apart from natural and physical sciences, domestic completions remained strong in health and society and culture – disciplines more likely to seek employment in the public sector.

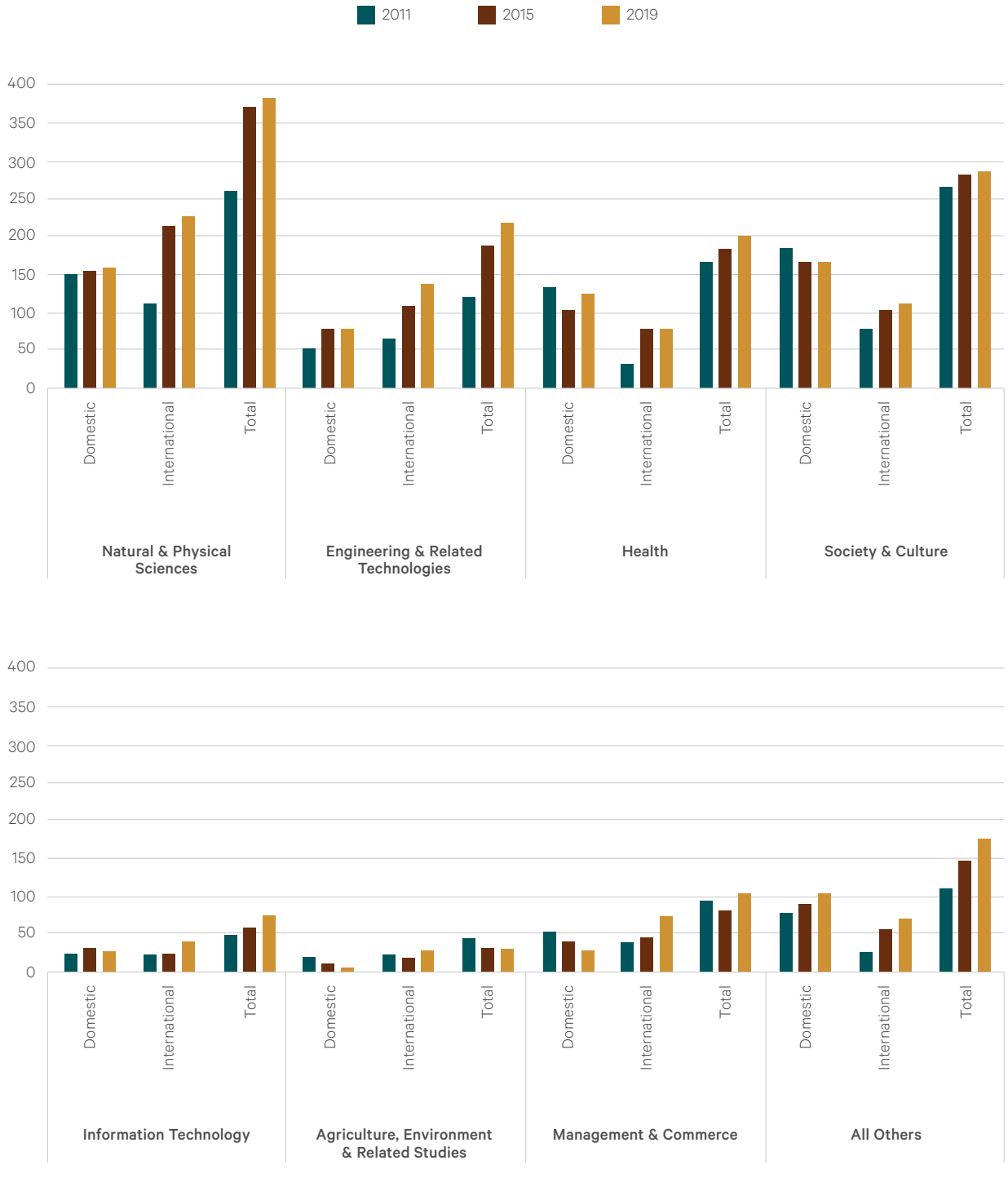

FIGURE 4 – Fields of study for doctorate completions in New Zealand.

[6] **https://www.educationcounts.govt.nz/__data/assets/pdf_file/0004/179959/Moving-Places-Destinations-and-earnings-of-international-graduates.pdf**

2.3 Demand for Employment in Universities and Other Tertiary Education Organisations (TEOs)

In section 1.1 it was shown that the headcount of researchers in universities grew from 8500 to 10,300 in the seven years from 2012 to 2019, an average of about 250/year, the bulk of whom would be expected to hold PhDs. This reflects the progressive rise in research funding gained (in 2016 dollar terms) from $40,000 per FTE academic staff in 2002 to $65,400 in 2016[7]. This research funding growth partly explains the growing headcount of people supporting teaching, freeing academic staff of other duties to meet contractual responsibilities to research funders.

Universities recruit in an international labour market, and a significant number of appointments are from overseas. Some of these are returning New Zealanders, but many will be inward migrants. Some of these recruited will fill the opportunities created by those that leave the university-based research workforce permanently e.g. through retirement, some will fill vacancies created as part of normal employment churn, and some will be to new roles.

Other TEOs (primarily Wānanga and what were the institute of technology and polytechnics – ITPs – now part of the New Zealand Institute of Skills and Technology) are still a relatively minor employer of PhD graduates: collectively they had only 600 FTE funded as research-active in the PBRF in 2018. In many such institutions it is existing staff who have completed PhDs and become research-active, and many research-active staff do not hold PhDs. Recently the ITP sector has been contracting. Overall, it is likely that, with the rate at which these sectors are increasing their employment of PhD holders, they are not absorbing any more than a small part of the extra PhD holders, entering the workforce year on year.

2.4 Demand for Employment in CRIs and IROs

In section 1.2 it was shown that there has been little change in research staff numbers in CRIs. Change in the staff complement in CRIs ultimately reflects change in the research funding won from government and commercial sources, and the change of recent years has been modest. CRIs and IROs would employ PhD graduates whose skills are immediately suitable for generating new commercial income.

Anecdotal evidence from the CRIs is that when they go to market for researchers, they often do not receive competitive applications from New Zealanders in spite of reasonable graduating numbers across sciences. As shown in section 2.2, there is a very small graduating cohort in agricultural, environmental and related studies on which some of the relevant CRIs might draw, and the domestic sub-set is even smaller. Further, CRIs are often looking for applied scientists, with a motivation to solve New Zealand's pressing issues – it may be that within the natural and physical science graduating cohort there is only a small number in the specific disciplines needed by CRIs who hold aligned career aspirations.

Of recent years, some new IROs have been created through the creation of regional research institutes, so a low level of demand growth may have occurred. Nevertheless, the demand for researchers in the sector is small relative to the supply of PhD holders entering the work-age population.

[7] Data obtainable from **www.educationcounts.govt.nz**, RSP tables

2.5 Demand for PhDs in the Wider Public Sector

The census data set out in section 1 indicate that government health organisations and other public agencies do employ significant numbers of PhD graduates. Our health system practises research-based medicine so significant numbers of doctorates in the health sector is hardly surprising. Employment roles in public agencies range from roles in museums, social service agencies, to technical services in local government, technical specialists in central government agencies, policy researchers, specialists in Callaghan Innovation, and the Science and Innovation teams at MBIE. Unsurprisingly, there are significant numbers of senior public sector managers who hold PhDs.

There is no indication that these sectors are likely to increase in any significant way their employment of PhD graduates, and thus take up a significant part of the ongoing net increase in the doctoral workforce.

2.6 Demand in the Non-Profit Sector

Over the last two decades, a number of non-profit social service providers have increased their internal professionalism, and many hold significant service provision contracts with government. The increasing professionalism may well be creating new employment prospects for doctorates but there are no data on the scale of this potential. If it is significant, it would be expected to contribute to demand for doctorates classified under society and culture.

2.7 Demand in the Private Sector

Private sector professional services agencies (consultancies) and research and development roles in businesses would be expected to be major contributors to employment of doctorates. There are also PhDs in large technical service organisations like the IT and electricity infrastructure providers. There are a number likely to be employed in technical service and consultancy roles to the primary and industrial sector. The 2013 census data suggests low numbers in the private sector – for example, there were 450 in manufacturing businesses and 420 in the primary sector.

As set out earlier, a reasonable number of doctorates are self-employed, and there may be potential for employment in professional service provision of this type. Nevertheless, the extent of growth in the private sector is likely to reflect change in research and development spending more than any other factor.

2.8 Demand Driven by the Changing Nature of R&D Spend

Figure 5 summarises Stats New Zealand's 2018 report on R&D expenditure. It shows the modest growth in the higher education sector (as set out above), slightly higher growth in the other government sectors, relatively flat expenditure in the primary sector and manufacturing industry, and the big growth in services, led by computer services.

To the extent there is potential to absorb the net increase of doctorates in R&D roles, it seems to lie in the private sector (which is now more than 50% of R&D spend with that proportion likely to grow) rather than the public sector, and more likely in professional services (including computer services such as software development) than in processing or manufacturing industries.

With the introduction of the R&D tax incentive in 2019, these data may change significantly, but if change occurs (setting aside the impact of the present COVID-19 pandemic) it is more likely to be increase private sector investment than public sector investment.

2.9 In Summary

Whilst the universities have increased their employment of doctorate graduates over the last 15-20 years (and employ 20-25% of work-age PhD graduates in New Zealand), the net annual demand growth for PhD qualified staff is only a small part of the net increase in supply for the country as a whole. Even after taking into account the need to replace those leaving the academic workforce permanently, the growth in research-related roles, and the shift towards a greater headcount via part-time employment, the bulk of newly graduated PhDs have needed to look elsewhere for employment for some years now, and this is not likely to change.

When looking elsewhere, the only significant demand growth appears to be in private sector R&D services, and particularly computer services, yet the domestic graduating cohort available is trending away from the disciplines most likely to be sought by businesses.

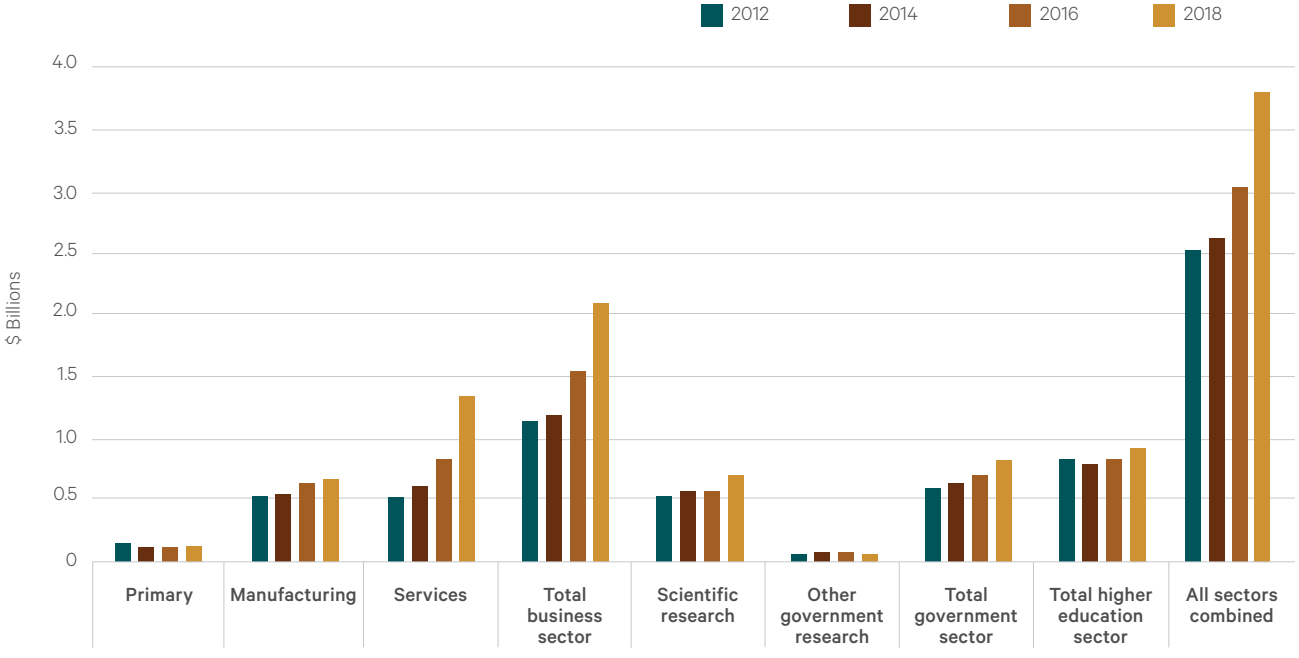

FIGURE 5 – New Zealand research and development expenditure 2018 (source: Stats NZ)

3. Career Experiences

3.1 Incomes of Recent Doctorate Graduates Who Stayed in New Zealand

Further insights into the experiences of PhD graduates can be gained from income data shown at **www.educationcounts.govt.nz**. These data are a snapshot in 2016 of what those who graduated in the eleven previous years and stayed in New Zealand were earning right now. In broad terms these showed that:

- Natural and physical science graduates were earning a median of $59,000 in year 1, rising to $89,000 in year 11.
- Engineering and related technologies were earning $70,000 in year 1 rising to of the order of $120,000 in year 11.
- Health science graduates were earning a median of $67,000 in year 1, this lifted to about $85,000 in year 4 and thereafter the data are unreliable due to small sample size.
- In the broad group "society and culture" in year 1 the median was $64,000 rising to about $85,000 in year 11.
- In all other sectors, the sample sizes were too small to identify a trend.

This can be overlaid with data on doctorate graduate destinations at the same website:

- In natural and physical science graduates, about half the doctorate holders were overseas, even as early as two years after graduation.
- Engineering and related technologies graduates were the most likely to stay in New Zealand (70-75% in year 1, but by year 6 almost half were overseas).
- A majority of health science graduates were in New Zealand in year 1, but the fraction overseas steadily increased, reaching 50% in year 6 and steadily increasing thereafter.
- In the broad group "society and culture" graduates were more likely to be in New Zealand than overseas at both years 1 and 11, but around years 5 and 6 more likely to be overseas.

3.2 Temporary Employment, Under-Employment and the Precariat

These data continue to add to a relatively gloomy employment picture within Aotearoa New Zealand for early career PhD graduates seeking research roles. Whilst outward migration is not necessarily a bad thing provided it is balanced by replacement inward migration bringing in higher skills, there are definite concerns about career progression locally. The only group, as a whole, to show early career salary progression in New Zealand were engineering and related technologies. This group would be expected to be the most private sector-ready.

Across all fields, year 1 and even year 2 median earnings were well below a relatively standard postdoctoral fellowship stipend (of the order of $80,000 in 2016). This suggests that many graduates may be taking lower level jobs just to get employment (often termed under-employment). In medical and health sciences, society and culture, and natural and physical sciences there was a failure of early career incomes to progress – indicating a high likelihood that a dominant form of employment was in temporary roles.

Significant periods of early career employment in temporary roles has become the norm in many but not all disciplines globally. With a persisting surplus of supply over demand, it has become necessary to build a track record through several short term assignments in order to gain a satisfying permanent role (often multiple and sequential post-doctoral positions). In New Zealand, the data show that only engineering and related technology bucked this trend, although it would be expected that information technology and perhaps management and commerce might show a similar trend if a sufficient sample size was available.

Poor employment prospects were also evident in the Census data presented in Figure 2.

One contributing factor to unemployment, and identified earlier, may be the impact of inward partner migration – if one of a couple gets a job in New Zealand and the partner also obtains entry, but then cannot find work, they might declare as unemployed (data on partner qualifications are not recorded). There is also anecdotal evidence of underemployment (accepting work below their skill level) in migrant communities.

3.3 Gender and Ethnicity

Figure 6 shows a snapshot of gender differences in 2018 for new entrants in some major fields. These illustrate that over recent years, women are more likely than men to complete PhDs in disciplines in which early career employment opportunities are more limited, especially beyond the universities. In the natural and physical sciences, the sub-set in biological sciences is strongly weighted by gender towards women and that in physical sciences to men.

Māori and Pacific participation in the research workforce continues to be low but participation by New Zealanders of Asian ethnicity is higher. In 2019 at lecturer and above level in universities, there were 365 Māori, 100 Pacific and 725 people of Asian ethnicity in a total workforce of about 6800[8]. The participation by Māori and Pacific graduates in the CRI sector is low.

In 2018, the 70 Māori and 25 Pacific PhD graduates were primarily in health and society and culture with very low participation in engineering and science, so there is little pipeline available to increase research workforce participation in the science and engineering sectors.

The 120 domestic graduates of Asian ethnicity in 2018 were about equally divided between engineering and science on one hand and health and society and culture on the other, and participation by people of Asian ethnicity across the various employment sectors is higher as a result.

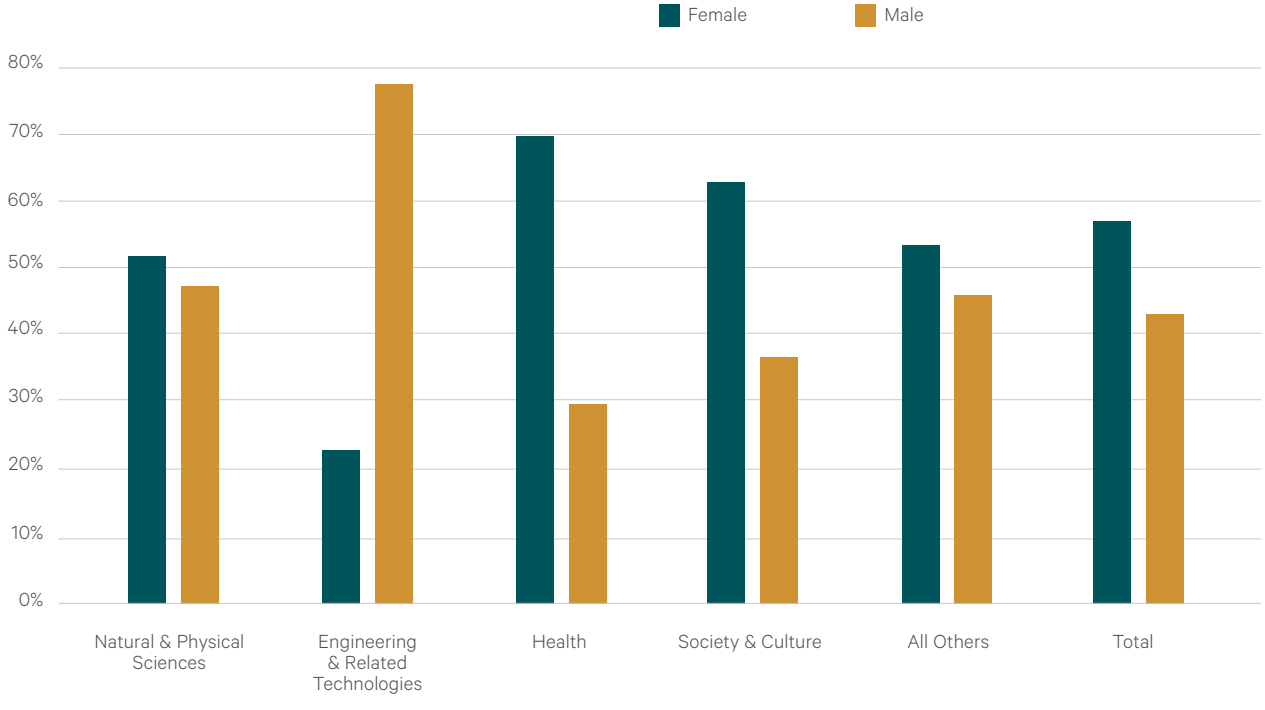

FIGURE 6 – PhD completions in 2018 by gender in some major fields (from **www.educationcounts.org.nz**)

[8] Data obtained from the information supplied to the Ministry of Education by tertiary education providers via the Workforce Questionnaire

3.4 Royal Society Te Apārangi's Early Career Researcher Survey

A total of 709 responses were received to an open survey conducted during 2018. Some key findings were:

- Almost two-thirds of respondents were female – perhaps indicating that they might be more motivated to complete the survey through being in more precarious jobs, but also an artefact of the shifting of the ratio of female:male domestic PhD completions over recent years;
- Māori and Pacific early career researchers were older – they commence their doctoral studies later;
- 65% of respondents were in universities and 23% in CRIs – but these are the places the survey was most likely to reach;
- 76% of respondents were from scientific disciplines - biological, environment and medical/health science account for 51% of respondents; biological and medical/health science for 41% - this is not unsurprising in the light of the graduating field data discussed earlier;
- Only 4% of respondents definitely did not want to stay in research in the next five years;
- Only 5% of respondents definitely did not want to stay in New Zealand.

These survey results are consistent with other findings set out above.

4. Consistency with Previous Studies

Commencing in 2007, and running for 2-3 years, the then Ministry of Research, Science and Technology undertook significant investigative work on the research workforce. At the time there was concern that with a focus on purchase of research on a project or programme basis by government, there might be inadvertent negative outcomes for researchers seeking to build their careers. In a snapshot of the research sector in 2007/08[9], a total R&D workforce (including postgraduate students technicians and other support staff) of about 24,000 FTE was reported, of whom 4100 has PhDs. The PhDs were primarily in higher education (2000 FTE – presumably counting only the research component of academic positions), government (1300 FTE – presumably mainly in CRIs) and the remaining 700 were in the private sector. Of the 8100 FTE undertaking R&D in the private sector the majority held Bachelors degrees. There was modest but steady growth in the R&D workforce in the previous five years. Migration data for the previous ten years showed a small net inward migration of science and technology professionals.

In 2010, the Government published *Igniting Potential*[10], a strategy for driving economic development through research and innovation. This drew on the earlier findings and data. It showed that only 14% of emerging PhDs in science would find a career in academia, 12% would find careers in government (including CRIs), and the remaining three quarters of science PhDs would work elsewhere. It argued that the Rutherford Discovery Fellowship was a means to address the dearth of early career opportunities. It also showed that from 2003 there had been significant inwards migration of university-level migrants.

These studies of the research workforce over a decade ago emphasises that the issues highlighted in more recent data are long standing. Arguably, they have been worsening in recent years.

5. In Summary

- In 2020 there are somewhere between 18,000 and 20,000 researchers (excluding PhD students) in this country, and about 10,000 of those hold PhDs.
- Whilst the research workforce has grown steadily, that growth has been far less than the growth in doctorate holders of over 1000/year, and since 2013 there may be significant unemployment amongst this group.
- About half our recent domestic PhD graduates are employed in New Zealand, many in temporary roles and/or under-employed, but some successfully compete against immigrants for the permanent roles that become available.
- The precariat of those seeking to build a track record via temporary employment in order to win a permanent research role in a New Zealand university or publicly funded research organisation is significant in size.
- Incomes and the job security of most PhD graduates who stay in New Zealand do not improve during the first decade after graduation; many go overseas seeking better prospects.
- Whilst churn will occur and there will be an ongoing but modest demand for replacement of those leaving the research workforce permanently, there are few new permanent roles being created in the university, other tertiary, CRI or IRO sectors. This is unlikely to reverse unless Government investment in R&D rises significantly.
- Whilst there may be significant potential for increasing employment in the wider public sector, there are no present indications to suggest that growth in doctorate employment opportunities there will be significant under a business as usual model.
- Growth in R&D spend in the private sector is likely to favour services, and those seen by employers as most employable in those roles are likely to be from business disciplines, engineering, information and related technologies – however over recent years, domestic completions in these fields has been eroding.
- The permanent job prospects in New Zealand for the large numbers of doctorates, and particularly those in natural and physical sciences, health and medical sciences, and society and culture (social sciences and humanities) are relatively poor, and their employment precarious unless they are prepared to undertake roles not historically seen as a progression from a PhD in their discipline.
- The ratio of domestic female: male domestic PhD completions has shifted upwards, and this is probably reflected in the precariat; more women graduate in fields that the data suggest are more difficult than others for gaining long-term employment.
- Māori and Pacific researchers are more numerous in fields which have high levels of precarious employment, and are thus highly at risk.

Taken as a whole, these findings suggest that the research labour market, and particularly the market for those holding doctoral qualifications, is not functioning well – there is a persistent oversupply relative to the demand for the types of roles for which doctoral graduates have been prepared and wish to pursue.

[9] New Zealand RS&T Scorecard 2010, Ministry of Research, Science and Technology

[10] *Igniting Potential*, Ministry of Research, Science and Technology, 2010

Part B
Wāhanga Tuarua

Some Factors Influencing The Research Labour Market, and Particularly Those Holding Doctoral Qualifications

In general, labour markets are seen to be well-functioning when there is elasticity – prices (salaries) change in accord with the balance of supply and demand, there is no inadvertent distortion by regulatory processes or system settings, and there is good quality information to inform decisions. In this section, factors that may be affecting the research labour market are identified. Given all these factors are in play simultaneously, causality between any of them and the evidence outlined in Section A cannot be established. Nevertheless, it is plausible that each may have had or be having an impact.

1. A Widely Applied Global Research Funding Model

A widely applied and almost global model for research funding is that funding is gained using proposals developed by permanently employed staff, and supported by their research track record, but then applied to bring in temporarily employed research workers not necessarily known at time of application. This model is very cost-effective for purchasing research outcomes, but leads to the existence of a large number of temporary researcher roles in most countries in the developed world. When permanent roles become available, those roles are more likely to be won by those demonstrating the greatest development from amongst the pool of temporarily employed researchers rather than by a person who has just completed a PhD degree.

If a country was to opt out of applying this funding model, but continue an open approach to researcher recruitment, it is likely that many permanent jobs would go to inwards migrants or New Zealanders returning (who can demonstrate a strong track record from temporary roles overseas), and not to local, recent PhD graduates with less-developed track records.

2. Highly Competitive Research Funding Regime

In most countries, the research funding available is vastly over-bid. Failure to obtain further funding in the same research area when an existing project funding finishes is a real and common occurrence and this can strand part or all of a research group with no further funding.

In universities, failure to obtain replacement funding when a grant or contract terminates will often lead to loss of role for the researcher employed specifically for that contract, but generally not of the academics involved. Academics also teach and in this country can earn their university income through the Performance-Based Research Fund (PBRF), so it is the temporary workforce in universities that is at risk when the pattern of funding changes.

The situation is different in CRIs and IROs because those organisations do not have the equivalents of teaching and the PBRF. CRIs have received a small amount of non-competitive funding, previously called core funding, but this has now evolved to become the Strategic Science Investment Fund (SSIF). Earlier, for core funding, the chief executive was allowed some discretion provided the use was justifiably in pursuit of the CRI mission statement. SSIF funding is more prescribed. From SSIF the CRIs are expected to maintain a variety of nationally important science functions, as well as undertake some strategically-focussed research. The net result is that failure by a CRI to successfully bid for a programme can lead to that CRI having little choice but to lay off researchers or re-deploy them to new fields. This in turn may incentivise the CRI to not commit to permanent roles unless future income sources to support the role can be envisaged, thereby increasing the precariat. Hence, it may be that a low proportion of CRI income arising through core/SSIF funding, and erosion of the extent of discretion for the chief executive to allocate this funding, are contributing factors.

IROs each operate unique models, but many are also at risk from lack of funding continuity in a highly competitive environment.

3. Caps on Research Funding Applications

There are a number of caps or rules of thumb applied by research funding agencies faced with over-bidding of excellent proposals relative to the funds available. Some of these can have the effect that only a post-graduate student and not a post-doctoral role can be fitted within the cap. Ideally, the level of experience of the researcher needed should be determined from the nature of the research and not the funding available. A plausible impact of funding caps is to shift the balance between post-doctoral and post-graduate roles available towards post-graduate, thereby increasing supply of, but reducing demand for doctoral graduates.

4. Performance-Based Research Fund (PBRF)

Established in 2003, the PBRF has rewarded tertiary institutions for post-graduate degree completions including doctorates. Whilst a successful completion is a valid indicator of a high quality research outcome, such a mechanism could create incentives for institutional or individual behaviour. For example, an institution could encourage its staff to maximise enrolments of suitable qualified students in their own discipline. At an individual level, staff members may see lifting their number of post-graduate students as a means to generate further evidence towards their own personal quality evaluation. This in turn could create an incentive to manage a PhD programme to maximise co-authored publications, and also to be overly optimistic in advising prospective students about the career benefits and likely employment prospects in the discipline.

5. Standardised Labour Pricing

It is well-established that in the private sector and even some government employment markets there are remuneration differences between graduates in different disciplines with notionally the same post-graduation level of experience. However, in the research labour market, those differences are not necessarily recognised. There are two informal standardisation mechanisms in use. One is for the stipends for PhD students, and the other the post-doctoral salary in universities.

PhD stipends are significantly below the starting net pay (clear of tax) for graduates in many disciplines. In other disciplines where the graduate labour supply exceeds the demand, then those stipends look relatively more attractive. Hence it is plausible that domestic student demand for those stipends will be stronger in those disciplines in weak labour markets (those with over supply of lower level graduates), and lower for those disciplines where other opportunities are stronger.

This follows through to post-doctoral labour. If a discipline has strong post-doctoral employment opportunity outside the university system then a post-doctoral fellowship will be less likely to be sought. If alternatives are not available in sufficient number, the demand for post-doctoral roles in universities will be higher.

Interpreted in the context of Section A, standardised labour pricing could be expected to lead to relatively low numbers of domestic students and relatively higher numbers of international PhD students in disciplines like information technology and engineering. The large numbers of science graduates in the precariat is also consistent with a theory of standardised pricing affecting the labour market.

Standardised pricing could also be expected to result in significant out of field employment. In itself some out of field employment can be a very good thing economically for a nation. Those people bring different thinking to the norm in the field they are entering, which can drive worthwhile

change. However, large scale out of field initial employment is economically inefficient, and there is a difficult transition for the people concerned to have to take career pathways different to their preferred option.

6. Nature of PhD Programmes

PhD programmes were first delivered in significant numbers in New Zealand universities in the 1970s. At that time the universities were growing rapidly, and preparing PhD graduates to work in our own universities and government research laboratories made sense. However, since that time, whilst some flexibility has been introduced, by and large the PhD is still preparing graduates to undertake research in an academic context.

The creation of the CRIs in the early 1990s formed organisations very focussed on applied and commercial research – it is plausible that the competencies those organisations now seek are more distinctly different from the attributes of an academically-prepared PhD graduate now than it was 25 years ago.

It was shown in section A that few PhD graduates will find permanent employment in academia. There is thus a probable mis-match for many of the graduating cohort between their leaving skills and what their likely employers seek. That is not to say that their highly developed analytical skills will not eventually be valued by and provide excellent value to employers – it is just that there is a perceived barrier for their gaining employment outside academia through the need for them to adapt to the employer environment, and accept their future lies away from academia.

7. Labour Immobility

If a PhD graduate is in a two-person household, their ability and willingness to move employment may be limited by the nature of the other adult's employment. That may hold them to seek work near the place where the PhD was studied. Such occurrences can lead to localised over-demand for roles.

This effect might be exacerbated if the household includes children. It is not uncommon for one parent to view their employment as more interruptible than that of the other parent, when the children's needs clash with employment duties. The parent whose employment is seen as interruptible may be prepared to take on less demanding work or accept temporary roles if this is seen as the only way to achieve the necessary flexibility. It is possible that the aggregated choices parents make of whose is the more interruptible career is not gender balanced. The data in Section A showed that women might be strongly represented in the precariat.

8. High Cost of Hiring a Researcher in Small to Medium Size Businesses

New Zealand has very large numbers of small to medium size businesses. For such businesses, the cost of adding one PhD level researcher is high (can be up to $150K/year) relative to the overall business revenue. This acts as an impediment. The Callaghan Innovation R&D Career Grants scheme[11] was established in an attempt to address this. That scheme is popular, but limited in scale.

9. In Summary

There are a number of identifiable factors that may be affecting the research labour market in this country, and each would be expected to lead to the sort of evidence set out in Section A. Causality and the relative importance of these or other factors cannot easily be established.

[11] **https://www.callaghaninnovation.govt.nz/student-grants/rd-career-grants**

Part C
Wāhanga Tuatoru

Possible Changes and New Initiatives

There is national benefit if our best and brightest are able to bring their talent to bear in a way that is personally rewarding, but also creates great outcomes for New Zealand. Whilst there are benefits in a significant group of our PhD graduates moving overseas to further their experience, hopefully with many returning, and also from a steady stream of well-qualified incoming migrants, it is desirable that bright New Zealanders, committed to this country, can have rewarding and successful careers here.

Hence the starting point for the new thinking is not to suppress the numbers of PhD graduates to match supply of PhDs with the permanent job market for such degrees, but rather to address the mismatch between the relatively narrow skills graduates exit their PhD studies with and the skills needed in employment roles in which they could launch successful careers of value to New Zealand as well as themselves. The market for PhDs grows when research sponsors are motivated to create new roles to capture the demonstrated value of the well-rounded graduate they have been sponsoring.

If the national R&D investment does grow towards 2% of GDP there will be an increasing research workforce, and the bulk of the new roles will be in the private sector.

1. A Large Scale Collaborative PhD

The New Zealand Productivity Commission[12] has identified that the New Zealand economy lacks the capability to sufficiently and rapidly adopt new knowledge so our labour productivity remains persistently low. This is sometimes referred to as a lack of research absorptivity in the private sector. There does not seem to be the skills in businesses to sufficiently rapidly recognise and adopt new advances.

The September 2019 draft Research, Science and Innovation Strategy released by the Ministry of Business, Innovation and Employment recognises the issue of weak connections of researchers to end users in this country. The latter is by no means solely a New Zealand issue. Other countries have intervened to address the gap between academia and end-users, for example, under the auspices of United Kingdom Research and Innovation, there are a number of cooperative programme schemes fostering end-user/academia interaction on PhD programmes, e.g.[13].

New Zealand has had similar, but relatively small schemes, offered through Callaghan Innovation[14] to improve academia/industry links.

The conceptual model for a Collaborative PhD builds on an existing successful scheme, the Callaghan Innovation R&D Fellowship Grants, but with the form of the PhD programme becoming much more flexible, and with the student working on a real problem of a private sector or non-profit organisation (the sponsor). The concept of such a PhD programme was discussed in the 2020 Society Presidential address.[15]

[12] Technological change and the future of work. New Zealand Productivity Commission, 2020 **https://www.productivity.govt.nz/assets/Documents/0634858491/Final-report_Technological-change-and-the-future-of-work.pdf**

[13] Cooperative awards in science and technology programme, UK Research and Innovation e.g. **https://epsrc.ukri.org/skills/students/industrial-case/**

[14] **https://www.callaghaninnovation.govt.nz/grants/student-grants**

[15] **https://www.royalsociety.org.nz/news/professor-wendy-larners-final-presidential-address/**

Possibilities include that the student might undertake a significant part of their research on the sponsor's premises, being visited by the supervisor, and the programme is designed to enable a range of forms of output rather than an academic thesis to be used for the summative assessment at the end of the project. Many sponsors will want to draw on the results as the project proceeds so they can derive benefits immediately. The goal is to prepare a PhD graduate to be enterprising in a wide variety of employment contexts, not necessarily for employment in business.

A Collaborative PhD programme could have the following dimensions:

- A university and an industry body, private sector or non-profit organisation would jointly apply for Collaborative PhD funding, ideally with a student already identified.
- Proposals would specify a real-world problem from the perspective of the sponsor and confirm that the university supported research being carried out at PhD level into the problem.
- Proposals would include a budget that might include elements such as (a) salary/wages for the student to spend time working in the sponsor's premises, (b) costs associated with investigating and researching the problem, and/or (c) costs for the university and sponsor in overseeing and administering the research.

What is most needed is for such a scheme to have sufficient scale, the form of the PhD to be flexible so it does not act as an inadvertent impediment, have the grants set at levels that are highly attractive to sponsors, and set the student stipends at competitive levels compared to alternative employment in the relevant disciplines.

2. Market-led Stipends

The absence of pricing signals in the PhD labour market can be addressed by adding a further feature to the Collaborative PhD concept. If the field of study is one with high market demand for graduates, and consequentially high remuneration, allowing the sponsor to top-up the stipend beyond the accepted standardised level set by government would be highly desirable.

3. Extension of the Collaborative PhD Scheme to CRIs and IROs

There would be benefits in extending the Collaborative PhD scheme to CRIs and IROs provided they were not allowed to use it to cross-subsidise other programme or project funding from government. If a CRI or IRO forecast a future need for new staff in a particular discipline, they could use the Collaborative PhD and the opportunity to provide a market-led stipend to support PhD students, working on the CRI or IRO premises. That would then create a pool of labour for the CRI or IRO to draw on.

Wider extension across the public sector, e.g. into social as well as scientific delivery agencies, could be contemplated.

4. PhD Programme Designs Suited to Te Ao Māori, and Pacific Contexts

A Collaborative PhD suited to the private sector would ideally be paralleled by a PhD programme design (or designs) well suited to Te Ao Māori and to research conducted in Pacific contexts. If such a scheme is well-designed and executed there is a high likelihood that the graduates would create their own future employment role as they successfully undertake their studies partly or wholly embedded in their end-user community.

[16] **https://royalsociety.org/-/media/policy/projects/doctoral-students/doctoral-students-career-expectations-principles-responsibilities.pdf**

5. Core Transportable Skill Elements as a Core of all PhD programmes

As set out earlier, it is beneficial that some out of field employment continues, but under-employment is undesirable. Even if a student undertakes an academic-style PhD there would be benefits if they were required to undertake a core element of preparation for future employment. For example, The Royal Society[16] (London) has provided a recommended set of guidelines for assisting PhD students better plan their careers, intended to be supported by higher educational institutions delivering personal development programmes. This is something that New Zealand universities could agree to develop themselves.

A desirable by-product of a core skills programme is that it incentivises students to think about developing their skills in such a way that they might create their own future employment role.

A secondary benefit of such a core element would be that it would provide a means for ensuring all PhD students received good quality information on career prospects, and this in itself would be likely to improve the labour market performance.

6. Re-examination of Government Policy Settings

The potential impact of funding models, extensive over-bidding, funding caps, low levels of core/SSIF funding in CRIs, and the PBRF are set out above. These might warrant further examination. Part of that examination should be to consider whether there are any effects that are borne inequitably by female PhD graduates.

There may be benefits to review the scale of, and improve awareness amongst end-users of, the various schemes operated by Callaghan Innovation for improving business–academia linkages, and ensuring that the forms of post-graduate qualification do not form an impediment to scheme uptake.

7. In Summary

The central theme for possibilities for improving the research labour market is allowing for different forms of the PhD, so it is a programme shared between end-user and university communities. Building into those flexible forms, the opportunity to vary labour pricing would also lead to improvements. A core skills component of all PhD programmes would also be beneficial.

There would be benefits from policy work on the design of government research funding instruments to ensure they are not creating unintended distortions with negative impacts on some parts of the research workforce.

By these measures, the precariat can be significantly reduced in size, and those of our best and brightest who want to contribute to this country will see exciting and meaningful opportunities.

Part D
Wāhanga Tuawha

Impact of COVID-19

The following may occur as a result of the COVID-19 pandemic:

- A reduction in employment opportunities open to Bachelors and Masters graduates, which may lead to a higher supply of domestic students wishing to enrol for a PhD;
- At least in the short term, there will be major disruption to the number of international PhD students — those enrolments may never return to previous levels;
- Inward migration of doctorate holders will be disrupted and likely reduce very significantly for some time;
- The net rate of increase in doctorate holders amongst the work-age population is likely to remain significant, at least in the medium term;
- In real terms, public research funding could reduce slightly, and may not increase for some time, so employment opportunities in public sector research roles may well be limited in the short term, and only recover slowly;
- Private R&D expenditure in some sectors may be cut back, at least for a period of time;
- The precariat may be disproportionately affected. If staff reductions are to occur, letting fixed term contracts run out may be a preferred choice;
- Anticipated research outcomes of existing research programmes may not be met, meaning that those involved, and particularly those in the precariat, may have a lesser track record than anticipated.

The suggested re-evaluation of relevant government policies in section C may not have high priority amongst the other urgent matters that government will face. Further, the fiscal ability of government to make changes that involve new investment will be severely limited, so if changes are to be made soon, they may need to be cost-neutral and undertaken by other players in the research community.

This may place the onus more heavily back on universities to look at the nature of the PhD programme, and to modify it to give students improved preparation for the very different post-COVID world. Some universities might choose to seek sponsors for the style of Collaborative PhD envisaged in section C, which in turn would grow the demand for their PhD graduates.

The CRIs and IROs may also choose to invest strategically in a “made in New Zealand” research workforce as part of their COVID-19 response.

Part E
Wāhanga Tuarima

Outcomes from Research Workforce Workshop Held 30 November 2020, Te Whare Apārangi

A. Workforce Overview

The aim of the workshop was to look at how well the numbers and characteristics of research-capable people entering the workforce aligns with long-term employment opportunities in the Aotearoa New Zealand research sector.

It is acknowledged that there is a significant and growing body of evidence that recognition and career progression of female researchers, Māori and Pacific researchers, and perhaps other researchers of non-European ethnicities in at least some employment contexts may not be equitable. The workshop and its briefing paper did not set out to examine such career progression issues arising within long-term employment, focussing instead on factors affecting the initial attainment of long-term employment. This in no way suggests that one or other issue is more important. Both need consideration.

These notes represent a distillation of the briefing paper elements on which there was broad agreement, discussion outcomes that were reported back, further elements taken from table discussions, and a little new material in order to construct an interpretative narrative.

1. From the Briefing Paper

- There are 18,000 to 20,000 researchers (excluding PhD students) in this country, about half in universities, no more than 5% elsewhere in tertiary education, close to a quarter in CRIs and IROs and the remainder in the private sector.
- Of the 30,000 PhD holders of work-age only about one-third are employed in research.
- Growth of research employment is slow and far less than the 1,000+/year net growth in doctorate holders. Net growth is determined by subtracting those leaving the work-age cohort from the sum of domestic graduations, some retention of international students, and inwards migration – both to jobs and as partners of visa holders.
- To the modest extent that researcher employment growth is occurring, it is in research-only roles in universities (likely to be fixed term), and research in services in the private sector – but the latter is in those disciplines with low numbers of domestic PhD completions – engineering, IT and business disciplines.
- The vast majority of PhD graduates can expect to make careers outside both academia and even the wider research sector – their prospects depend on their generic transferable skills and willingness to adapt and learn, not the academic outcomes they have achieved.
- Researcher career experiences show (outside engineering and related technologies) significant unemployment or under-employment, reliance on temporary roles in early career, shifting overseas to seek research work, and little income progression in the first decade post-graduation.
- In New Zealand there is a significant size precariat seeking to build a track record via temporary employment to win a permanent research role, and this precariat is largest in natural and physical sciences, health and medical sciences, and society and culture (social sciences and humanities) – the fields in which New Zealanders prefer to study.
- Women, Māori and Pacific researchers are strongly represented in the precariat – in part because they are more numerous in fields which have higher levels of precarious employment.
- Creation of more temporary roles increases the number of people in precarious employment, and probably also increases the dwell time in the precariat to build a sufficient track record to win longer term employment.

2. Additional Information Brought Forward at the Workshop

- About two-thirds of the 4,000 or so CRI staff work in research teams (including technicians etc.).
- CRIS recruit 75-100 PhDs annually, of which just over 40% are from off-shore, but some of these are returning New Zealanders.
- Over the last decade, joint supervision of PhDs by CRIs with New Zealand universities has declined from 441 to 315 students (but Masters students are increasing); however, there are increasingly formal co-supervision arrangements in place (e.g. joint graduate schools), and about half the co-supervised PhD students work on CRI premises.
- CRIs are taking on more post-docs (present headcount of close to 100) as the number of PhD students they co-supervise has declined.
- Anecdotally, some CRI recruits prefer a limited term post-doctoral role to a permanent researcher role – they perceive the post-doc title as more career enhancing, and are prepared to accept limited term employment in order to get it.
- IROs have similar experiences to CRIs: geographically they are not in places where PhD students are produced; their work is in primary industries/environment, infrastructure and economy and health – to meet their needs they also go overseas to find suitable staff.
- Anecdotally, some PhD graduates struggling to find employment have resorted to not showing their PhD on their CV in the belief that holding a PhD could act be a deterrent to employment.
- Prospective employer experiences are that New Zealand-educated PhD graduates have an aspiration to continue the style of research they learnt in university.
- The motivations for many Māori and Pacific PhD graduates are service to their community rather than economic outcomes, and they seek employment with this ethos. Opportunities for them are limited if available research funding is strongly directed to achieving economic outcomes.

B. Problem Definition

- New Zealand has a significant mismatch between the fields of study and aspirations of its PhD graduates, and their likely employment opportunities – what is known as a poorly performing labour market.
- If it can be demonstrated that those who work out-of-field, or accept work not meeting their initial aspiration at graduation, are collectively contributing in positive ways to New Zealand, there is no reason to reduce the numbers of graduates; rather, the issues leading to the mismatch should be addressed.
- The human cost to many of this nation's best qualified people of large scale temporary employment in the research sector is both significant and unacceptable in the longer term; particularly if reasonable actions to reduce the extent of mismatching can alleviate or reduce those costs. Creating more temporary employment (e.g. post-doctoral fellowships) can have short-term benefits, but may worsen the long term issues.

C. Potential for Improvement

- Effective matching of people with skills to opportunities is supported by good quality information being readily available to participants to support informed decision making, ensuring the remuneration offered is competitive with alternative forms of employment for the skill set, and the absence of restrictive or distortional system settings. Additionally, there is the possibility to change the skill set of those seeking employment to better match the types of skills in demand by employers, or the possibility to change employer expectations.
- Because the issues and the ability to attract research sponsors differ between fields and the differing aspirations of different student cohorts e.g. many Māori and Pacific PhD graduates have a strong community focus, there is no one size fits all approach.

1. Data and Information

- Very significant improvement would be expected if the sorts of information in the briefing paper, plus comprehensive career trajectory data are routine collected, analysed and communicated at multiple levels, for example:
  - Prospective and enrolled PhD students – so that they have realistic expectations and can factor the information presented to them into their decision making on the benefits and likely career outcomes of undertaking a PhD, choice of project, supervisor and university, and their desired future career.
  - PhD supervisors – so that they more accurately inform prospective students of follow-on employment prospects, and supervise the development of broader skills to better support likely future careers, rather than just supervise the research project.
  - Universities – to inform prospective students, design and implement different PhD models, develop relevant core skills modules etc.
  - Other research organisations – so that they might choose when to co-invest with universities in skill development of prospective employees.

2. Renumeration Levels

- Different levels of stipend by field is a potential tool to encourage student choices to better align with future employment prospects. With an apparent oversupply of graduates in the most popular fields of study, and a pervading sense that all students should be fairly compensated, there are some reservations about using differing levels of remuneration by field to make study in a particular field more or less attractive compared to alternative employment opportunities. However, it should be recognised that standardised stipends are a convention and not a requirement. Greater availability, e.g. through research sponsor contribution of top-ups to stipends in high-demand fields such as agriculture/horticulture,

IT and engineering, would encourage students into those high demand fields. Communicating this possibility in itself could be helpful.

3. Changing the Skills Sets of Those Entering the Workforce

- There would be significant benefits from broadening the types of available PhD programmes to include the collaborative style of PhD set out in the briefing paper. One size does not fit all, and having a wider range of PhD styles would create a graduating pool that better fits more employment niches than solely academia.
- A complementary idea is of a "pre-doc" programme – the prospective PhD student spending time with a potential project sponsor and supervisor (like an internship) during which time there is relationship development and refining of the research project concept.
- Delivery of core skills programmes as part of PhD programmes with the goal of assisting PhD graduates to quickly adapt and assimilate into employment roles that are intellectually challenging but unlike their PhD study would also be beneficial.
- The journey through a PhD and then extended temporary employment in the precariat can be an uncertain, emotionally draining and sometimes unsafe experience; pastoral care and support systems may need to be better tailored to meet the reasonable needs of both individuals and identifiable cohorts such as Māori and Pacific students – ultimately enhancing their ability to contribute to the nation as well as advancing their own employment prospects.
- Data collection from potential employers to better understand their needs may be beneficial.

4. Changing the Expectations of Employers

- The possibility of educating prospective employers so that they can better understand, and thus can better use the skill sets of PhD graduates was discussed.
- Outside the material presented at the workshop there is a body of evidence of low research "absorptivity" in the New Zealand private sector compared to other OECD countries – low absorptivity means employers seem unable to take up and benefit economically from new research findings.
- Arguably, "pioneers" who shift from the research sector into the private sector, by demonstrating the ability to work in both worlds are likely to lift research absorptivity, and then make the case for and employ further researchers, including PhD graduates.
- This raises the question of the relative merits of educational programmes to change the expectations of employers, versus preparing more "pioneers" who have the skills to succeed in the private sector and change the culture there towards employing further researchers.
- There may be potential for educating public sector and even non-profit managers on the benefits of employing more PhDs, but arguably in those sectors the pioneering approach may be superior.

5. Distortional System Settings

- The system settings identified in the briefing paper as contributory to the issues were generally regarded as plausible. There was a range of views on how to address system settings from a complete system-wide review involving all players, to looking at particular instruments where immediate benefits can be demonstrated.
- One sub-group proposed to re-establish a national post-doctoral scheme.
- One sub-group identified the full cost model for research funding as encouraging applicants to propose PhD studentships rather than employ other researchers who would attract overhead costs.

D. Next Steps

- There was a consensus view that an ongoing programme of work is justified – the human cost of not seeking to address the issues is unacceptably high.
- It is important that the relevant Minister(s) are aware of the important issues, how understanding of those issues and potential solutions is developing, and that there is a commitment across the sector to see what can be done in short, medium and longer terms.
- Communication of what is already known from work to date can commence without delay – sub-sectors within the research community can take this upon themselves.
- Further collection, analysis and communication of various types of data as set out above is highly desirable, but requires an organisation with the access, resources and mandate – whilst some participants would like Royal Society Te Apārangi to take on this role it is not resourced nor mandated to do so.
- Royal Society Te Apārangi's Early Career Researcher Wānanga in April 2021 will provide an opportunity to gather more information from present early career researchers, and may lead to new insights.
- Subject to resourcing, the tertiary education sector can already take practical steps towards making available a broader range of PhDs, consider "pre-doc" programmes, and introduce core skills components of PhD programmes. Royal Society Te Apārangi might be able to assist the latter.
- Major actors in research funding like MBIE, TEC/MinEdu, HRC and the Society plus peak research organisation groupings such as Science New Zealand, Universities New Zealand and IRANZ might come together to discuss the extent to which system settings should be further reviewed.
- There would be benefits if Royal Society Te Apārangi was again to use its convening power in about one year's time to bring together a similar workshop to review progress.

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