Transforming NZ companies through innovation

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Future Pathways - Green Paper Submission from the Product Accelerator Submission #2,

Executive Summary

The first submission from the Product Accelerator (Submission 1) to this Green Paper contained general feedback about the science and research system in NZ from the viewpoint of industry, and background about the collaborative network established under the MBIE funding programmes of 2009 and 2013, for context.

This second submission addresses Key Questions and Points from the Green Paper, and provides feedback on how they can be addressed by changes to our research system and process, using the New Zealand Product Accelerator network and research model.

Introductory Remarks

The relationship with international trends in Research Systems is commented on often in the Green Paper. The connection of New Zealand researchers to the international community is often quite strong: for example the Product Accelerator has had international representation (x 3 leading professors) on its science board for 11 years and they were particularly useful at making connections into the UK Catapult network, network of CRCs and CSIRO in Australia, and the Advanced Manufacturing centres and NSF in the USA.

From our reading of the Green paper, we set out in this document to comment on a number of key passages and questions in order to demonstrate a different ***Research System approach,*** using collaborative, more inclusive networks which can marshal the best team around an issue, rather than efforts by a single institution alone. These Networks could focus on and address certain national research priorities in a much more effective, rapid way than at present. Of course, each Network would need to have accountability, and funding. The example of the Product Accelerator with its quarterly reporting to Callaghan is a 'pilot' example. But the Bioresource Processing Alliance (BPA), and the Food Innovation Network (FIN), are others. These networks are not yet tasked with National Priorities, but they could be.

The research institutions themselves, and the outstanding researchers within them, would then be tasked with developing the deep science capability to input into these Networks, and be held accountable for doing so. This capability development would sit alongside and complement the scientist-led, competitive Marsden and Endeavour grant processes. Thus a Focus on National Research outcomes, Deep capability building, and blue sky research…sitting alongside each other, in balance and complementary to each other. This is quite a long way from the thinking in NZ at present, but internationally it is more usual now, and we do have the successful pilot networks already in New Zealand.

Crucially, it is also evident over more than a decade of Product Accelerator projects that getting real world impact in commercially relevant timeframes, also requires a shift towards a new ***Research Process*** as well, one in which business and community needs are defined and analysed first, to identify the missing science. Our way of doing this is called Engage, Define, Connect, Deliver. Actually there are other similar approaches globally, they are just not yet used widely in NZ. The Green Paper does not get to this issue directly, but the desire for inclusivity and engagement of scientists with the community and business does come through in the Paper, and this will need a change in the general research process to achieve since it is not intuitive (or incentivised) for scientists to work first on the business and community needs in partnership with those groups. This partnering research process also drives a new collaborative, outcome-oriented culture, within research groups who apply it.

Summary Recommendations on Research System design

This section brings the findings from the bulk of the Submission below into a summary form for ease of reference. More detail is given on each, within the body of the submission.

1. National Research Priorities should be systematically decided and regularly updated and sharpened by the establishment of a peak 'Innovation Council' convened by MBIE and consisting of innovators across the sectors, communities and including key research leadership. Priorities should be described as Outcomes for New Zealand, with 1-year, 2-year and 3-year milestones and timeframes, so that rapid innovation is essential to reach the community and economic goals.

2. More effective and productive connectivity should be developed across the researcher/practitioner/community/Maori/business communities through a robust and systematic collaborative model. Established Industry/Academia/Community Collaboration models like the Product Accelerator and the Bioresource Processing Alliance have been iteratively developed and proven over a number of years in the New Zealand environment and have succeeded despite entrenched competitive attitudes and financial barriers. These working models provide the pilot for New Zealand to deliver tangible and valuable national outcomes. We need to expand this existing activity, and seed more of the same types of activity wherever connectivity and collaboration are weak.

3. The best young researcher pipelines should be developed with students who are actively involved in creating outcomes that are clearly beneficial to the nation's prosperity, safety, health and welfare. This framework would ensure that science education is inextricably linked with research that creates the most valuable scientific outcomes. These in turn, as it has been repeatedly shown, are collaborative outcomes.

4. It is necessary to review how our education and science institutions relate to collaborative alliances, and inclusive networks such as those exemplified here. These networks bring with them their own governance, executive management, and resources, and should be hosted at commercial rates that recognise not only that they are less overhead-intensive, but also that they uncover the best new horizons to both teaching and research, and therefore benefit the institutions' health in the long term.

Green Paper Feedback

Green Paper - Foreword and Introductory pages.

1. A re-designed Research System must respond to the nation's present and future needs, for example in the Economy. The following are listed as potential impact areas:
    a. Food and Fibre
    b. Industry Transformation
    c. Knowledge intensive industries
    d. Productivity and Frontier firms

2. Weak connectivity between researchers, and with industry, Māori, international players and the public sector is recognised as a major problem with the current system.

3. The absence of clear national research priorities is the second serious weakness, since most organisations have conflicting and multiple priorities.

Feedback (Key questions 1,2, and 9, 13)

The focus in the paper is on how the various research organisations can be persuaded or designed to work together and with stakeholders – industry, Māori, public sector – to improve connectivity, through changes in the Research system. There is no mention throughout of how this problem is being addressed successfully in NZ over the last decade however – in pilot programmes and networks such as the Product Accelerator, as an example.

In fact, the power of collaborative networks which include the 'stakeholders' and institutions as partners is not mentioned. In the Product Accelerator network this collaborative power is focused on the country's economic wellbeing, with several national research priorities emerging over the last decade through hundreds of community and enterprise engagements. A national network makes the difference for a great many of our enterprise partners . Dean Rope from The Comfort Group put it this way:

"we appreciate the exposure to the wider NZ Product Accelerator's network. Working with the NZPA has become an important part of how we operate as a business and is now specified as part of our R&D budget process."

https://www.nzproductaccelerator.co.nz/2022/01/11/the-comfort-group/

More case studies appear on the same website above.

Green Paper pg. 18-24

4. The problem of many and conflicting research priorities and projects across the system is observed early in the paper, leading to poor use of limited national research resources. A method for selecting and reviewing National Research Priorities is urgently needed, so that the message about what is important to the country is clearly understood. Possible examples of these high level priorities are also given:
    a. Climate change
    b. Fresh Water
    c. Infectious diseases
    d. Food
    e. Advanced Manufacturing

    There is currently no single set of research priorities for New Zealand. And the question about how to determine these priorities, in scope but also in process and operation is posed (Qu. 1-3). What principles should be used ?

Feedback (key questions 1-3, 9, 13, Figure 1 on RSI organisation)

We think the above examples of high level priorities are very good ideas, and need to be an outcome of a national innovation system and process. In the Productivity Commission report (Frontier Firms, chapter 11, pg. 187), and in our Submission to it, a new structure was proposed to enable the opportunities for innovation, and their target outcomes for the country to be distilled and agreed. In some sense this process is delegated to Ministries in the areas of Wellbeing, and Environmental priorities but without sufficient connection often to the development of new science and technology.

In the area of Economic wealth creation, there is a more serious disconnect because the wealth generation through exports is diverse, poorly represented, and therefore not well understood. Innovation in advanced technology and advanced manufacturing specifically, are developing far faster than other areas and have the potential to completely change the export and domestic landscapes in all three spheres – economic, wellbeing, and environmental. If we can grasp the opportunity.

National Research priorities need to be analysed and sharpened over a period of time, using up-to- date information about the trends and patterns of innovation within NZ enterprises and where the scientific gaps/deficiencies are. The new, permanent structure, first proposed in our submission to the Productivity Commission report (Frontier Firms) was an Innovation Council, with business, Māori, and other community representatives and research leaders, perhaps operated in a similar manner to the MBIE organisation of the Advanced Manufacturing ITP, and reporting to a group of Ministers (MBIE, MPI, MfE etc). The Innovation Council would also have representatives of

innovation networks, VC's, NZTE, and others to call upon in order to have sufficient data to be informed of trends in innovation both locally and globally.

However this Innovation Foresighting process also needs to be bottom up, and start with grass roots innovation. In the Product Accelerator this is achieved through, Engagement, and Definition steps with the communities and diverse groups of New Zealanders concerned. The engagement process and initial discussions with industry does not start with Research priorities, but with the on-the-ground Priorities for economic, social and environmental wellbeing, and the opportunities to improve wellbeing. A partnership, rather than a stakeholder process to Innovation is needed: He waka eke noa.

Below these national research priorities, at the more detailed level, each priority needs to be defined in terms of questions and opportunities which come through interaction with innovators in all sectors, including and especially from diverse groups such as Māori, businesses, entrepreneurs, public sector, and technology developers. These interactions are formalised as Engagements and Projects in the Product Accelerator and are reported against, along with outcomes each quarter and annually. These data will be made available to MBIE separately on request, and is a design feature to hold the network accountable for its work and its impact.

Poor connectivity between the Research System and the rest of the community is, at present, preventing real progress. Solving this problem requires deliberate and systematic steps to Connect with the community groups and enterprises in partnership, and to Deliver a plan with actions and real world outcomes. This work is most complex in economically related national priorities such as Advanced Manufacturing where the innovative enterprises are many and small in size.

A trusted, 'NZ-Inc' network approach is a fast, effective way to get good breadth and also depth of coverage with these enterprises, working alongside other organisations such as EMA, KiwiNet, and VC groups like Matu. In this way the network rapidly gathers sufficient data about innovative technology opportunities to address them in a platform manner for larger and larger clusters of enterprises. An example is surface coating technologies which are being developed for many NZ enterprises through start-ups such as Inhibit Coatings. This company grew out of the Product Accelerator network through addressing the key aspects of the commercial and market opportunities of manufacturing and coating companies using advanced technology , along with the research needed to achieve or contribute to this technology.

https://www.nzproductaccelerator.co.nz/2022/02/08/inhibit/

The result of this engagement and outcome-based definition process is to focus more researchers on the national goals and their own actions which contribute to these, rather than having to select their ideas (or what is hot in the journals) as the topics for research in isolation.

Rather than changing every existing organisation to develop and adopt this new alternative research process, we strongly recommend that the Government examine the

process which has been developed already and piloted over 12 years by the Product Accelerator, containing the above four sub-processes. For example, the research priorities required to accelerate advanced manufacturing in New Zealand cannot be predicted or invented by researchers alone. The research questions are being 'pulled' through the collaborative network from the innovative enterprises that partner with it, using the engagement process previously outlined, to define the market opportunities and research questions. The result over the last decade is rapid, transformational change in many of these businesses, through shorter, intensive research projects which could never have been predicted, nor have been undertaken within a single institution.

An implicit assumption in parts of the Green Paper is that transformational research is long term and driven by 'stretch' or novelty science alone. This is a damaging assumption, and deeply flawed, at least in economically-related research which must produce results within a year at the outside, and first indications within 3-6 months. The new, inclusive and collaborative research process piloted by the Product Accelerator (and in a similar way by the BPA), has also been applied in several countries including the UK, Australia, Singapore and the USA, and starts with an engagement process using expertise across extensive, trusted networks of research and technology providers in industry. It is now time for New Zealand to include these network structures into the basal design of its research system.

Green Paper Chapters 3,4

5. The features of a modern research system are discussed in the paper, in conjunction with funding of the research priorities and the design of the research institutions themselves. Features of a modern (international) research system are listed, such as:
    a. Future-focused
    b. Adaptable, responsive to national research priorities
    c. Connected
    d. Strong leadership role in future state of nation
    e. Others

6. These characteristics are seen to be the result of design of the system, and the institutions themselves. Therefore with the right system design (and of the institutions) we should be able to achieve the research priorities in New Zealand, along with a distinctive guiding principle of Te Tiriti.

Feedback (Figure 1 on RSI organisation, Key questions 9-10, 13-16)

It is probably a mistake to assume that research institution(s) organisational design can be re-fashioned to achieve these sought-after characteristics, or even that these characteristics themselves will produce research outcomes matching the national research priorities. Our experience in the last 12 years is that the whole research process often needs to be different to achieve real world outcomes. This includes deeper engagement and partnering, and crucially the definition of the broader community challenge and research question being undertaken – collaboratively with the clients, right from the start.

Our suggested approach instead is to imbue new, single purpose network structures with one or more of the new national research priorities each, with these priorities stated in the form of high level, multi-year outcomes for the country. Each network could be funded through grants awarded to its constituent partner institutions, these being used specifically to fund the network operations, at much lower overhead rates (since the funding is essentially for people). The networks need to have independent governance (e.g. a Board), so that they include multiple institutions but can make their own decisions based on the Outcomes they are tasked to achieve, outcomes which contribute to economic growth of exports for example. Individual institutions would be incentivised to contribute scientists to the network(s), but the network leadership teams would contain sufficient experience in the real world (e.g. industry) and authority to develop the collaborative culture required for success.

Industry and other clients will partner with these 'designed' networks on projects which include the practical outcomes, engaging using the new research model to define them, and paying for the projects in small staged blocks such as 3 months, or more. The

enterprises need to pay, or pay their share of direct project costs in this network model, with Government funding providing the underpinning resources for the network to engage continuously with an expanding ecosystem of clients and technology providers throughout the country, and including international market linkages as well.

Government funding could also include progress towards Network milestones defined by a National Research Priority, to ensure that the commercial or enterprise related project activities contribute to this priority – to the Public Good in other words. The Government funding also goes hand in hand with appropriate Governance arrangements and transparency of operation for each network – recent models for this include SfTI, and also Ara Ake in Taranaki, as well as the pilot networks exemplified above.

*The issue of **Research Overheads** levied by institutions on all research grants/projects is a current barrier to the growth and even the establishment of these network structures, as well as a barrier to the employment of institution-based researchers directly on national research priorities, where more intensive and diverse researcher engagement with the community is urgently needed. Below we offer one suggested simplification to the research overhead system which would remove this barrier:*

- *i) Research Overheads would be calculated and levied as a justifiable % of all research projects and grants based on the actual support provided: 30% of the total grant or project, would be internationally competitive. This was where some Commercialisation units at TEOs used to be, for example.*
- *ii) The institutions would receive a core, administrative funding grant from the Government, for their main functions, including education, and/or deep capability development in designated areas. This might include some PBRF and other KPIs, such as the impact on New Zealand of its research according to agreed criteria (e.g. public good science, economic relevance, start-up businesses and footprint). Although publications will still be important for reputational reasons and international students, at least for most of this decade, the KPIs should also reflect Impact in NZ. Such a shift will necessitate major re-thinking of academic performance in New Zealand, although this process is already underway in Universities and Government research institutions internationally..*
- *iii) Institutions would receive another significant incentive payment in proportion to their contribution to the achievement of National Research Priority Outcomes, based on how well each institution supports the work of the Networks tasked with these priorities. And the Networks should have input to how well the Institutions have actually done this. For example, institutions which allow flexibility in the Research Process (previously described, focused on Outcomes) used by their employees through removal of discriminatory Academic standards and employment categories (academic versus professional staff) would score higher in terms of contribution to the networks and their national goals.*

The above funding structure will incentivise the institutions to behave collaboratively and strategically, in order to maintain and grow their funding and research on the national research priorities and especially on their outcomes. Our observation on several

occasions is that if these network structures become part of the permanent research system, they can assist with alignment and change within the partnering institutions, and especially in the characteristics listed in the Green Paper such as connectedness, and responsiveness to national priorities. This is not only because of aligned funding incentives, but also because the 'pull' from communities and businesses for specific research through the networks becomes properly connected with the longer term, underpinning research within each institution. This translation is already proving valuable for both the institutions and for the communities which want to be connected to the latest research.

Green paper pg. 30 -38, 62

7. The section deals with the operational oversight of the research priorities, governance and the way that research excellence is achieved and assessed. The need for dedicated funding of each research priority is noted, and the number of different governance models are also evident – in part because of the complexity of many different types of organisation being involved.

8. Importantly it is also noted that research excellence may be differently defined based on the type of research being undertaken (which priority is being addressed). This is not discussed in detail however. The linking of transformational and research excellence is not made explicitly but is clearly still an ultimate goal of the research system. In this regard it seems that developing the New Zealand system to be similar to the European system has been selected as an important direction in the paper. Grand challenges are also mentioned in this regard, as an international trend to which researchers aspire.

9. There are observations about the fragmentation of the research system and also the lack of engagement of innovators with NZ research in many areas. There does not appear to be any analysis about why this fragmentation and disengagement has occurred in New Zealand. This analysis could be more useful than looking to Western Europe for solutions.

10. Commercialisation, as a route to achieve research impact is discussed in detail (pg. 62 on). The first barrier to impact is said to be that "Not all research findings are capable of being operationalised outside the research environment…It can be prohibitive or sometimes impossible to establish whether this is the case early in a research programme."

Feedback (Key Question 13, about Operationalising research, Impact, and Outcomes)

Historically, our research institutions have been multi-purpose, and are in no way designed to specifically target and deliver practical results on research priorities for New Zealand communities. This is even evident in the assessment of research excellence, which is seen only in terms of international benchmarks. If the research system design is to be improved as discussed in this Green Paper, the difficult step of re-defining research excellence will have to be taken. Excellence needs to relate to the connection, relevance and impact of the research in New Zealand communities. Of course it must also be informed by international work, and in many cases the work of NZ researchers will be in adapting science and developing technology which originates off-shore.

This is a fundamentally different research pathway and will apply for some, not all of the national priorities, particularly where speed and outcomes are key to success. For example, Food research, and Advanced Manufacturing need this research acceleration process, but so does research on Infectious Diseases. New vaccines, and new, knowledge-intensive product breakthrough have many similarities and both must occur within months from identifying the market, not within 3 – 10 years.

Yet these breakthroughs are transformational !

A new research process will not occur through the existing research institutions alone, since all of the institutional processes are based around long (PhD) degree completions, multi-year grant funding, and promotion of individuals based on publications. Changes are incremental and very slow, if they can occur at all, as demonstrated by the PBRF process over the last two decades.

Structures which include membership of the institutions, but also integrate the innovators, public sector and technology development enterprises into a ***collaborative network*** *are needed. Networks are now a proven mechanism, albeit only at pilot scale. In the NZ Product Accelerator, the research process has moved from the old, linear sequence of isolated research tasks, without real world signals or time constraints, to a parallel set of connections, tasks and analyses of existing knowledge. The outputs of these Defining tasks is an agreed technological pathway, and usually a very specific basic science question where high level research is needed. The collaborative process, and rapid progress towards a viable technological pathway gives the client enterprise or community the confidence to invest in the subsequent research and delivery of the technology, especially in the case of businesses – since their failure risk is quickly reduced and managed through the speed of the initial outcomes – such as the feasibility or otherwise of their product concepts.*

A research process based on Community Pull, not Researcher Push, and with real outcomes in 6-12 months, not years or decades is what Excellence looks like. Yet on page 60 in Figure 3 of the Green Paper, outcomes, time scale and research process are not actually mentioned.

Then on page 62 in respect of commercialisation, the comments regarding the difficulty of predicting or knowing whether research can be commercialised at the start are in large part due to the old, linear style of research process being employed, rather than a collaborative definition of the actual problem or question which needs to be solved. ***This is probably the main reason for poor commercial application of economically related research in New Zealand over recent decades.***

Green Paper pg. 68-69 on, and key question 14.

11. The research talent pipeline is of critical importance in the research system, and is presently under-resourced in general and especially with respect to Māori. Question 14 addresses this issue with respect to how workforce considerations can be incorporated into the design of the national research priorities.

12. The statement of the current situation (page 68) is clearly correct: "In particular, we will need to have, attract and grow research leaders who excel at working in multidisciplinary and multi-organisation environments, to draw researchers together to deliver excellent and impactful research."

13. The observation is made that researchers are incentivised to publish more papers, rather than for their work in leading research groups and programmes – due to global norms for research careers.

Feedback (key questions 10, 14-16)

Young New Zealanders mostly do not enter the research system in New Zealand at all. This has been the case for several decades at least and has been masked to an extent by the large number of talented international students who have enrolled at our Universities.

Why do New Zealanders not want to do research? The answers to this question are to be found in every recruitment discussion that we, as academics have with our final year students each and every year: "I need to get a job", "I want to do something that makes a difference", "I enjoy working in teams with other interesting people – not on my own writing papers that not many people ever see".

The answer to attracting and retaining talented New Zealanders in research here is to make the research process and its organisation something that meets these expectations. It is time to 'democratise' research in New Zealand so that it becomes relevant to everyone, especially young people, and actually looks like a 'real job'. However these are not the environments or the work that most researchers in New Zealand are engaged in. And that is because the research process is still driven by an elitist, 'novelty/hot international topic/grand challenge' view of excellence. It could be that in the past, global norms lay behind this problem. This is hardly an excuse now however, with many countries producing data showing almost no readership (apart from the authors) behind many, so called high impact journals. This in no way means that all academic papers are a waste of time. However, the balance of researcher communication has become completely weighted towards academic papers. At least half, and possibly more of the communication must in the future be focused on community impact, rather than academic publication.

It is really encouraging to us that the Green paper has identified the need for "research leaders who excel at working in multidisciplinary and multi-organisation environments,…to deliver excellent and impactful research." This is something we have been continually conscious of and have systematically addressed within the Product Accelerator network. Every research project that we undertake with commercial enterprises is led by a Project Lead, and this role is filled by young and mid-career researchers who work with the enterprise partner and a multi-institution, multi-disciplinary project team to achieve defined outcomes in product and process development over months, and then over years. This role is using advanced scientific and research methods to solve real world problems, through an extensive, supportive and knowledgeable network

Redressing the balance is about what our research system measures and how that influences funding of research on the new national research priorities. The new measurement system needs to be outcome-centric, rather than researcher-centric. For example, the NZ Product Accelerator seeks and reports information from client partners about 1) the Potential Revenues and other real world outcomes from projects, and 2) what revenues and other outcomes have actually been achieved each year. Another indicator of equal importance which is reported is the students and researchers who have transitioned out of the institutions to work within the enterprises engaged with the NZ Product Accelerator network. Publications are also reported, and co-publishing with the enterprise clients is especially encouraged.

To achieve and report these indicators, the time scale of individual research projects needs to incorporate some applied research and client delivery steps of 3-6 months, interwoven with potentially longer programmes of 1-3 years involving more basic research training. Crucially, these longer research tasks remain connected to the delivery of outcomes to clients, through the project management and control activities within the network.

Students in this research environment therefore have both basic and applied research training, as well as the multi-disciplinary and multi-organisation experience which allows them to build relationships through the whole innovation ecosystem and to then lead programmes themselves. Some go on to run start-up companies and set up R&D activities within existing companies, while others lead multiple projects with clients in the network. The MacDiarmid Institute, and Dodd-Walls Centre are two more networks doing the same type of client-facing research, and have been connected intimately with the Product Accelerator network since 2019.