Submission to the Productivity Commission on 'New Zealand firms: Reaching for the Frontier"
17 Jan 2021

Precis

New Zealand Frontier Companies' successes are almost entirely based on innovative R & D that is not a separate part of what they do but embedded in everything they do – they innovate "on the fly".

The submission presents a perspective on NZ's advanced and technology rich exporting firms by those involved in them which is more sophisticated than traditional perspectives. This viewpoint reveals that traditional approaches to stimulating and growing this sector need to be significantly adapted to be effective in New Zealand.

In the markets that suit New Zealand's size and relative isolation, there is no established technology – our Frontier Companies are creating that as they go.
If we focus on trying to get Frontier Firms to emulate, or blueprint, competitors overseas we will fail through lack of scale and resources. Where successful, we have been, and must continue to aim to be, the technology yardstick that others use to measure their R & D effectiveness.

The future of Productivity for NZ is about the value of our products in short run, complex market niches. We need to concentrate as much as possible on creating even more clever New Zealand companies targeting niche technology markets that support higher margins and prices, and thus reduce the country's reliance on low value commodity exports. The net effect being to increase our average output per productive employee and the number of high value jobs, through a progressive change in activity mix across the economy.

The focus should not be on numbers like percentage investment in R & D (since it doesn't incorporate most of our product development costs) but on the right people, the right thinking, the right technology-defined niche markets, and trusted Networks; and on tuning infrastructural, and particularly innovation support, to multiply the impact of Frontier Companies, their financial success, and their inspirational role model roles in encouraging other start-up and pivots.
There is no Panacea - We need a Paradigm Shift.

This submission focuses on explaining the character of NZ frontier firms, the barriers to their development, and the initiatives needed in an advanced manufacturing development plan to grow the sector as above.

Introduction

1. This is a submission on the Productivity Commission's draft report titled 'New Zealand firms: Reaching for the frontier", December 2020. The authors of this submission have extensive experience in the management and governance of innovative companies, the design and implementation of innovative business strategy, and the workings of the NZ science and innovation system. Two of the authors (Bentley and Wilson) have collectively over 20 years' experience as directors and chairmen of CRIs. Together the authors have extensive (50 years plus) experience in senior executive and governance roles in Frontier Firms.

2. We would appreciate the opportunity to present our submission to the Commission in person.

3. We are in full agreement with what we see as the two key recommendations in the report (2.1 and 7.4) which we reproduce here:

The Government should develop a clear overall strategy and take deliberate steps (in collaboration with business, workers, educators, and researchers) to upgrade New Zealand's innovation ecosystem and support the export, at scale, of goods and services with a difficult-to-imitate competitive advantage.

As a complement to broad innovation policy, the Government should partner with stakeholders to:

- *choose a small number of areas of the economy to focus innovation effort for the purposes of raising firm productivity and export success; and*
- *support these focus areas with a large enough proportion of its funding for research, science and innovation, export assistance and economic development to make measurable progress towards its policy objectives.*

4. In this submission we prefer to use the phrase 'advanced manufacturing development plan' as embodying the objectives above. Innovation policy is important, but it is not the only important component of the plan, and that, as is implied, the initial focus must be on **a technology-based economy where cross-cutting advanced manufacturing processes within each of our export sectors are used to accelerate growth in GDP and GDP/capita. We need the right people, doing the right things, and addressing the right niche high value export markets.** The submission comments on the special character of NZ's frontier firms in support of these views and how this must influence the choice of initiatives that best support their development and the possible range of initiatives required. We conclude with some observations on implementation and governance aspects.

<u>Advanced manufacturing is key to GDP growth.</u>

5. We have no doubt that the development of the advanced manufacturing sector in its broadest definition is the key to economic growth and higher GDP per capita. **Using the example of the 1950's and 1960's where advanced manufactured products were our biggest export category, it is not coincidental that this was a period where New Zealand was ranked number 5 on the OECD scale of GDP/capita. Enhanced productivity for New Zealand is primarily about getting more of the productive labour force creating revenues in the $250,000 - $400,000 per person per annum range that advanced manufacturing can deliver – WELL above the National average.** Manufacturing supports high paid employment and increasingly uses sophisticated electronic and ICT technologies to create competitive advantage, which in turn underpins the development of the associated ICT sector, as well as world-leading sensing, robotics and materials technologies.

6. Small, advanced economies (Singapore, Israel and the like) came to understand this decades ago and have nurtured their manufacturing base accordingly with good long-term outcomes. Large economies like the US, UK and China, have more recently designed comprehensive manufacturing development plans and implemented extensive supporting policies. These are designed to create environments that encourage manufacturers to innovate, invest and to seek export growth. *These countries do not sit back and wait for private market decisions to determine whether their countries will, or will not, participate in high-tech, high productivity industrial production – instead they take matters into their own hands with industrial development policies that nurture private companies and private investment while channelling them to produce maximum benefits for the domestic economy.* (From "Manufacturing Still

Matters", by Jim Stanford, Centre of the Future of Work, Australia Institute, June 2016, Section IV, page 9)

7. New Zealand has had no significant policies to develop manufacturing for three decades. Thus, the key draft report recommendations amount to a significant shift in thinking by the Productivity Commission which we fully support.

The NZ Frontier Firms

8. After three decades of neglect, NZ's advanced manufacturing sector has become extraordinarily fragmented and wholly self-contained. Frontier firms have long since learnt to be self-reliant in every way, and to operate effectively without sector collaborations, recognisable sector leadership and with the most minimal contact with central government and its agencies.

9. These firms operate in niche and fast-moving markets as discussed below. All this means that new policies to encourage innovation and sector development need to be designed with careful attention to their relevance and usefulness in a NZ context – simply adopting overseas policies will not necessarily work.

10. To illustrate this point further, the last and largest ever review of the state of NZ frontier firms, *Powering Innovation,* 2011 came to the clear conclusion that the single largest constraint for frontier firms was the disconnect between frontier firms and the NZ science system. **Firms find dealing with NZ's extensive and highly sophisticated science and technology capability so difficult and expensive that they avoid it**, choosing instead to recruit their own specialist advisors - mostly from overseas - or look to customers for assistance. To compound the difficulty firms find in dealing with the Science system, there has been a slow creep in what is judged "good science" amongst governance of the Science System, away from outcomes that have immediate potential commercial applications towards "stretch" blue skies, far horizon science. To quote some of the comments made by respondents to the "Powering Innovation" report: -

- *Publicly funded research organisations are set up as industry independent research providers and are not generally linked to a particular niche manufacturing sector or particular companies. Therefore, there is little networking and or interaction and companies do not identify with those organisations as being 'their' research providers.*
- *… none of the CRIs see it as their main role to visit companies to assess their needs and sell R&D services to them.*
- *Research organisations were not structured to perform contract or commissioned R&D in a commercially competitive manner.*
- *The way government funding is structured is a barrier/R&D grants favour big companies, not 'cash-strapped' young companies.*
- *… the level of cynicism/distrust of government funding mechanisms, arising from negative experiences around onerous processes, compliance rules and conditions that limit the practical effectiveness of the support and funding streams were "a tangled web."*
- *Research organisations historically developed IP in isolation, which led to solutions to problems that did not exist …*
- *We have found that very little of the R&D expertise in New Zealand research organisations is directly focused on delivering targeted output to business and industry.*
- *CRIs held the view that their primary role was investigator-led research …*

- *CRIs at times were expected to pursue research and commercialise it and, at other times, were asked to assist industry without having deep competence and were therefore unable to provide value to business and industry customers.*
- *IP was a barrier to companies using research organisations for R&D. CRIs have a 'we own it, you get no benefit' mentality and that universities are too rigid in their one-third (university), one-third (department), one-third (researcher) ownership and reward model.*
- *There is no incentive for business to engage with research organisations.*
- *… it is quicker, cheaper and better to do it yourself by using existing in-house staff and/or recruiting talented R&D-capable graduates.*

11. This situation is unprecedented in an OECD context, and in our view a hugely stultifying factor in the development of sophisticated frontier firms, and a poor reflection of the inadequacy of NZ government science and innovation policy over three decades. The situation as at 2021 remains no different from 2011. (We stress these comments are not a reflection on the NZ science system, which is world class, simply the outcome of the policies and funding environment it operates in.) Government has recently implemented a major R&D – based tax concession programme and an industry transformation programme which supports networking and discussion on sector issues. These programmes are in our view important but minor components of a comprehensive advanced manufacturing development plan, and on their own are nowhere near sufficient to make the paradigm shift required for manufacturing to contribute meaningfully to NZ's GDP, GDP per capita or export growth.

12. This is because NZ's export sweet spot for elaborately transformed products is in short-run niche production of 'leading edge' products. Our preparedness to provide the flexibility and effort to deliver and make money in these areas is now so much part of how the advanced manufacturing sector operates to compete on the international scene that we take it for granted. If it has been done before, or it is a large market on an international scale, it is not for a New Zealand company. For example FPH's declining market share of the sleep apnea market, in comparison to the global giant ResMed, despite FPH having pioneered it.

13. Frontier firms making products to address niche technological opportunities have become used to losing money on the first product made, the first batch, or even the first 100 batches; but that is typical of the majority of markets the frontier firms can get, maintain, and prosper from. In these markets product features iterate constantly and there is seldom a period of stable, high volume, production. R & D is constantly about D, where profits are made by determining how short a product introduction period can be, and how fast improvements can be made concurrently with production to get to profit. These practices are so engrained into how these firms operate that they tend to not even think of it as R & D. The costs of getting new ideas refined, market ready, and profitable are significant, but this is the nature of markets that represent the potential 'sticky business' for New Zealand frontier firms. This market adaptive behaviour has repeatedly created a widely held opinion that New Zealand companies underspend on R & D relative to their international peers. This is a dangerous fallacy. What is different in New Zealand is how we think about R & D. It is generally embedded as a huge part of "normal" operations.

14. The norm in most other countries is almost the complete opposite. Product introduction periods are long even for huge companies like Apple, Amazon, and the car companies, all R & D is done before production is even contemplated, and this R & D will be amortised over exceptionally large production volumes when the product goes live.

15. We can illustrate the unusual culture of NZ frontier firms in other ways. Why is it that there are virtually no companies that have survived in New Zealand ownership and profitable after moving their operations offshore? In fact, almost the only ones that have done so and survived have got there by rapidly retrenching to New Zealand (Glidepath, The Warehouse). Companies such as NZ Breweries, F & P Appliances, and Lane Walker Rudkin have failed dismally overseas with all the best management, engineering and governance New Zealand has to offer. Fletcher Building has tried to enter Australian markets multiple times, all ending in a mass of problems.

16. Further, why is it that when an overseas company purchases a New Zealand company that the company almost always rapidly disappears, unless the management and governance stays New Zealand based, as in companies like Sistema (where the sale/purchase agreement sought to achieve this) , Frucor, and the hospital IT systems company Emend? **These are not skills or knowledge issues; they reflect the unique cultural aspects of NZ frontier companies.**

17. On the marketing side things are also quite different. Marketing for a New Zealand company is all about convincing targets that we are trusted technology partners (or trusted NZ supply chains) who will work wonders getting new clever niche products to market in truly short times at very low cost. In Contrast, Marketing for most international companies is about aggressive brand support looking to enhance market shares by even points of a percentage as volumes are so high: - different skill sets, approaches, systems and management.

18. The CEOs and boards of NZ's frontier firms are characterised by strong leadership – **people who are independent thinking, inventive, and have the courage to make fast decisions** - but they have also implemented deceptively sophisticated management practices that carry staff with them in an inclusive and shared manner. This culture evolved in a minimal industry policy environment which has tolerated for decades and still tolerates a lack of collaboration between NZ frontier firms or in NZ supply chains and in country expertise, a lack of a shared goal across societal groups (like academics and industry groups), and a lack of interdependence of institutions and companies. It is not an exaggeration to call the NZ frontier firms as being 'man alone'. It is also why we know that these firms have little time or interest in engaging with government on innovation and industry policy.

19. It follows that the existing frontier firms are not necessarily a blueprint for NZ's future frontier firms, as seems to be suggested in the draft report. At Page 12 in the Commentary, it states "Exporting at scale is the way to reach for the global frontier" It is essential that there is reform of innovation and industry policy settings so that we develop a new cohort of frontier firms -

- that have much easier access to NZ's science and technology capability,
- that collaborate within and across sectors both up and down the value chain,
- that collaborate in sector related R&D development, and
- that have access to sophisticated NZ government – based venture capital investment funds to avoid forced dilution or exit during transition to commercial maturity and the consolidation of activities in NZ.

Innovation Policy

20. For frontier firms, the easiest opportunities to pursue are the creation of new sticky business in *known* markets and market segments, where often the specific science or technology needed is relatively well defined and can be addressed quickly. But as noted, frontier firms keep close control over R&D outcomes and technology development – hiring specialists, often from overseas to assist, and they have abandoned, with some exceptions, dealing with CRIs, Callaghan Innovation and the universities. The *Powering Innovation* report documented this in detail on the basis of extensive interviews of firm CEOs, and at the time it was a surprise to many.

21. The reason NZ firms find it hard to get quick, flexible, affordable interactive help from the science system is simply that the system isn't designed to deliver this. CRIs and Universities tend to be focused on delivering on major research grants, such as the Endeavour or Smart Ideas grant schemes, and supporting small business is less appealing, less profitable and distracts seasoned researchers. Commercialisation units such as UniServices and Vic Link, if approached, can broker a research study into a firm's request. However, this leads to a report with no implementation outcomes or even a possibility of one. The CRI Industrial Research Limited collapsed because it simply priced itself out of the market doing this – it had about 10 customers when it was closed. The universities also find it hard to engage with small businesses for similar reasons, but also because they are set-up to provide Research, and the PBRF funding programme discourages technology development or transfer, rather focusing on academic outputs like research journal publications, rather than applied outcomes in the community.

22. The treasury inspired initiatives to make sure CRI's are efficient led to the development of a system where they are forced to obtain large chunks of their funding (as Universities are) through contestable funding rounds (the Strategic Science Investment Fund – SSIF), rather than through their core funding. They are also forced to pick focus areas for SSIF funding and stick to them over some years, ensuring that for the period the science focus is 'frozen'.

23. CRIs obtain their contestable funding by chasing little pockets of funding much in the way a fantail darts around after pockets of insects. The way judgements are made by MBIE on these contestable funding sources, means that bids are not generally successful unless the focus is sufficiently blue sky to be considered "stretchy". Also, as is well known many CRI's and universities are forced to spend substantial amounts of funds to present good proposals (as the success rate is less than 10%) so that when the costs and senior investigator time associated with preparation are taken to account, the eventual funding obtained often only just covers the cost of application and detracts substantially from the institutions' capability to focus on the needs of manufacturers.

24. Further as these research programmes get traction, they start mopping up what little surplus funds CRIs have (as there are no MBIE funds for commercialisation) – as the CRI or University attempts to get the idea commercially relevant and thus sellable, and many institutions end up ditching multiple opportunities and focusing on one – surely a high risk strategy by any measure.

25. All of these settings distract institutions from doing economically relevant science and assisting frontier firms. However, to be clear we know there are many highly sophisticated

science teams in institutions, doing great science, *but they are not always doing the right things.* Thus, it is not only the structure and fully priced cost recovery business model that the science providers operate which is the problem. The additional problem is that we do the wrong science.

26. NZ decides where it will do government funded science through two programmes. The first is via the outcome of highly contestable funding programmes (Marsden, Endeavour, Smart Ideas, PBRF). The second process is where teams of scientists make choices through the CRI core funding and the core or PBRF funding received by the Universities.

27. The contestable funding programmes dominate the science spend, but the whole process is unbalanced in our view with the vast majority of programmes directed by government to support stretchy blue-sky research, and not enough on economically relevant science. This deeply skewed system is further undermined by the scientist-only selection panels. There is a good argument for the Marsden blue-sky fund, but the remaining funds should be allocated in our view with an economic component and the involvement of leading business CEOs.

28. Further, MBIE's various programmes are overly focused on research and not on technology development. The latter requires the wider aspects of business such as pilot plant and prototype development, engineering systems, skills development, and early-stage market assessment. As we have discussed small businesses don't want R&D in the traditional sense — they want fast solutions for low cost, and often D without R. This is a distinct feature of the food and beverage sector, where innovation is a continuous process of product development. Here, as elsewhere, high R&D does not necessarily equate to high levels of innovation.

29. There are plenty of alternative ways to prioritise where economically relevant funds could be spent. The "Knowledge Wave" was the most recent example at an attempt to get thought leaders from the science community brainstorming wish lists of potential new business areas that could be enabled by science in New Zealand. The idea was a good one but in this case the initiative was poorly implemented, and little was gained. However properly done, the outcomes of such a process could be framed into a science plan which split out the desired specialist research areas and delegated them to the most relevant national, cross-institutional team in each case. It should be noted that most economically important ideas do not and will not fit into either a single CRI or University space and now need to be allocated to science and industry collaborations as new focus areas for NZ – such collaborative structures have been operated in the UK (Catapult network), USA (advanced manufacturing centres), and in Australia (CRC's) for more than a decade now. Our CoRE's in contrast have been focused on fundamental research and education, rather than employing a pull mechanism to provide technology solutions to firms or even sectors. Now, by narrowing the focus under a broad definition of sector cross-cutting, advanced manufacturing processes, we believe that prioritisation is readily achievable, and moreover largely obvious.

30. A critical weakness of science and innovation policy in NZ is that the frontier firms are not at the table and have no coordinated voice or position on MBIE programmes or planning. The science community is highly organised and has captured the system. We have a chief scientist reporting to the PM for example. Leaving out the R&D tax credit, approximately 90% of government funding in this area currently goes to untargeted science – as the diagrams in the draft report show – surely a luxury NZ cannot afford.

31. Each University has a science commercialisation programme which to quote one '……. *connects entrepreneurial researchers with experts who are focused in their area of research. We help ideas become reality by wrapping a team of specialists around the researcher and their invention to see it through to success. By testing, protecting, and shaping ideas, we help create them into real-life applications that solve problems and change lives.'* In our view a great deal of effort and money is wasted by Universities in trying to push new science into some form of potential innovation. This model should be replaced with an industry pull process such as the NZ Product Accelerator, where firms and people with deep industry knowledge can guide identification of technology gaps, through interacting and accessing new science and technology. This leads to rapid evolution and application of new technology (see Addendum 1).

32. The NZ Product Accelerator (NZPA) programme evolved at eight Universities and CRI's (hosted by University of Auckland) through the last decade to provide a local, sophisticated, and easy to use capability for NZ firms with opportunities to innovate *in materials science initially*, and it has progressively expanded its reach to all economically important manufacturing areas, all regions of the country, with all Universities, GNS and two CoRE's involved, and working as part of the overall Callaghan Innovation agency. An addendum 1 to this submission to the Commission discusses the NZPA business model and track record, and why, in an extended development, the NZPA could provide the key 'pull' mechanism that enables manufacturing firms to connect with the university and CRI science and technology capability in all areas of technology development, both immediate and longer term.

33. A Science and Innovation Policy shift is essential right now to restore balance in the science system, and correct the issues identified in 27-29, and 31-32 above, as follows:

a. Creation of a suitable legal entity, and funding quantum for a scaled up NZ Accelerator, so that industry driven manufacturing innovations can be rapidly resourced and managed nationwide by the group, in concert with Callaghan Innovation, with participation across the public and private sectors. IP so generated would then be managed by this group on behalf of NZ industry, without imperilling IP generated and owned by individual firms. In fact a 'common NZ IP pool will accelerate development and application of other firm IP's through collaboration with them. **This action can be incorporated into the Strategic Review of the NZ Product Accelerator being undertaken Q2 2021 by MBIE and Callaghan Innovation.**
b. A live 'Menu' of fundable science and technology questions for investigation by NZ institutions (CRI's and Universities) should be created and include the identified science or technology gaps to maximise New Zealand benefit now and in the immediate future. This would include those recommended by the NZ Accelerator through its wide network of Industry and Academic practitioners, and entrepreneurs. Note this is a 'pull' process in which the people with deep industry knowledge guide and lead the definition of the technology gap to be addressed – a lesson learned the hard way through the precursor to the NZ Product Accelerator, the Materials Accelerator.
c. The Fundable Menu would be operated and updated annually by MBIE with the objective of rebalancing research in NZ so that a fixed proportion (say 50%) of new investment each year is directed to increasing triple bottom line value for New Zealand within a 5 year time horizon. Successful real world outcomes by an R&D team in this time frame should be rewarded with additional funding provided the

next value proposition (and the results) continue to stack up – thus growing stronger teams.

d. The above changes would require a significant proportion of R&D outcomes to be achieved in 1-2 years from inception, and to be integrated tightly from the very beginning with industry innovation. Ie. by using an 'industry pull' model such as that developed and proven by the NZ Product Accelerator.

The Advanced Manufacturing Plan

34. It follows from the above discussions that an advanced manufacturing development plan is multidimensional. For example, an Australian analysis listing 10 components is found in the following paper *'Manufacturing (Still) Matters: Why the Decline of Australian Manufacturing is NOT Inevitable, and What Government Can Do About It' Jim Stanford, Centre for Future Work at the Australia Institute, June 2016.*

35. However, as discussed, NZ frontier firms have their own set of issues, and we propose below eight component areas for policy development that could comprise together a comprehensive NZ manufacturing plan.

Proposed components of a NZ manufacturing plan

a) Sector Strategies
This involves government identifying the advanced manufacturing sub sectors with the competitive advantage and track record to warrant government nurturing and support. As discussed, this support is less about funding than intervening to create an environment that encourages approaches to sector-wide collaboration and new opportunities for innovation at the firm level. To achieve this will require significant changes in some long-established practices amongst science providers (point 33 above) and new or refreshed organisations focused on sector development.

b) Facilitating access to technology and science
Science providers need to be funded in new ways to allow frontier firms low cost and much easier access to their skills and knowledge, as has been discussed above. This would be achieved as discussed in 33. above using a scaled-up version of the proven NZ Product Accelerator model summarised in Addendum 1, with industry innovation as exemplified in Addendum 2.

c) Collaboration in delivery and marketing, the identification of industry good R&D requirements and the creation of sector networks, eco systems and clusters to facilitate all this.
Current Industry Transformation Plans are intended to describe an agreed vision for the future state of the sector in question and outline the actions required to realise this vision, including investment, innovation and skills development. These appear to us to be somewhat clumsy objectives. The ITP programme could easily be modified - *reflecting that real economically important innovation can only occur at the firm level* - and to focus instead on sector – based R&D requirements, sector- based collaboration in routes to market and marketing, and defining sector skills requirements.

d) Leveraging local procurement

Local procurement is significantly important in the establishment of many advanced manufacturing firms.
Example 1 - Engineered timber structures: recent research centred at Canterbury University shows that best quality pine can be engineered into a variety of sophisticated engineering products that can significantly and economically improve the earthquake resistance of houses, schools, hospitals and similar local and central government structures and can form the basis of a significant modular building export industry. This opportunity would be significantly enhanced if there were a significant NZ track record of government and local government purchasing and construction. Government agencies all chose to use historical construction processes in the Christchurch rebuild and an opportunity was lost to give proof of concept for timber engineered buildings for potential exporters. Engineered timber buildings are especially relevant in low rise construction (2-4 storeys) as is common in hospitals, schools, and numerous civic environments. Canada has developed a view that hospital timber buildings promote patient wellbeing and faster recovery and mandate them accordingly.

Example 2 – Medical technologies: NZ surgeons and specialists have a proven track record in medical device innovation at scale – but the ongoing pipeline of innovations depends on Pharmac continuing to allow DHB's to purchase and use evolving technologies (under strict oversight) as they have been doing for decades.

e) Creating a labour force that can work in advanced technology firms.
There appear to be major barriers to attracting school leavers into the fundamentally important vocational careers in engineering, electronics and ICT at Diploma or BEngTech level. The current average age of those in these programmes is in the high 20's and there are relatively few direct entrants from college. This situation seems to have been created by misleading university propaganda picked up by parents that university degrees are best, and also by the poor advice given to schools by the Ministry of Education.

f) Facilitating access to finance.
The NZ Government has no coherent programme for supporting the commercialisation of innovative companies by way of serious seed funding or pre-seed funding. The existing cohort of frontier firms have chosen to and learnt to organise business to self-fund innovation from cash flow, given the inherent risks in the innovation process. However, we propose there is a need for a sophisticated NZ government – based venture capital investment fund that firms could draw on to avoid forced dilution to foreign investors or having to relocate offshore during transition to commercial maturity and the consolidation of activities in NZ. We acknowledge this will not apply in all cases, but we assess there are plenty of innovative companies that in the past could have been be sensibly encouraged to stay in NZ through short- or medium-term equity or finance investment by a NZ Government agency.

g) Ensuring there is effective commercial and intellectual property law and standard setting.
The complete collapse of standard setting processes and monitoring, which followed the folding in of Standards NZ into MBIE, has significantly increased the risks of new innovations being undercut by rogue imports of substandard intermediary and finished products. In addition, the access to IP developed by institutions doing R&D in

manufacturing is very difficult for firms to access. This restriction is removed in the NZ Product Accelerator model and access to the best knowledge and IP is facilitated.

h) Implementing much more targeted and more effective tax incentives.
As discussed above, frontier firms do R&D to survive – it is an inherent continuous process in-built into the governance, management, and skills capabilities of the firm. As a consequence, R&D tax concessions do not in our view incentivise R&D in any frontier company and do not assist in creating innovative companies or innovative collaboration between companies. Of course, the firms like them and simply bank the cheque. This viewpoint is strongly held by two of the submission authors and comes from their personal experience managing and governing many innovative companies and being active participants over decades of many different innovative company's investment decision making. Where incentives become important is in capital projects such as pilot plants, and expensive market surveys and information collecting in overseas markets. We recommend the R&D scheme be adapted to explicitly include these types of activities. Note also tax credits by their very nature are paid long after the expenditures relating to the innovation are made (and possibly long after they were actually needed), and non-labour related tax credits are only available when a firm is actually profitable and paying tax, a further reason why there are much more effective ways to support innovative firms than by paying a credit against tax paid.

Implementation Aspects

36. The development and implementation of a comprehensive new development plan for the advanced manufacturing sector will necessarily involve government creating new ways to connect with and seek the inputs and assistance of the frontier firms. This is because we do not see significant reach or capability in most of the existing business facing organisations when it comes to the advancement of the advanced manufacturing sector or a refresh of science and innovation policy. However, the raw capacity of science and engineering faculties of most universities, several Government organisations (NZTE, Callaghan and the manufacturing focused CRIs Scion, GNS and Plant and Food), and the extensive resources within MBIE are able to strongly support this outreach process if the policy settings and peak innovation structures encourage it.

37. For these reasons we propose that Government appoint an advisory group that would scope out the key elements of a new advanced manufacturing plan leading to the creation of a concept ready for in-principle government approval. The committee should in our view include representatives from the frontier firms, NZTE, the universities, and the government science providers, and preferably be convened by a private sector person. Our preference is that the Chairperson report to the Minister of Finance but that the committee be hosted by MBIE. **The advisory group should primarily be populated by senior executives of Frontier firms.**

38. In a second stage, after appropriate government approvals, the concept will need to be taken into detailed design, and guidelines for policy formation prepared. As is current government practice (e.g. in carbon for example) the advisory group could be reformed as a government 'Innovation Council' linked to Callaghan Innovation, with a cabinet approved mandate as the Innovation Agency.

39. Of the eight elements of the manufacturing plan set out above, the first three (choosing sectors, facilitating access to technology and science providers, increased sector collaboration)

will require the Innovation agency and MBIE to engage in extensive industry and science provider consultation. However, the remaining five elements (leveraging local procurement, creating a labour force that can work in advanced technology firms, facilitating access to local finance, ensuring there is effective commercial and intellectual property law and standard setting, and implementing much more targeted and more effective tax incentives) mostly involve the Innovation agency working with and advising specific government ministries and departments on the detail of possible new policy initiatives.

40. The Innovation agency, operating through Callaghan Innovation and the NZ Accelerator, would progressively assume the role of monitoring the implementation of the plan and advising government on an ongoing basis of opportunities' to further enhance the contribution of the advanced manufacturing sector to the economy.

Key Points of Submission

- **A key part of achieving an increase in GDP per capita that is sustainable is focusing on enhancing and developing business in technology-based manufacture.**
- **This needs a change of focus in a number of areas, but particularly in funding and governance of the NZ Innovation system.**
- **Key changes needed include:**
    - **Focusing on "pull" science, not "push" science – science that will create new "Sticky Business" for New Zealand**
    - **Developing an innovation and science eco-system and structure which addresses known opportunities for niche technology-based business for New Zealand**
    - **Redefining what is considered "good" science with a bias towards development of a stronger, technology-led, economy.**
    - **Expanding the New Zealand Product Accelerator to ensure that "Pull" science prevails – with science done by the best available teams, led by governance that is Industry-centric (incorporate into Strategic Review of NZ Product Accelerator in Q2 2021)**
    - **Re-thinking the educational, and vocational training systems to provide a work force that is more (unashamedly) biased towards the highly productive parts of the economy**

Concluding Comment

41. The submission authors would be pleased to discuss the submission further with the Commission.

Steve Wilson MNZM, , Fellow NZIM, Executive Director and owner of Talbot Technologies Ltd.
Chairman, Advisory Board, Product Accelerator
Richard Bentley CNZM, Dist Fellow IPENZ, Fellow IoD
Professor Mark Taylor, FIChemE. (London), Professor, Chemical and Materials Engineering and Co-Director, NZ Product Accelerator, University of Auckland

Addendum 1. NZ Product Accelerator Model and Track Record

Addendum 2. Industry Exemplars of Innovation, from the NZ Product Accelerator

Addendum 1: NZ Product Accelerator Model and Track Record

Model

There is latent need for New Zealand to do better in terms of turning Science into new jobs and exports and better welfare and sustainability. Many "pivots" have been tried as means to channel science to create good of all outcomes, and many have failed. In this context the New Zealand Product Accelerator is widely recognised as a rare success.

Rather than a mission-led or investigator-led science approach, the New Zealand Product Accelerator starts with the value proposition of the enterprise itself, or group of enterprises in larger projects. That leads to a question or challenge for the enterprise and the accelerator team, in collaboration. And usually with a short, commercial time frame within which to solve it.

The NZPA contract between MBIE and University of Auckland ended on 30 September 2019, at which time NZPA was transferred to Callaghan Innovation (CI) and a new contract between CI and the University was put in place. The NZPA have been allocated $2.2m of direct funding per annum for the next 4 years which unfortunately will run out earlier due to growth of the network.

The NZPA connects businesses seeking specialist expertise, to talent within the Universities and the wider R&D ecosystem, to solve real and diverse challenges in our market. It operates a 'best team' approach nationally for each unique challenge, bringing specialists and industry experts from whichever institutions and government/non-government organisations contain them. NZPA's network into all universities and crown/private research functions makes it the only partnership of this nature in NZ.

Track Record

From government funding of $12.7Mi over 6 years, this group has delivered more than $20OMi in realised revenues for NZ companies This has been achieved by a network of science and technology teams, involving people drawn mainly from 8 institutions working directly with NZ businesses. Hundreds of projects have been completed with more than 400 companies, with completion times generally between 3 months and one year.

This direct economic impact was recognised by the Government in Budget 2019 with the Product Accelerator receiving the above base funding, under Industry Futures, for a further four years.

The cohesive impact of an inclusive, trusted R&D network for NZ on the science eco-system is now starting to be felt in the Tech community, through less competition and more collaboration.

Future Development

NZPA achieve significant results with a team of just 40, and one main hub for Operations in Auckland, handling and triaging all company requests for assistance out to the network around the country, depending on where the expertise lies.

Future plans for NZPA include the creation of similar, multidisciplinary NZPA hubs around the country, with plans for a Wellington hub moving into operation now, and ones in Dunedin and Christchurch entering the planning phase with other hubs likely in the North Island as well (Waikato and Manawatu); on their own the three additional major centre hubs potentially treble the size of the present network. This is anticipated to open doors to many more innovative regional firms often under-represented by the existing R&D ecosystem. If approved, it would catalyse growth across the network, allowing it to engage with far more firms, scale up supervisory capacity and expand economic focus areas by attracting new expertise.

Richard Bentley, in his book Innovate!, originally proposed technology-centred hubs around New Zealand to allow regionalisation of the accelerator network. Over time it has been found that the diverse nature of the firms themselves, and the many specialisations in each research institution around the country, requires a different organisation of the regional hubs from that originally envisaged by Richard. Thus, although the Wellington hub has a world leading industrial design expertise, it also has substantial capability in areas of materials science and in digital manufacturing and robotics. Thus, Wellington plays an important role in company driven design projects nationally, but the Wellington regional hub also participates in materials and manufacturing projects as its specific expertise and capacity allows.

In fact very few of the approximately 500 firm projects undertaken in the last 8 years involve only one research institution, with most having at least two if not three institutions represented on the project team.

Over time, expanding the use of the NZ Product Accelerator innovation model further to incorporate 300 -400 applied and basic researchers in the institutions – roughly half of NZ's engineering researchers –all contributing their expertise to the "best teams" approach to solving multiple and cross sector, industry defined problems, would close the gap between science and industry in New Zealand and boost innovation across many productive sectors.

Exemplar, higher value projects being proposed by the NZ Product Accelerator network, but requiring immediate resources are:

- Pre-feasibility study for Tiwai Point Innovation Park, based on flexible, high value manufacturing, to achieve a good of all outcome.
- Technology for an intelligent Borders System for NZ Customs (underway) and selected international partners, aiming at realising the vision of "the World's smartest borders".
- A new, fully integrated bio-products industry from Forestry. **Bio-materials** has the potential of becoming our largest Primary Industry over the next 20 years if the missing science is quickly developed and successfully deployed in practice.
- Bespoke NZ products and processes based on hybrid digital manufacturing and creative design.
- New products from Waste Food/Bev streams (Timaru, underway)

Policy

The potential impact of an enlarged Accelerator network would be achieved through shifting some science investment (see Policy in the body of the submission) from Science Mission-led to this proven, Needs-led technology development model, and create and accelerate a high value exports pipeline of $2bn - $10bn/annum over a period of 5 years for NZ companies, and across many productive sectors currently developing ITPs.

To achieve this result and create this value pipeline, several policy changes are required in the Science System now, to harness and focus the country's talent in technology development and these are discussed within the submission (Point 33).

Addendum 2. NZ Product Accelerator Industry Exemplars

1) Inhibit Coatings-a rapid journey from PhD to Start Up Company

In response to a number of company's market pull, the NZ Product Accelerator funded a PhD scholarship for Eldon Tate at Victoria University of Wellington to research how silver entities could be incorporated and bonded to a variety of materials to develop new antimicrobial coatings and surface treatments. Silver is a known antimicrobial with a wide range of uses. Eldon's supervisor was Professor Jim Johnston, who has been a key contributor to the Product Accelerator team since its inception. Jim and Eldon worked closely with The Polymer Group Ltd, a specialist coatings company in Auckland.

Eldon's research using a deep capability base in chemistry, demonstrated nano silver could be bonded to a variety of polymeric materials such as resins and plastics. The Product Accelerator during his studies introduced him to several potential end users which enabled him to get early insights into commercialisation opportunities.

This insight led to the formation of a start-up company Inhibit Coatings with Dr Eldon Tate becoming their first CEO. Inhibit Coatings first product was a floor coating and trials to date in food processing plants have produced excellent results at controlling *Listeria* and *E. coli* outbreaks. (www.inhibitcoatings.com)

Inhibit Coatings has recently had an oversubscribed capital fundraising round which will enable them to expand their product range. They were recently awarded by MBIE a Covid 19 grant to investigate the efficacy of their technology on viruses. These tests in the US have confirmed they are effective against viruses including Covid 19 which will result in significant new market opportunities.

Inhibit Coatings is a great demonstration how fundamental research can be directed by industry needs, and when supported through the traditional "valley of death" by both R&D and industrial networks can quickly lead to commercialisation via a start-up company. From PhD to CEO in a short time frame-a great exemplar for many PhD students in NZ.

2) Development of a New Environmentally Friendly anti-fouling coating for Propspeed NZ Ltd

Propspeed is privately owned by Jacobsen Holdings Limited, an entrepreneurial holding company, established to manage and grow the business interests of the Jacobsen family. Propspeed, Jacobsens Flooring and Tredsafe are their three trading companies.

Propspeed manufacture and distribute globally, market leading foul-release coatings for vessel propellers and associated running gear. Their coatings are exported worldwide through a network of distributors with staff based in NZ, US and Europe.

The Product Accelerator team led by Dr Karnika De Silva is developing a new environmentally friendly primer that does not contain hexavalent chromium which poses health concerns to both humans and the marine environment. The objective of the project is a new, non-toxic primer system compatible with the existing topcoat.

One of Propspeed's primary considerations was to ensure they could research, design formulations and test the product in a comprehensive, credible and timely manner, ultimately achieving commercialisation as quickly as possible.

The NZ Product Accelerator team meet with Jacobsen's senior management team to discuss the company's business plans and need for new product development. Initial visits were made to Tredsafe which did not lead to any project work but established the relationship & credibility of the Accelerator's capability.

Dr De Silva was contracted by Propspeed to do a literature review of anti-fouling primers. At the same time Propspeed had been working with an international R&D provider and were disappointed with the lack of results so they decided to engage a broader team which Karnika and the NZPA are the key drivers of this new development. Propspeed have secured Callaghan Innovation funding for the development with NZPA as the research provider.

The global anti-fouling coatings market is estimated to be $US8.8 billion and few environmentally friendly options are available so the pressure is on to find new coatings. If this project is successful Propspeed stand to maintain and significantly increase their global market share.

3) Transpower's Robots-their Eyes & Ears

Transpower owns and operates the national electricity grid so maintaining electricity supply throughout the country is an essential service that powers the economy as well as providing New Zealanders with electricity for health and general well-being.

Facilitated by the Product Accelerator, Professor Johan Potgieter, a key member of our network at Massey University has developed a substation robot for remote switching, condition surveillance, monitoring construction & maintenance as well as providing visual imagery for staff training.

Currently Transpower has a call out service in place with contracted providers who respond to events at their remote substations. These contracts as costly as well as having time delays for the providers to reach the site and establish what is causing the problem. The robot is overcoming all these issues and most importantly a faster response time to alarms.

To date three robots have been deployed and are meeting Transpower expectations. Their long-term goal is using robots to be their eyes & ears in their substations and respond to any events that might arise.

A platform technology has been developed which Transpower envisage other uses could include pest prevention, 3D mapping with Lidar, gas sensing, ground penetrating radar to locate underground assets and many others.

Interest in the robots has been received from international utility operators so there is a big opportunity for leveraging this NZ development worldwide, but most importantly the robot has enhanced Transpower's capability of maintaining secure electricity supply to NZ.