

## **Submission to the NZ Productivity Commission**

### **Issues Paper – *New Zealand firms: reaching for the frontier***

I am commenting on the Issues Paper as an individual, but drawing on my current roles as:

- Professor in Information Science, Otago Business School, University of Otago
- Professor of Software Engineering, School of Engineering, Computer and Mathematical Sciences, Auckland University of Technology
- Deputy Chair, Software Innovation New Zealand, the national software research network
- Technical Advisor, Office of the Federation of Māori Authorities Pou Whakatāmore Hangarau - Chief Advisor Innovation & Research

I am also Deputy Director, and Theme Leader: Data Science and Digital Technologies, in the *Science for Technological Innovation* NSC but the Challenge has made a separate oral submission, to which I contributed.

Given the above, my comments relate to the digital technology sector, particularly those firms and organisations delivering services (and service-products) built around data and software.

Preceding my comments and my suggested responses to some of the questions posed in the Issues Paper I would make a general comment re the following two matters: (i) (p.19) “The goods-producing sector includes the following industries: manufacturing (including food processing), electricity, gas, water, waste services and construction. Services are market-provided services and so exclude services provided directly by the government such as health care and social assistance, education and public administration and safety.” Increased digitalisation and Industry 4.0 underpin the assertion that ‘every company is a software company’ and so the distinction just made is not as straightforward as it seems; goods-producers are increasingly also service-providers. (ii) (pp.26-27) “R&D and patenting activity is highest in the manufacturing industries... The set of firms that do R&D and file patents...” Of course, it is not possible to patent software in New Zealand, so it is not a relevant indicator of innovation for the local digital technology sector.

#### **Better as well as more**

I applaud the emphasis on the need to help our existing enterprises to improve, this is a positive counter (or complement) to the many initiatives, policies and strategies that are focused only on increasing the number of enterprises. Both are potentially beneficial. Moreover, given the limited resource base in the digital sector – basically the limits on labour – the emphasis for New Zealand should be on delivering better rather than more outputs from the same resource base. Recalling the mantra of ‘fast, cheap, good – pick any two’ we should aim to produce good and better services fast enough to secure a premium price. Innovations in quality rather than efficiency can leverage our Aotearoa Inc. advantage of being a trusted provider of goods and services, and so may have more value in the digital space, especially where these quality innovations are well-grounded in evidence and supported by a philosophy of systematic and continuous experimentation, rather than trial and error innovation based on anecdote.

#### **15 new distributed ecosystems rather than 50 new companies in Auckland (or both)**

While having a higher number of digital enterprises that are medium-sized or even large on an international scale would be beneficial it is not necessarily the only way to scale. Another is to have multiple enterprises work in partnership; these could all be enterprises of a similar size, or tens or even hundreds of smaller niche service-providers centred around one or two larger platform companies. This software-as-a-service plus API model has already proved to be successful in this country, the Xero ecosystem being probably the most well-known. So long as suitable digital infrastructure is in place an additional benefit of such an approach is that the enterprises can be located almost anywhere – perhaps an opportunity for regional development by co-locating high-tech enterprises and researchers in regional hubs.

## **A sector-only view is too narrow**

Seeing and supporting innovation through a sector lens can be useful in terms of enhancing focus and delivering a shared (and therefore commonly understood) context; however, it can also mean innovation efforts and outcomes are siloed and not shared across sectors. New digital techniques and tools that are useful in one sector may well be useful in others, so mechanisms to enhance shared learning within and across sectors are necessary.

## **Barriers to achieving economic transformation**

There are several:

- Massive inertia in an economy centred on ‘traditional’ strengths, supported by powerful and well-organised advocacy groups. This has meant it has been hard to shift the composition and complexity of our export basket to higher-value products and services.
- A lack of understanding of what excellent and impact look like for the new sciences and the sectors built upon them and a naivety concerning the interests and actions of global digital enterprises.
- An unbalanced R&D portfolio that seems to be increasingly oriented towards discovery-type Research and, although to a lesser extent, accelerated Development. This means there is limited support for medium-term incubation research or for the development of broad-impact platform technologies and capabilities that are targeted particularly to the country’s many SMEs that cannot (and frankly should not need to) employ their own research function.
- An investment model that is evaluated based on activities and inputs rather than outcomes – how well have the policy settings been acted upon? Where is the return-on-investment analysis?
- New digital firms are focused, in this order, on market share, revenue, return on assets and then profits. Productivity is considered late, if at all. In part this is due to the difficulty of productivity measurement in a digital services context: determining the input cost is comparatively straightforward, being dominated by personnel, but the output part is notoriously difficult to measure. For some firms this results in a ‘fake it till you make it’ mentality, a tendency to take on (potentially too much) technical and financial debt while chasing the market. In other jurisdictions software engineering has been regulated, in an effort to increase quality and competitiveness and to more quickly weed out poor-performing firms – if they can be identified. Maybe a ‘reinvention rebate’ should be made available to encourage failing firms to pivot. Such an outcome would also better enable labour reallocation.
- With respect to skills, management and governance quality, we need a bigger pipe more so than a faster pipeline. There has also been low diffusion of scientists into industry due to a mix of unawareness, scepticism and disinterest. Finally, re Boards, do they have the tech smarts to “support strategic risk-taking”? Do they take a long-term view in an industry that is focused so much on short cycles? Founder Owners are indeed good in establishment, it is also good to move them out when there is a need to grow, but the professional CEO should not then quash technical innovation; an appetite for technical R&D needs to be sustained.

## Responses to some of the questions posed in the Issues Paper

*Q1 How should the inquiry define frontier firms?*

Avoiding the question somewhat... however it is defined there should be an expectation of *sustained* behaviours or performance – a function of sustained investment in research and innovation, sustained performance, sustained ‘growth’...

*Q4 What makes frontier firms different? What do they do differently, or have that other firms don't?*

They have longer horizons and they value both research and innovation. They avoid change saturation and disruption fatigue by applying innovation-consolidation cycles. They are not too busy to improve.

*Q6 What are the most important drivers of the diffusion of technology, ideas and business practices from frontier firms to other firms in New Zealand?*

Evidence suggests that they are informal, personal, anecdotal – so not always the most effective.

*Q7 How easily do resources flow from lower to higher productivity firms and vice versa?*

In the digital space good people are *very* mobile – almost too much so in terms of embedding sustained value in the enterprise.

*Q8 In your view, what are the key ingredients that would lead to a successful New Zealand economy, and what would success look like? (Also relates to Q13 What are the main challenges for New Zealand firms that aspire to reach the performance of the best firms globally?)*

Some of the key ingredients: an ecosystem attitude; a sustained pipeline of world-class talent; reduced risk aversion and reduced complacency; a portfolio approach providing options; a quality focus; genuine and sustained engagement in research and innovation across multiple horizons...

What success would look like: A future where New Zealand's prosperity is underpinned by a dynamic digital tech research and innovation ecosystem fuelled by a sustained pipeline of world-class talent.

*Q12 What explains the research finding of a weak connection between innovation and productivity growth among New Zealand firms?*

Perhaps that the innovations are not the right ones, or the optimal ones...

*Q15 How do New Zealand's frontier firms learn about, adapt and adopt cutting edge technologies and practices?*

Largely from informal sources – meetups, blogs, former colleagues, maybe consultants. Digital is such a global marketplace that international knowledge diffusion is not particularly problematic in this ‘sector’.

*Q18 Why don't other firms follow the example of frontier firms? What's holding them back?*

There is a continuous battle to grow, recruit and/or retain the very best people.

*Q19 How could the lessons from New Zealand's frontier firms be better shared?*

In part – by contributing to and drawing from a curated, shared repository of evidence-based, context-informed research and innovation outcomes.

*Q24 What resources/opportunities and constraints/barriers are unique or greater for Māori frontier firms, compared to non-Māori firms?*

Māori frontier enterprises are values-led and have clarity of purpose. They are also very far-sighted, concerned with stewardship more than ownership. Many have been here and will be here 'forever' so short-termism for sale is not a goal. While many of their business interests are indeed in resource-based industries this makes Māori enterprises great candidates for high-tech value-add. I am less convinced that they are as conservative and risk-averse as portrayed in the Paper – many of the Māori enterprises I have encountered are ambitious, strategic, forward-thinking and forward-acting. They are good examples of portfolio-based enterprises. (It is a shame that some of the commentary in the issues paper is based on a report that drew on data from 2003-07 – my own personal experience of interacting with the Māori economy paints a somewhat different picture than that conveyed in part in the paper.)

### **Responses to some of the discussion topics raised in relation to computer system design and related services**

#### ***Innovation***

*How well is the domestic innovation ecosystem working – in terms of institutions, funding, skills, regulation, connections between research institutions and firms, and so on?*

It is working quite well, in the sense that many of the indicator measures of success are strongly positive (e.g., see the TIN200 report on export revenue growth), but I suspect it could work even better. Higher targeted investments in digital skills (across development *and* use) would enable more enterprises to engage more effectively in digital trade (e.g., via the recently signed DEPA).

In regard to connections between research institutions and firms and funding, some recent strategic investments have been made (e.g., the Data Science and Cybersecurity research programmes) but, if we compare ourselves to our small advanced economy counterparts, we fall well short of what has been done elsewhere. Connections therefore tend to be sporadic, short-lived, and based on personal links, rather than supported by a systematic and sustained programme of (co-)investment. Once digital technology enterprises are made aware of the research support that they could access they tend to express strong interest, and a willingness to support with in-kind contributions. However drawing a straight line between digital innovations, capability development and business benefits is known to be very difficult; as such, research proposals of this nature tend to be rated poorly, particularly when compared to those that have a much clearer line of logic from innovation to profit.

*Are there ways in which the innovation ecosystem could be improved to better support domestic innovation and diffusion of new ideas?*

I have recently proposed a national industry-facing digital technology R&D alliance that I believe would help address some of the gaps and to support better knowledge diffusion among digital technology enterprises.

*To what extent do New Zealand firms in the computer system design industry build on existing technologies and practices (including from overseas), versus innovate with truly novel products and services?*

There is a real mix of both approaches. Given digital technologies may be service platforms rather than shrink-wrapped products they can be customised for use in multiple ways. We have good examples of enterprises who build offerings around other local and international platforms and those who have developed their own unique new-to-the-world services.

### ***Firm growth and international connections***

*What are the main barriers to up-and-coming computer system design firms acquiring the resources they need to grow? How could the government help to reduce these barriers?*

Securing and retaining talent is an ongoing challenge for digital enterprises in what is an internationally competitive marketplace – Covid19 notwithstanding. To some extent this challenge is exacerbated by industry expectations of new hires – IT Professionals NZ has been vocal in calling out industry for expecting too much of new hires. Schemes to support internships and on-the-job training of recent graduates would benefit all parties; and as noted above, further funding for medium-term applied research as well as other forms of R&D would support greater innovation.

*How well-connected are New Zealand computer system design firms with the latest developments and trends overseas?*

My sense is that, in general, New Zealand firms are well connected to overseas developments. Such developments are typically widely reported in specialist press, blogs and commentaries, and at events such as developer conferences, meetups and so on. International speakers, pre-Covid19, seemed willing to travel to New Zealand to present (e.g., see Agile Auckland), or to present via videoconference (e.g., HINZ), so that has been another useful channel through which to see coming trends.

*Which types of international connections make the biggest difference to the spread of new ideas and technologies? What could be done to improve these connections?*

All of the above are fine in and of themselves but I believe more could be done to leverage international and national research outcomes for the benefit of New Zealand enterprises. Having a shared repository (as noted above) and a 'Rapid Reports' type dissemination channel could ensure research outcomes are made available in an accessible way to the practitioner community.

### ***Māori firms/entities***

*Do Māori computer system design firms/entities face particular opportunities or challenges in innovating, growing or exporting?*

Some Māori enterprises find the science and innovation system difficult to understand and navigate. Trusted brokers to bring parties together, to build partnerships and co-design research and innovation programmes, would be of benefit.

*What might make the biggest impact in supporting the success of Māori firms/entities in this industry?*

A secure pipeline of Māori STEM talent.

Addendum from my submission to MBIE's RS&I Strategy:

***Areas of focus - more of the same or transformation?***

[T]here are some broad horizontal research domains that are strategically important across multiple sectors. One of these is digital. Software-based technologies have the potential to deliver two-fold transformation: 1. digital enterprises can themselves lead the world at relatively low-cost (being highly scalable and requiring limited infrastructure); 2. software-centric products and services can enable enterprises in all other sectors, including those of particular strength in New Zealand (fintech, agritech, health/medtech), to lead the world. You only need to look at the 2019 TIN200 report to see examples of both. Finally, digital R&I can occur in the regions just as it can in the major metropolitan areas. Yet *public* funding for research in the underpinning science and engineering for digital advances has been low for many years (the recent SSIF Data Science Programme investments notwithstanding). Our own experiences and discussions with MBIE suggest a lack of familiarity with what excellence and impact look like in these disciplines (though I am encouraged by the framing of excellence in the draft strategy as “the best thing possible *in its context*” [emphasis added]). Researchers in these disciplines have also struggled to articulate the importance of their work. To genuinely attract, develop and retain the very best research capabilities in these disciplines, in order to enable true transformation rather than more of the same, we need to strategically address the digital technologies R&I opportunity (perhaps including prioritisation or more targeted/weighted investments). Such an approach has been immensely successful in Ireland, Norway, Sweden and Finland.

***'Public' and 'private' R&I (and R+D rather than R&D)***

The distinction between public and private R&I is convenient but it is also somewhat artificial, at least as far as some public R&I is concerned. Certain 'public' schemes suggest, encourage or even expect corresponding 'private' investment – applications to the Endeavour Fund's Research Programmes scheme, for instance, are strengthened by private contributions, some in-kind, others in direct cash.

We need also to find mechanisms to encourage higher levels of private investment in R[esearch] rather than/in addition to investments in D[evelopment], to lift business horizons beyond today/tomorrow. One of our challenges with past efforts has been that – in general – too much support has been directed to immediate-term problem-solving by businesses that are too busy to improve. What I hope this Strategy will enable is suitable support for businesses with sufficient vision and scale to undertake *genuine R&I* to serve their growth and productivity ambitions.

Software startups are a case in point: some may be innovative but they are not really among “the main actors within the RSI system” (p.11). Many smaller software-intensive businesses have (very) short horizons; start-ups in particular need capital and business mentoring, and are too highly geared to embrace research whether scientific or otherwise. Such companies tend to not be receptive to opportunities for genuine research, being neither prepared to invest, nor to wait, given their focus on delivery and on building a market. In such circumstances short-term mentoring, capital investment and problem solving via consultancy (and likely focused on efficiency) seem more appropriate. This should not be called R&I, however, nor should it be supported as such. Genuine R&I in software should extend well beyond a single release cycle and/or a single team.

Such mechanisms could require or even incentivise businesses to partner with public research providers to form the best teams to co-design and conduct closer-to-market research. An indirect benefit of such an approach would be the increased capacity of businesses and public research entities, and the individuals involved in each, to engage with one another, enhancing the flow of personnel across structural boundaries. In turn this could help us to retain top R&D talent in New Zealand – a major challenge in some sectors.

***Premium service ecosystems as an alternative means of scaling up***

It is in our services sector that there is the greatest potential for sustained – and environmentally sustainable – growth in productivity. Service ecosystem and platform opportunities in particular enable co-operating partners to scale collectively where they could not do this on their own. Take the Xero ecosystem – a great example where hundreds of smaller players can access a large customer base by leveraging the market created by the central platform. We know that customers will pay more for premium-quality services so that too is an opportunity, given that New Zealand goods and services are highly regarded globally.

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