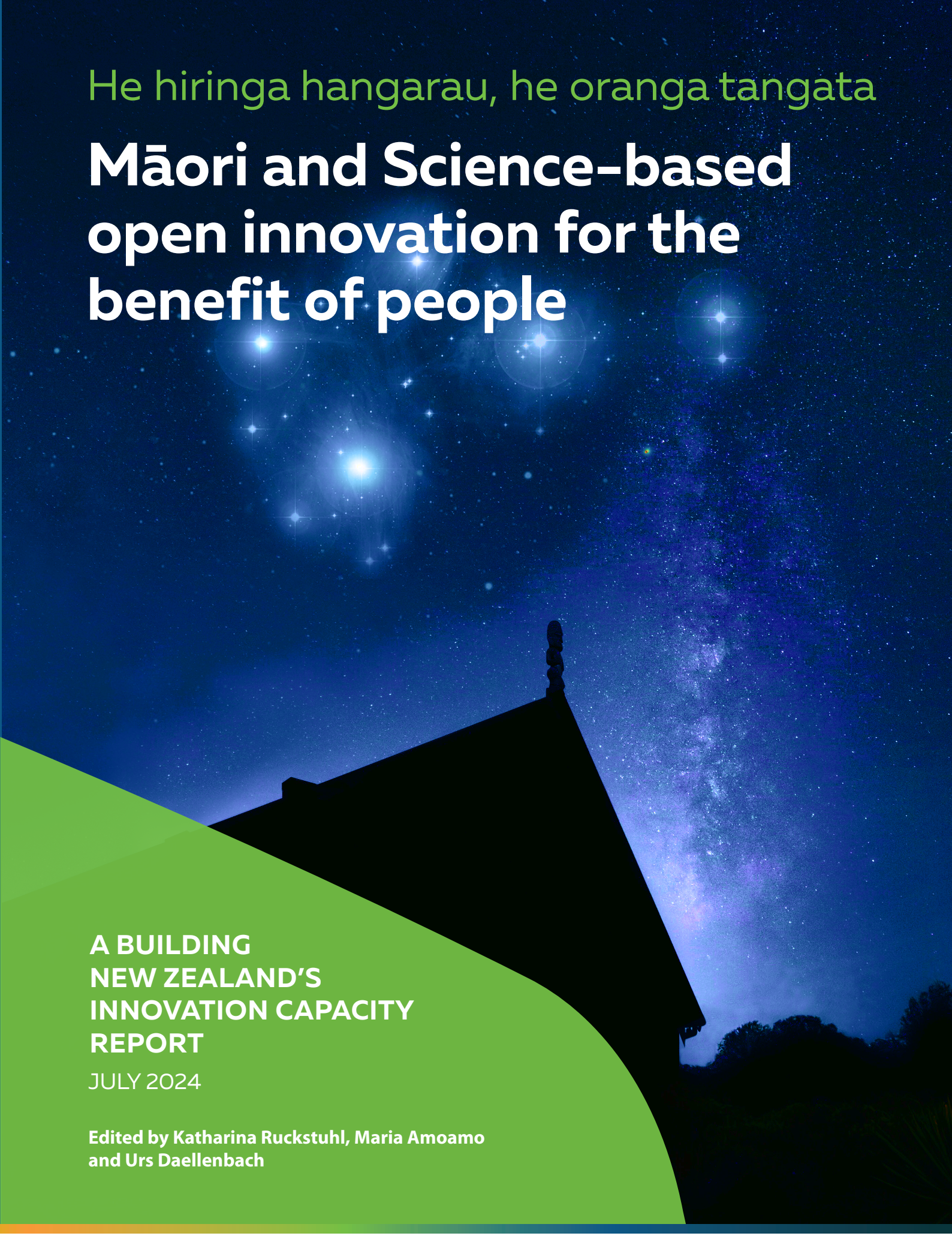
He hiringa hangarau, he oranga tangata

Māori and Science-based open innovation for the benefit of people



A BUILDING NEW ZEALAND'S INNOVATION CAPACITY REPORT

JULY 2024

Edited by Katharina Ruckstuhl, Maria Amoamo and Urs Daellenbach

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SCIENCE FOR TECHNOLOGICAL INNOVATION
Kia kotahi mai – Te Ao Pūtaiao me Te Ao Hangarau



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The BNZIC team acknowledges all those individuals, organisations and businesses who took part in our surveys, workshops and interviews.

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Moe mai e te Rangatira.

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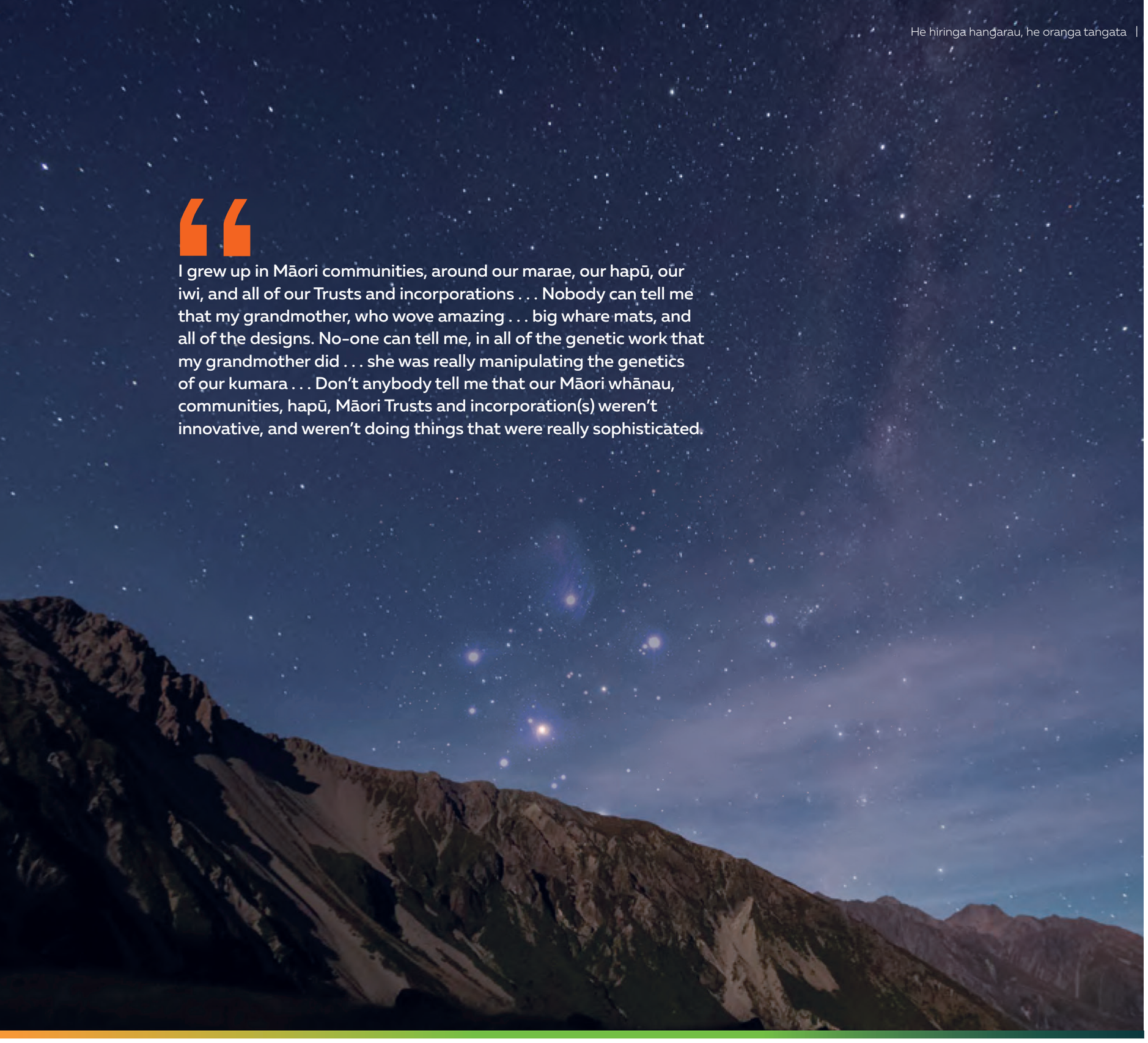
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> I grew up in Māori communities, around our marae, our hapū, our iwi, and all of our Trusts and incorporations . . . Nobody can tell me that my grandmother, who wove amazing . . . big whare mats, and all of the designs. No-one can tell me, in all of the genetic work that my grandmother did . . . she was really manipulating the genetics of our kumara . . . Don't anybody tell me that our Māori whānau, communities, hapū, Māori Trusts and incorporation(s) weren't innovative, and weren't doing things that were really sophisticated.

About this report

This report is about how Māori engage with and take advantage of science-based innovation. As the anecdote that opens this report makes clear, Māori have long been innovative and sophisticated in their development approaches.

In this report we examine a particular type of Māori innovation that arises from the interface of 'high-tech' research and development (R&D) and Māori knowledge, experience, environments, and practices. We look at how science-based innovation is being taken into Māori organisations and businesses, what impact this is having, and the capacities and capabilities Māori have gained and might need in the future.

The report is based on research that took place in 2022 and 2023 from projects led by Māori social scientists from the Science for Technological Innovation National Science Challenge (See following pages 6 and 7).

Science for Technological Innovation (SfTI) 2014-2024



SfTI aimed to enhance the capacity of Aotearoa-New Zealand to use physical sciences and engineering for economic growth and prosperity with a focus on building enduring partnerships between researchers and Māori organisations and industry.

The vision was for New Zealand to have a vibrant and prosperous technology-driven economy, with new businesses offering high-value services and products that may not yet have been invented.

SfTI research was across four main 'themes' and involved large spearhead and small seed projects in high-tech areas. More information about the Māori focussed projects can be found at the end of the report.

Māori and SfTI

SfTI aimed to unite mātauranga Māori and western science to explore new and exciting opportunities to build a vibrant and prosperous technology-driven economy. Guided by a Kāhui Māori, SfTI aimed to enhance Māori capacity through four key focus areas:

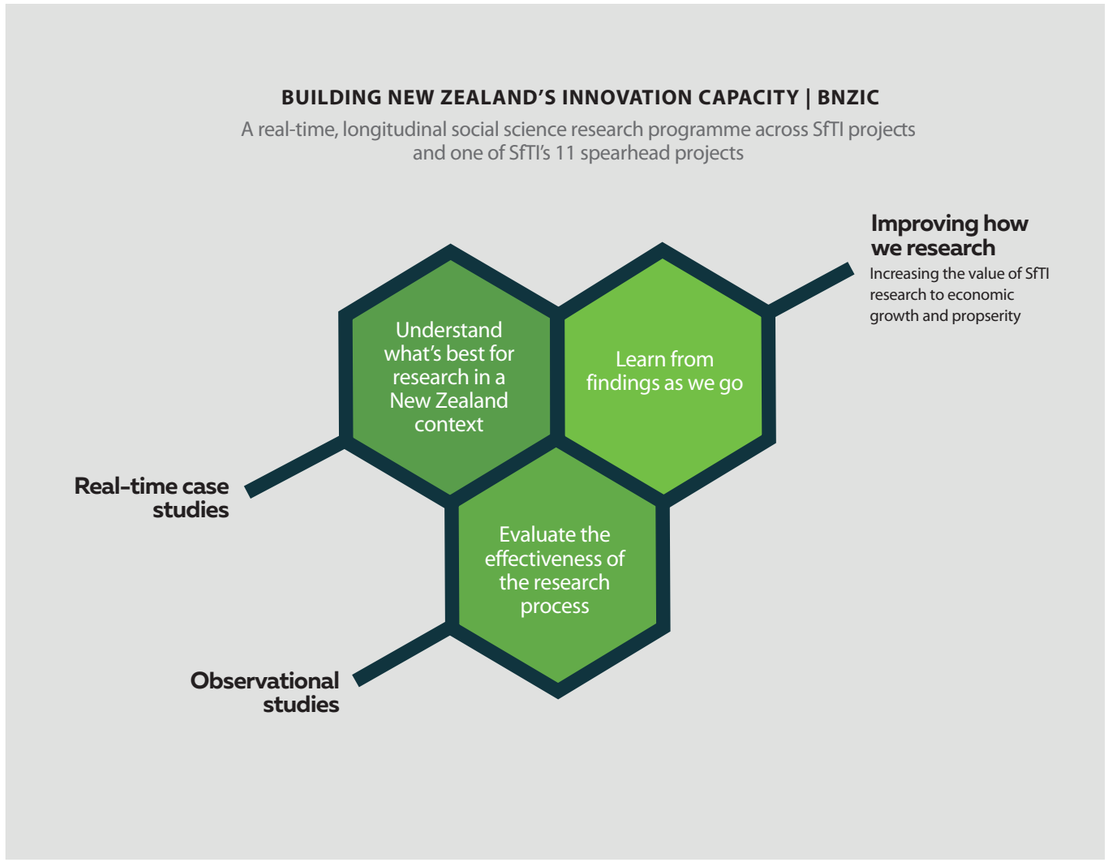
1. Productive relationships and networks
2. Highly developed capabilities and capacities
3. Advanced tools and technologies
4. Fit for purpose Intellectual Property.

Building New Zealand's Innovation Capacity (BNZIC)

BNZIC conducted real-time, longitudinal social science research into SfTI projects to identify the enablers and barriers of collaborative science and innovation – looking at how scientific research was best done. BNZIC was the first long-term study of its kind in New Zealand aiming to understand how researchers, industry, and Māori organisations work together to innovate.

BNZIC had a specific focus on how te ao Māori capacity and capability in science research has created tangible outcomes for Maori, and how it can be built on to in the future.

A list of BNZIC's Māori-focused reports and publications can be found at the end of the Report.



Structure of report

We have organised the report into the following sections.

Section 1

Katharina Ruckstuhl and **Kiri Dell** interview Māori involved in SfTI's research projects. In this segment, interviewees give their views and experiences of what science-innovation capacities were enhanced from their perspectives.

Section 2

Jarrod Haar and **David Brougham** take a broader perspective to find out whether there are barriers for Māori in collaborating with universities to help solve business challenges. Their findings fare from a large survey of 510 New Zealand and Māori businesses along with interviews with 50 business owners, half of whom were Māori.

Section 3

Maui Hudson, KatieLee Riddell and **Natalie Kusabs** look at how Māori think about commercialisation when it comes to taonga species. Their research for this report is based on a workshop involving Māori practitioners, academics, business owners, entrepreneurs and stakeholders and provides provocative and challenging points of view.

Section 4

Maria Amoamo and **Katharina Ruckstuhl** provide reflections from SfTI leaders and organisers who focussed on capacity-building to consider what SfTI achieved for Māori and the science sector more broadly.

The report concludes by drawing together some observations from the preceding sections, including what else might happen to bring about *He hiringa hangarau, he oranga tangata* – **Innovation in technology for the benefit of people.**



> So, the one thing from a Māori point of view that perpetuates, is our own organisations. They stay around. They've got our tikanga, they've got our philosophy, our values, all woven into them. But, you weave the same innovation ethic, I call it, into those same organisations.

1

Māori views on science-based open innovation

Katharina Ruckstuhl and Kiri Dell

This section is a summary of interviews with 17 Māori community and business organisations who partnered with or were involved in a SfTI project. We take a starting position that Māori have a holistic view of the purposes of science-based innovation and already have many capabilities that can activate and engage with the science system.

We also recognise that science-based innovation of the type that formed SfTI's mission requires a distinctive set of individual capabilities and organisational processes. Based on our interviews, we see that science-based technology projects can develop, enhance or even accelerate these capabilities and processes through providing resources, technical infrastructure and access to global science and innovation at the cutting-edge of science and technology.

About our participants and the projects

Our participants had a variety of experiences of New Zealand's science and innovation system. Many were with organisations in provincial parts of the country. Some were science and technology experts with postgraduate degrees. Others had degrees or diplomas in related or unrelated fields while several had extensive governance and tribal experience in fields such as environmental restoration, business, cultural or whānau development, with participants often involved in these fields simultaneously. Some participants were quite young, while others were senior leaders or kaumatua, with vast local or central government experience.

Some participants ran their own businesses as sole traders. Others had worked or were still working in science or government-funded organisations, with one being seconded to a tribal group and two others using their personal business consultancy to progress the project with their potential Māori business partners. The majority were or had been employed by a hapū or iwi during the time of the project. Some though were either taking time out of their paid employment or were unpaid liaisons to the project.

All the projects were technically complex, placing different demands on the lead Māori participant, depending on the type of project, organisational size, and situational contexts. Some projects required high proficiency in using specific tools, software, programming languages, hardware components, laboratory analysis or operating systems. Others required a deep understanding of principles, theories, and concepts relevant to a particular technical domain, such as visual data analysis or artificial intelligence or sensing in water environments.

For this report, we focus on the extent to which SfTI's operational and relational processes contributed to enhancing Māori science and technology capacity, and whether more broadly some activities should be sustained, accelerated or stopped.

Our approach

We interviewed 17 Māori participants and partners either face to face or online. The participants spoke widely about their and their organisation's involvement in the SfTI project, their experience of and background in other science and technology projects, the importance and ongoing significance of the research and what made it easier or harder to be involved, and the science and innovation system more generally.

We analysed the interviews first by reflecting on and discussing our observations.[1] The participants checked the transcripts and then we looked to create descriptions and general patterns, coming up with specific codes and themes[2] to make comparisons and identify relationships across our information. Themes were classified by examining convergences and divergences across participant interviews, from which we created 'capability' categories – relational, technical and human – to help answer the research questions. These were then further refined as we explain. In this report we draw on participants' verbatim quotations to illustrate their understanding using their language.

Our findings

Our analysis showed that individuals gained new technical understandings from being involved in the project and were able to align the science to their existing mātauranga or vice versa. For example, one interviewee described the project as 'good because it opened your eyes to the immense amount of data that's out there', but also recognised their mātauranga was important as a 'way of building up a model for them (the science team)'. Another stated that it was 'not every day that I sign up to be part of a research project' but that he did so because 'when you go to the market and try to do these (science-technology) things, they're not in the market … the people who are actually responding and thinking about this stuff are more academic' and therefore he found this prospect 'exciting'. Another interviewee stated that it was better to 'guide the science research on the inside', rather than 'not knowing what's going on', expressed by one interviewee as being able to 'help design at the very front end of the…project'.

Some had established science relationships prior to the SfTI project from experience in other science projects as the following quotes show:

So, there was no relationship being built, but me and (scientist) have kept in touch since I was 18, and I'm 33.

I trust and I respect (scientist) a lot, and if she brings something to the table, she gets my attention straight away – we start talking.

Other relationships started through the project and were expected to carry on afterwards:

I still feel that relationship with them, because we went through this together; it's our common denominator

…but then I met with (scientist), and I just felt blessed

I think we have established really strong relationships. We know that there are people we can call on if we need to.

There was some expectation that the Māori participant would be able to broker or develop relationships between the project team and the organisation. This was not always the case, and sometimes led to difficulties and tensions between the Māori interviewee and the broader organisation as shown in the following quotations:

Once again, it's always one person holding it, but when you lose that one person, where's the knowledge-base?

…obviously a lot of support (from the hapū), but then a little bit of antagonism.

weren't many people that were involved in the process of supporting it.

Many of our interviewees were clear that their organisation both needed and was open to enhancing their understanding and use of science-based innovation. For some, economic development was a key, but not exclusive factor in project participation:

By getting these research grants, we've been able to employ more Māori PhDs and researchers, and actually do work.

'…looking at … different parts of data needs across the value chain …

Research and Development, that's really how we develop new capabilities and new technologies that we can utilise to make our product even better.

For others, however, commercialisation discussions with researchers could 'freeze some conversations', with some lacking interest in 'trying to achieve world domination like Big Tech, like America. We don't need a billion customers.' For these interviewees, the science-based technology project was seen as an opportunity to address a particular issue, to develop culturally, or to assist overall organisational development.

We're getting there, and we're starting to go, 'actually, these people – they can help us – they can do stuff for us.

it's also kind of tied to us trying to reinforce our cultural identity and be able to share that with the whānau outside the rohe.

the driver – not so much the commercial concept of it. It was the cultural mātauranga concept of it.

partnering up with those technical and scientific research institutions are a critical part of that process, to allow us to develop.

Key to engaging with the science project was moving from 'theory. . . to practical examples', expressed by one interviewee as 'the low-hanging fruit … (that) … our Māori people . . . can look at it, see, feel and touch it easily'. This enabled support and subsequent uptake of the technology:

I must acknowledge … a lot of sceptics were swung over when we gave the presentations, and the data that was presented to the hapus and the shareholders – the kaumatua and the kuia – as we could justify and explain the credibility of this technology.

we had a huge turn-out when it was launched, and they showed (the technology) and all the trustees showed up and had a look, and I think there was quite a genuine interest.

Some interviewees saw the science technology project as part of their overall future-orientation to "give you information that you need five years down the track – not the stuff you need right now". This future orientation was expressed by some as a means of mana motuhake and independence. This could be seen in several organisations' desire to drive the whole research process independent of government constraints and be seen as a full research partner, including partnering with global organisations at the cutting-edge of science and technology:

we've got (to) the level where it's more a 50/50 partnership.

they actually love the idea of – being able to control it.

it's not actually the research per se that Māori are that interested in – it's actually having input or a voice, in that rangahau space.

they're setting (up) in conjunction with – I think it's Denmark – a range of really ambitious projects on the go.

it makes sense to have long-term partners with people such as (research organisation) . . . We can't trust based on past experiences with the Crown and other agencies."

The last comment in particular shows that Māori organisations are becoming selective in who they partner with. As one interviewee noted, there were "some learnings for us, to not necessarily pursue funding if it's clearly got restrictions around how we can get impact from it."

We saw that intergenerational knowledge sharing through exposure to the science or technology also played a key part in enhancing the organisation's future capacity:

it's being able to bring in intergenerational knowledge into the different projects.

they've got quite an active group of younger ones.

all this stuff is about us transferring knowledge to our own people…our younger ones… so that they can … then help build this sort of technology.

we connect what our people are doing . . . to the latest gidgets, gadgets and technology.

Additionally, many of the projects enhanced other Māori and non-Māori organisations' science-innovation knowledge, although this was dependent on timing, the other organisation's technical capability or clarity around the project's alignment Māori organisational mātauranga expectations:

… my role is not directly about the (technology). It's about positioning it into all the Councils – attending hui and talking about it and everything.

The other thing that's come off the back of (researcher) going into that school is that other high schools (became interested in the technology).

One of the unintentional consequences … is (that the) … relationship with (iwi) has gotten stronger … They wanted to be an early adopter … (but) it was difficult for her to commit her board when she couldn't see what was coming through.

The success of that (other project) was that we had Māori who were technicians.

Most participants were aware of and took active steps to protect their mātauranga, with some having Intellectual Property (IP) specialists who advised on contracts.

Without this being settled, even encouragement from a Māori organisation would not overcome a refusal 'to work with the scientists because they just didn't feel comfortable around the IP'. As one interviewee stated, 'There is no policy in New Zealand currently … that truly understands and actually responds to the interests of Māori and IP.'

Our conclusion

We conclude that engagement in SfTI projects has enhanced individual and organisational capacity. There is a huge desire for Māori to be at the cutting-edge of science-based innovation, both to support commercial success and broader social, environmental and cultural development. There is an equally strong desire that this should be in balance with Māori values, and for 'science partners to really understand our mātauranga aspirations.' We are confident that Māori have capabilities to lead science-based innovation in their own right. As one interviewee said, 'It's our turn . . . resource us to participate . . . we'll get sharp and quick as anything".

We cannot ascribe all science-innovation capacity enhancement to SfTI given that several individuals and organisations had long-standing and multiple science and technology relationships, and in some cases were technical experts themselves. However, we can say that involvement in a SfTI project enabled many of the participants to accelerate their understanding and uptake of SfTI's specific science-based innovations, with efforts to embed this knowledge into their organisations as part of a way to enhance their future orientation.

Additionally, we saw a ripple effect beyond the original project and into broader whānau, hapū and non-Māori communities. This particularly supported Māori organisations in more remote locations where access to science technology resources were limited or non-existent. This has led to impact beyond the project – to schools, to other Māori organisations, to local councils and to international partners.

We also note that issues around IP set up certain expectations with Māori organisations, such as that the technology might 'scale', as one interviewee was advised. For the majority of these partners, however, as one interviewee stated, 'a business proposition just kind of doesn't really make sense' when, as another reflected 'we're just trying to make things better for Māori, as an organization'. This was echoed by another who stated, that while not averse to commercialisation 'the driver (was) not so much the commercial concept of it. It was the cultural mātauranga concept of it.'

Learnings from our Māori participants

These interviews highlight several capacity and capability factors that Māori organisations might continue, accelerate, or rethink.

1 Continue developing technical expertise as an internal capability.

Potential actions

- Foster individuals with sci-tech capabilities (experts) OR passion (advocates).
- Build future capability by ensuring partners include whānau in projects (either as students or as non-expert collaborators) and support Māori to access R&D environments (e.g., labs, equipment, infrastructure)
- Develop IP expertise – either as an in-house capacity or through strategic partnerships (e.g. with other iwi or other organisations).
- Identify whether an organisational R&D co-ordinator should be appointed.
- Develop a strategy to engage rangatahi with high-tech R&D developments.
- Develop a project-sponsors system to avoid isolation of individuals or miscommunication.

2 Accelerate access to science-based innovation through strategic relationships.

Potential actions

- Strengthen connections to global science and innovation through developing this expectation with research organisations.
- Ensure research partnerships allow for connection beyond traditional boundaries through access to national and international opportunities. This includes funded opportunities or platforms for Māori knowledge-sharing with other iwi, hapū or Māori businesses.
- Insist that Māori are equal partners in research relationships through funding Māori as 'lead' organisation.
- Develop a R&D strategy that identifies best practice expectations for partner research relationships. Make this strategy publicly available.
- Develop a decision-matrix that assesses current against future R&D and innovation needs.
- Develop organisational policy on commercialisation to avoid misinterpretation and un-realistic expectations when contracting with external research organisations. Make this policy publicly available.
- Accelerate efforts to develop a cross-New Zealand practical approach to mātauranga Māori and IP.

3 Rethink whether research relationships align to future Māori organisational R&D needs.

Potential actions

- Be selective about relationships. Ensure partners are aligned e.g., through formal agreements.
- Reconsider organisational capacity to sustain 'one-off' projects if they do not lead to more sustained relationships.
- Reconsider whether 'blue-skies' projects (i.e., projects with no apparent immediate use) can be supported vs projects with more applicable outcomes. Rethink how to prioritise such projects. For example, insist that science partners provide models, visualisations, or tangible 'products' to ensure early and continued support for a project. Build this into research agreements.
- Rethink the broader context of a high-tech project and whether the organisation has sufficient infrastructure, equipment, resources to participate. If these are required, ensure that the partner organisation has allowed for this – including any training or infrastructure purchases – into agreements.

1. Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (4th ed.). Thousand Oaks, CA: Sage; Paton, M. (2014). *Qualitative Research & Evaluation Methods. Integrating Theory and Practice* (4th ed.). Sage Publications Ltd.;

2. Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). Sage Publications Ltd.



> Research needs to be thought about as a strategic business activity.

2

New Zealand and Māori Businesses: Challenges and the role of University collaborations

Jarrod Haar and David Broughton

Overview

This research summary explores New Zealand and Māori business challenges and engagement and collaboration with universities and Crown Research Institutes (CRIs) to determine the barriers to collaboration.

We undertook two studies to explore these phenomena:

1. A quantitative survey of New Zealand and Māori businesses.
2. Interviews with Māori and New Zealand business owners.

While our interest is on research collaboration, we are also interested in the role of context: intense competition (Study 1) and business challenges (Study 2) to clarify if these are contexts that universities could help solve business problems or innovate within.

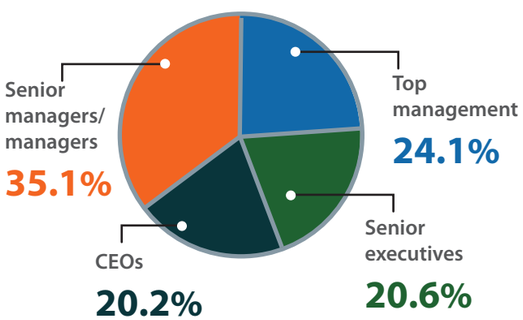
STUDY 1

Survey of New Zealand and Māori businesses

Sample and participants

We collected data from 510 New Zealand firms[3] of which156 businesses (30.6%) were Māori. On average, respondent firms were 21.4 years old (SD = standard deviation =15.1) with the majority in the private sector (78.8%), followed by government/public (17.3%) and not for profit sector (3.9%).

The survey targeted respondents who were managers of which 20.2% were CEOs, top Management (24.1%) or senior executives (20.6%) with the remainder senior managers or managers. On average, respondent managers had been in their position 7.2 years (SD=4.5).



Businesses were widespread by size: 17.5 per cent were micro-sized (up to 10 employees), 20.8 per cent were small-sized (11-50 employees), 24.3 per cent were medium sized (51-250 employees), and 37.5 per cent were large sized (251+ employees).

Firms came from all 20 industry codes, with the largest groups being:

17.5% financial and insurance services

12.2% professional, scientific and technical services

12.2% retail

8.6% manufacturing

Study questions

To understand **R&D Partnerships** we asked a single question: "Within the past three years, how many Science, Technology, Physical Sciences and Engineering (researchers) – outside your organisation only – have your firm engaged with?"

Responses were coded:
0 for none
1 = 1-5 researchers
2 = 6-10 researchers
3 = 11-15 researchers
4 = 16-20 researchers
5 = 31+ researchers.

To understand **Product Innovation** in relation to partnerships we used four questions.[4] "To what extent does your organisation engage in the following:"

- increasing the variety of product/service
- improving qualities of product/service
- extending the market coverage of product/service
- enhancing the manufacturing technology of new products.

Analysis and fndings[5]

Table 1 shows that R&D Partnerships are significantly correlated with all forms of product/ service innovations (all r > .17, all p<.01). R&D Partnerships are **also significantly correlated with Māori firms** (r= .50, p<.01).

Further, Māori firms are significantly correlated with all forms of product/service innovations (all r > .09, all p<.05), although improving qualities of products/services is the weakest (r= .10, p< .05).

Table 1. Correlations and Descriptive Statistics of Study Variables

Variables	Mean	Std Dev	1	2	3	4	5	6	7	8	9
1. Firm Age	5.61	2.88	_								
2. Firm Size	2.82	1.12	.30**	_							
3. Sector	1.25	.52	.23**	.09	_						
4. R&D Partnerships	1.30	1.30	.11*	.50**	-.05	_					
5. Māori Firms	0.31	.46	-.07	.43**	-.21**	.50**	_				
Product/service innovations											
6. Increasing variety	3.77	.91	-.05	.16**	-.15**	.25**	.26**	_			
7. Improving qualities	3.88	.88	-.05	.05	-.08	.18**	.10*	.39**	_		
8. Extending market coverage	3.84	.87	-.10*	.20**	-.13**	.28**	.23**	.52**	.38**	_	
9. Enhance manufacturing tech	3.69	.92	-.07	.29**	-.12**	.37**	.26**	.42**	.24**	.39**	_

N=510. *p<.05, **p<.01.

In Table 2 the analysis confirms that after controlling for firm age, firm size, and sector, that R&D Partnerships are significantly related to increasing the variety of product/service (β= .12(.04), p< .01), improving qualities of product/service (β= .13(.04), p< .001), extending the market coverage of product/service (β= .14(.04), p< .001), and enhancing the manufacturing technology of new products (β= .20(.04), p< .001).

The analysis shows this accounts for significant but small amounts of variance (3-6 percent, all p< .001).

Further, this model showed that while **Māori firm status was positively related to increasing the variety of product/service (p< .05) it was not significantly related to any other type** and did not interact significantly with R&D Partnerships.

On a positive note, this shows that **Māori firms are at least as competitive as New Zealand firms in turning R&D Partnerships into enhanced innovations**.

Table 2: Product/service innovations analysis

Variables	Increasing variety	Improving qualities	Extending market coverage	Enhance manufacture tech
Controls				
Firm Age	-.02(.01)	-.02(.01)	-.04(.01)**	-.04(.01)**
Firm Size	.04(.04)	-.02(.04)	.10(.04)*	.15(.04)***
Sector	-.19(.08)*	-.09(.08)	-.16(.07)*	-.15(.08)*
R^2 Change	.06***	.01	.08***	.12***
Predictor				
R&D Partnerships	.12(.04)***	.13(.04)***	.14(.04)***	.20(.04)***
R^2 Change	.03***	.03***	.04***	.06***
Moderators				
Māori Firms	.23(.11)*	-.05(.11)	.07(.10)	.05(.10)
R^2 Change	.01*	.00	.00	.00
Interactions				
R&D Partnerships x Māori Firms	.03(.07)	.09(.07)	.00(.07)	-.06(.07)
R^2 Change	.00	.00	.00	.00
Total R^2	.10	.04	.12	.18
F Statistic	9.54***	3.84***	11.63***	18.62***

β = unstandardized regression coefficients, SE= standard error. All significance tests were two-tailed.
*p< .05, **p< .01, ***p< .001

Table 3: Māori firms versus New Zealand firms

Items	Māori Firms		New Zealand Firms		t-test (sig)
	Mean	Std Deviation	Mean	Std Deviation	
R&D Partnerships	2.28	1.25	0.87	1.08	t=12.919(p<.001)
Increasing variety	4.12	0.76	3.62	0.93	t=5.960(p<.001)
Improving qualities	4.01	0.83	3.82	0.90	t=2.182(p=.015)
Extending market coverage	4.14	0.70	3.71	0.91	t=5.296(p<.001)
Enhance manufacturing tech	4.04	0.74	3.53	0.95	t=6.052(p<.001)

Overall, in Table 3, the findings show **Māori firms reported engaging in more R&D Partnerships than New Zealand firms** (average 2.28 versus 0.87), indicating the Māori firms saw engaging with Science, Technology, Physical Sciences and Engineering (researchers) – outside their organisation, **as an especially important approach.**

Importantly, these differences further exist towards different types of innovations, with **Māori firms out innovating New Zealand firms** on the factors of increasing the variety of product/service, improving qualities of product/service, extending the market coverage of product/service, and enhancing the manufacture technology of new products.

Fundamentally, **Māori firms appear to be innovating well and doing so via R&D Partnerships** (amongst other untested factors) and doing this **at levels above those of other New Zealand firms.** They gain no additional benefits on innovation from R&D Partnerships (see regression analysis above), but in comparison, they are achieving superior R&D Partnerships and innovations.

STUDY 2

Interviews with Māori and New Zealand business owners

Research approach

Five pilot interviews were conducted to test the interview guide[6] before the final semi-structured interview schedule was finalised. Fifty interviews with business owners/ top managers were carried out at the end of 2022 and beginning of 2023. Businesses ranged in size from one employee up to 5,000 with half of the businesses Māori owned. We followed cultural protocols around interviewing Māori participants.[7]

Of the 50 interviews, seven were followed up to gain greater insights into how interviewees worked with universities and to discuss potential barriers in more detail.

Interviews ranged from 30 to 60 minutes with three critical lines of questions:

1. Why or why not, do firms work with universities?
2. To what extent universities were useful in developing new innovations?
3. What were the challenges and barriers with working with universities?

The data was analysed using thematic analysis.[8] Themes were coded in NVivo and triangulated between the two researchers to discuss key findings, themes and to confirm the results.[9]

Findings

Table 5. Engagement with Universities

	Engaging	Not engaging
Māori	7	18
Non-Māori	2	23

Business challenges

Table 6 provides participant quotations that summarise the key challenges businesses faced and whether these are problems that universities can solve.

We observe that many challenges relate to macroeconomic issues that universities may be able to offer best practice advice on, but not be able to solve (e.g., countrywide staff shortages, skill shortages, inflation cost pressures, supply issues, etc).

General barriers to research engagement

Very few businesses were actively working with universities. We have identified the following barriers:

Ivory Tower Syndrome: Many business owners felt that universities were disconnected from business and were still working in their 'ivory tower'. However, some noted that the sector was also 'ignorant' to what the universities were doing.

Table 6: Themes

Māori Business owners	New Zealand Business owners
Getting the right staff. Would be good staff but getting the right staff with good engineering experience. Good quality trades people (#7).	Probably recruitment and retention are the biggest ones (#26).
Crew are getting old and costs are going up. Lost knowledge about the fishery (#8).	A lot of people don't want to work in the health sector (#27).
Difficult to get high quality staff, I have some people here with 20- and 30-years' experience, and when they go, you can't get those people back (#13).	Getting truck drivers, staff for the attractions, costs… All majors. (#28).
Getting the staff that we need at the right time, the right skills (#14).	And one of the difficult challenges as companies to grow, scale is employing the right people. And talent is a natural challenge for a lot of companies. (#34)
Costs are getting out of control, and we can't get good staff (#22).	Finding drivers and keeping them. (#36)
Finding and keeping our staff, they keep leaving to get higher paid jobs, retail doesn't pay much (#23).	Staff so getting appropriately trained staff, so mechanics are pretty hard to come by. (#37)
Not enough skilled people (#24).	Probably the biggest challenge would be hiring qualified people (#38)
	Everyone wants a pay rise and even the new ones coming in think they are going to get paid way more than I even did after 10 years on the job (#44).

Connections: Many felt that they didn't know how to find experts in their area and felt that they needed a point of contact. Access to the university was very difficult with websites challenging to navigate and find skills.

Fighting fires: Many simply hadn't considered working with universities as they were "fighting fires" on a daily basis and just focusing on the problems and opportunities in front of them. Covid-19 has created a challenging business environment with rising costs and difficulty finding staff.

Resources: When businesses needed expert or scientific advice, the large businesses within New Zealand (e.g., listed NZX50 companies) could build their own laboratories for product testing. They can also use international testing facilities or high-quality ISO standards agreed by experts (ISO, 2023). Businesses could also buy off the shelf products from big USA tech companies (e.g., Microsoft, Apple, Amazon etc.) without needing to innovate or create their own.

Research: Research tended to be done by independent research bodies (e.g., survey companies) and external consultants (e.g., PWC, KPMG, EY, Beca etc.) due to the perceived lower cost, faster turn arounds and quality of work compared to the universities.

Perception universities aren't needed: Many businesses simply didn't think they needed universities as many of the products were developed by large external companies or consultants.

International collaboration: Some of the businesses were working with universities outside of New Zealand (e.g., Australia).

Existing skillset: Some businesses already had PhD qualified staff to do their own research or called on CRIs if needed. CRIs could point business owners in the right direction. Businesses that were engaging with universities had very specific reasons for this. These were normally to do with hard science problems that needed to be solved within the innovation process.

Māori businesses working with universities

More Māori businesses were working with universities than overall New Zealand businesses (see Table 5). They were typically smaller businesses that didn't have access to labs or could not afford external consultants. Some common reasons were:

1. They felt that there was an upswing in universities wanting to partner with Māori iwi and communities.
2. They were seeing a greater commitment to Vision Mātauranga. While these partnerships could be improved, they noted that were much better than they were 10 years ago, and they expected this trajectory to continue.
3. Some of the participants worked with universities to set up scholarships for Māori within their iwi. They felt that there was a great deal more that iwi and universities would be doing in future to understand their local communities.
4. One business owner and community leader was setting up funding in perpetuity with universities to fund students into medical, legal and science degrees to ensure their iwi had people with skills in these areas based on current and future needs.

Table 7: General Engagement Enablers

Skills, knowledge & expertise	Hard science was needed to overcome a very technical or science-based problem. Universities could validate their (businesses) knowledge in a particular area with the university the credibility from an "expert" for further funding.
Access	They needed to use the university facilities (e.g., laboratories and testing equipment) as the businesses were not large enough to warrant setting this up. Working with the universities was becoming easier in the last decade. Academics were willing to offer their free time to projects providing they can publish in journals afterwards.
Training and building capability	For many businesses, the extent to which they had any contact with universities was to maintain or set up a graduate work programme for potential students to formally train. This was a more recent phenomena given the shortage in staff -they were looking to hire and develop talent directly from universities.
Serendipity	Some participants would walk the halls of the university just to see who they could meet in the break rooms and common spaces and discuss ideas within the Colleges of Science. Others kept an eye on media regarding the latest research work universities were doing in certain areas.
Government Funding	Sometimes organisations like the Ministry of Business, Innovation & Employment would commission research from the universities that might be used by business. But the businesses would not directly work with the universities on this.

Summary

STUDY 1 shows that engaging with R&D is beneficial for firm innovation, with Māori firms engaging in levels superior to New Zealand firms in general. The largest sized firms appear the strongest in engagement, as do older firms (26-35 years). This might represent the 'sweet spot' where established firms maximise their innovation. Private sector firms were the most innovative, but public/government organisations are also doing well in R&D innovation and in engaging partners

The quantitative survey data also showed distinct differences between Māori and non-Māori firms.

1. Māori firms are engaging in more R&D Partnerships than New Zealand firms (average 2.28 versus 0.87).
2. Māori firms out-innovated New Zealand firms on the factors of increasing the variety of product/service, improving qualities of product/service, extending the market coverage of product/service, and enhancing the manufacture technology of new products.
3. Māori innovation via R&D Partnerships is at levels above those of other New Zealand firms.
4. While Māori firms gain no additional benefits on innovation from R&D Partnerships, in comparison to New Zealand firms, Māori are achieving superior R&D Partnerships and innovation.

In **STUDY 2**, we found few businesses working with universities because they perceived that it was not needed for business success. However, more of the Māori interviewees engaged with universities than non-Māori to innovate or to overcome business challenges.

Generally, businesses engaged with universities when they needed certification or to overcome specific science-based problems. Universities also offered the opportunity for access to latest developments, 'expert' accreditation to pursue funding, and 'free labour' on a business project provided researchers were able to publish in journals afterwards and there was agreement about intellectual property assignment.

Māori businesses that were working with universities, did so for the following reasons, some of which were more to do with the changing context of engagement with Māori:

- the upswing in universities wanting to partner with Māori, iwi and communities.
- a greater commitment to the Vision Mātauranga policy on the part of universities.
- opportunities to develop scholarships and funding for Māori students.

Regardless of business size we encourage people to reach out to universities to see what types of services and help can be provided. Our results highlighted that many small businesses were working with universities with significant effect. You don't need to be a large organisation to form a relationship. This was particularly true for our Māori businesses as many universities are interested and helping small Māori businesses thrive. Many of the larger organisations used to have connections with the university through graduate programmes, but these had fallen by the wayside. We encourage businesses and universities to reform these relationships at a minimum to provide a steady pathway of employees to the sector. From here, businesses and universities can form better relationships and discuss potential innovation and development pathways.

Universities will need to show what they have to offer as many businesses felt that there was a lack of relevancy. This will be even more important as traditional funding models for universities change, and they will be required to work more and more with businesses. Overall, many participants noted that finding their way into the university could sometimes be the biggest barrier, suggesting universities might need to change the way they invite firms to interact, especially small Māori firms.

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3 For further information on process used in this survey see Bernerth, J.B., Aguinis, H. and Taylor, E.C. (2021), "Detecting false identities: a solution to improve web-based surveys and research on leadership and health/well-being", Journal of Occupational Health Psychology, Vol. 26 No. 6, pp. 564-581.

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> If there are benefits of commercialising some of our taonga species for the benefit of our people, as well, then there's certainly no reason why we shouldn't be able to explore some of those options.

3

Commercialisation and taonga species

Maui Hudson, KatieLee Riddle and Natalie Kusabs

For Māori, taonga species are much more than just animals and plants: they are treasured living beings with deep cultural significance. Taonga species have often played a crucial role in the spiritual and physical well-being of our communities, providing food, medicine, and resources, as well as serving as symbols of identity and connection to the natural world.

However, the use of these species for profit poses legal (Intellectual Property (IP) rights) and ethical (exploitation) questions. There are also concerns about how traditional knowledge (TK) and cultural practices associated with taonga can be protected.

These issues have been highlighted in a recent attempt to trademark the term 'mānuka honey'. The commercialisation of mānuka honey has created significant economic opportunities for Māori communities, who have TK and practices associated with the mānuka itself.[10]

However, Intellectual Property Office New Zealand (IPONZ) ultimately ruled that mānuka honey as a term is unable to be registered under the Trademarks Act 2022.[11]

In this report, we explore the challenges of commercialisation and IP protection for taonga species, including examining options to protect taonga. We believe that is important to analyse these issues so that Māori communities are better informed of their entitlements and options. Our view is that New Zealand will need to grapple with the complex legal, ethical, and practical challenges in safeguarding and sustainably utilising its natural heritage.

This report arises from a workshop held in July 2023 that brought together Māori practitioners, academics, business owners, entrepreneurs, and stakeholders. The views were provocative and challenging but also solutions focussed. We frame the discussion of the workshop with some broader contextualising comments and considerations. Finally, we provide a set of recommendations for future action.

Commercialisation and taonga species workshop

The workshop canvassed the issues surrounding the commercialisation of taonga species and explored the challenges and limitations to obtaining IP protection. Workshop participants recognised that the intrinsic and holistic value of taonga species was essential, as this ensures the preservation, protection, and respect for the communities that foster a relationship with the species.

Participants also recognised that the commercialisation of taonga species can have significant impacts for Māori communities:

Economic Benefits: Including job creation, income generation, capacity building and community development. This can contribute to the well-being of the community and have significant holistic benefits.

Cultural Awareness: Commercialisation of taonga species can raise awareness of iwi and hapū connections to their whenua, create and enhance the modern cultural significance of these species, enhance the mana of the community, and promote cultural identity. It also encourages the maintenance of whakapapa relationships and maintains the wairua and tapu of the species.

Environmental Impacts: Education on regenerative harvesting and habitat protection which can have long-term implications on the ecological balance of the ecosystem and positively affect the survival of the species.

Protection of Cultural Intellectual Property rights: The use of TK and mātauranga Māori may require protection as it is shared within commercial processes and R&D environments

A broad range of challenges were also discussed.

1. Defining and identifying taonga species is difficult. Perspectives on taonga species and their traditional uses vary among iwi and hapu. A lack of scientific knowledge about taonga complicates establishing legal protections.
2. Cultural ties to multiple communities complicate the creation of provisions that respect simultaneous rights and interests.
3. Balancing Western legal concepts with tikanga Māori principles is often challenging. For example, it is difficult to balance individualistic notions of property alongside collective responsibility and kaitiakitanga.[12]
4. It is difficult to account for existing and future community interests.[13]
5. The current IP legal system falls short in protecting TK and mātauranga Māori. There is a need to explore separate mechanisms including the Waitangi Tribunal Wai 262 recommendations for a *sui generis* system, which may provide a reliable foundation for claiming and safeguarding taonga species.[14]
6. Recognising TK as pre-existing IP within commercial agreements is not always common but is effective.
7. Low awareness of IP and commercialisation processes can lead to prior disclosure, negating the ability for any party to successfully be granted IP rights, and thus losing out on potential valuable commercial opportunity.[15]

> "... because we're using taonga plants potentially every step is underpinned by what we call our access and benefit-sharing framework, and just making sure everything's done … in accordance with tikanga, but it's a very massive process."

Contextualising comments

Definition and scope of taonga species: A key question is: what rights, responsibilities and protections does taonga status confer onto a species?[16] In terms of scope, there are significant challenges when taonga species also includes its derivatives and subspecies. An additional definitional difficulty is that taonga species are not mere commodities — they are intertwined with the concept of rangatiratanga.[17] To date, The Protected Objects Act has granted Courts the authority to decide what may or may not be considered a taonga.

Value: The value of taonga species is multifaceted. For example, the concept of input value, including the resources the species depend on, is paramount. Iwi, hapū and whānau may value taonga species differently, reflecting their historical relationships and uses. This value can change over time, as exemplified by the transformation of mānuka from being considered a pest to a prized honey producer. Recognising taonga species as having intrinsic value promotes an ethic of sustainable and responsible use and conservation use to protect the species for future generations, thereby enhancing the mana of the species.

Relationships: Māori are not the only ones to have relationships to taonga species. Those with competing interests include private landowners, non-Māori commercial interest holders, and other indigenous groups.[18] Mechanisms are needed to bridge the gap between theoretical perspectives of kaitiakitanga and actual practices in communities.

For example, will hui help identify multiple users and ensure inclusive consultation? How can researchers be made more aware of who are kaitiaki of taonga?[19] Do researchers, commercial entities, and governments recognise the financial and cultural obligations of being a kaitiaki? What are the opportunities to collaborate with international corporations to enhance the protection of mātauranga Māori?

Legal Rights and Interests: Legal, ethical and cultural considerations play a significant role in the commercialisation of taonga species, such as the difference between rights to utilise and rights to benefit and emphasising the importance of involving kaitiaki in a meaningful way. There is also the complex question of recognition for the uniqueness of taonga species, which could give rise to unique legal protections, such as assigning legal personhood to taonga, as was done for the Whanganui River.[20] This would require a human advocacy element, which is already embodied within a kaitiaki relationship.

Benefit Sharing: For Māori to 'share in the benefits from the use of their cultural heritage and cultural knowledge',[21] mātauranga Māori should inform IP in relation to taonga species, such as in research agreements and contracts.

Benefit sharing can be operationalised in different ways. It can be 'used to recognise a party's contributions regardless of whether they are ultimately the legal owner or inventor…by recognising each party's relative inputs to the Project IP'.[22] While benefit sharing is often monetary, 'economic benefits from commercial use, and non-economic benefits such as capacity building or training' can be used.[23] It is also common that benefit sharing arrangements are made before access is given to information, in this case access to mātauranga Māori.[24] The difference between small and large businesses introduces unique considerations, with smaller Māori entrepreneurial businesses often focusing on community benefits.

Entrepreneurial and community benefits can be derived from the process of commercialisation of taonga species, even in cases of project failure. Establishing a national benefit sharing entity could facilitate relationships, guide kaitiaki, and develop benefit-sharing mechanisms. Real-life case studies offer examples of best practices, although confidentiality clauses may conceal details. Pricing end products must consider accessibility for New Zealand and Māori buyers. The intangible asset of goodwill, along with Māori provenance stories, adds value to commercial products. It would also be useful to establish a network or directory to connect researchers with kaitiaki can facilitate collaboration.

Data: Many international indigenous communities are demanding the return of data about taonga from collecting institutions. This presents are range of practical challenges for Māori communities, including data aggregation and IP.

International Agreements: New Zealand is a signatory to the Convention on Biological Diversity (CBD), but not the Nagoya Protocol (NP), which has implications for indigenous entrepreneurship. Where the CBD creates obligations around TK promotion and protection, the NP creates obligations around benefit sharing which are currently not enforced in New Zealand. The need for regulation to prevent the unauthorised collection of samples is evident. Effective mechanisms to regulate private commercial research are needed to protect indigenous rights. Meeting these commitments would require regulation of private commercial research which would create more accountability and transparency.

Recommendations

In this section, we provide recommendations to address issues raised by the workshop attendees as well as potential areas of future exploration.

Institutional Framework: Develop an institutional framework that formalises the reciprocal relationship between commercial development and kaitiaki responsibilities. This framework should provide a mechanism for acknowledging the intrinsic value of taonga species and compensating kaitiaki for their role in safeguarding these assets. Alongside this, the integration of Māori knowledge systems into the commercialisation process involves recognising and valuing TK held by Māori and bridging the perceived gap between contemporary scientific and industrial methodologies and mātauranga Māori.

Policy Development: Companies, institutions, and researchers should develop clear and comprehensive policies which uphold Māori rights and interests in data and commercialisation in relation to research, legal and extra-legal agreements and taonga species. This is essential for effective management and protection of taonga species, and the relationships associated with them such as that of a kaitiaki interest. They should be developed with Māori communities, stakeholders, industry professionals, scientists, and relevant government agencies all in mind to ensure a collaborative and inclusive approach. Sharing these policies publicly can also ensure that institutions and potential collaborators can be held to account and inspire others to also develop culturally responsive policies in relation to taonga species, TK, mātauranga Māori, Māori data rights and IP. Transparency of policy also generates confidence for Māori looking to collaborate or partner with these institutions to know that their rights and interests will be upheld. A by-product of this is that other iwi who wish to collaborate would be assisted to engage in the process and enable efficient participation.

Guidelines and Best Practices: Create non-prescriptive guidelines and best practices that offer flexible guidance for commercial ventures involving taonga species. These guidelines should encompass diverse perspectives and approaches to accommodate the unique cultural contexts of different Māori communities. They could also create an opportunity to align commercialisation practices with ethical considerations and cultural values. This involves embracing strategic thinking that prioritises cultural and environmental sustainability.

Community Partnership: Encourage proactive community engagement and partnership between researchers, Māori communities, and commercial entities. Establish mechanisms for establishing pre-existing and non-transactional relationships that foster trust and ensure cultural compliance. Implementing a concentrated effort to move the status quo from one of exploitation to collaboration, fostering stronger, mutually beneficial relationships.

Cultural Valuation Framework: Disentangle commercial development from the essence of taonga by recognising its holistic and intrinsic value in and of itself. This disentanglement is often already reflected in the cultural relationship that kaitiaki have with taonga species and any associated TK. By facilitating a framework development that recognises the symbiotic relationship between Māori and taonga species, discussions about commercialisation, benefit sharing, and related considerations can embark from a more equitable standpoint.

Benefit Sharing Mechanisms: Develop transparent and adaptable benefit sharing mechanisms that consider economic, social, cultural, and environmental aspects. Use exemplars of real-life case studies and precedent-setting to shape equitable benefit sharing arrangements.

Data Management: Establish culturally approved or designed protocols for the responsible management and sharing of data related to taonga species. Ensure that data is handled in a way that respects cultural considerations and safeguards the interests of Māori communities.

Legislative Reforms: Advocate for legislative reforms that align with the recognition of taonga species' intrinsic value and kaitiaki responsibilities. Explore the potential for sui generis legal pathway that provides a contemporary context for defining and protecting taonga species.

Indigenous Entrepreneurship: Explore the benefits of New Zealand becoming a signatory to international agreements such as the NP. This could facilitate engagement with TK and culturally significant species from other countries, while also promoting the national focal point for access and benefit sharing (currently established at Te Puni Kokiri).

Strategic Consultation Capacity: Attendance to workshops can become limited in range of attendees due to a myriad of factors, such as the network of the researchers, the capacity of attendees to meet, etc. Discussions are more fruitful when held in a physical space, but time constraints and travel requirements are best met when a hybrid or solely online option is also available. Going forward, the ability to meet in a flexible manner would best facilitate further conversations on this kaupapa.

Collaborative Capacity Building: Awareness levels of commercial entities, policymakers, industry professionals, researchers, and Māori communities alike need to be brought together to form reciprocal knowledge sharing and relationship building. This requires a mana ōrite approach to the shared knowledge which targets various rightsholders and stakeholders. Subsequently, this fosters a collective understanding of the various cultural dimensions inherent in approaching commercialisation of taonga species. This can help create a broader cultural paradigm and norm shift towards a set of more ethically informed commercial practice norms.

Cultural Impact Metrics: Further research should be undertaken that aims at developing metrics for the cultural impact of commercialisation of taonga species. These endeavours should explore innovative ways to quantify cultural and holistic value of taonga species and their use.

Conclusion

The workshop outlined some potential actions for the commercialisation of taonga species, emphasising the importance of recognising their inherent value and the unique role of kaitiaki. By establishing an institutional framework, developing comprehensive guidelines, and fostering meaningful community partnerships, the future of taonga species commercialisation promises to be culturally respectful, economically viable, and environmentally sustainable. As Māori communities and commercial entities continue to navigate this dynamic landscape, the workshop served as a starting point to speak to the possibility of shaping a future that honours tradition while embracing innovation.

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> I think the key thing more than anything that I will walk away with is the whakawhanaungatanga amongst the researchers that we've built up within the SfTI workforce. I'm pretty sure that where I go for the rest of my life if I ever meet any of these people again it will be a happy day . . . the desire/dream is to meet them for my work capacity; we trust them. If there's an opportunity to work with them again, I will.

4

SfTI leaders' reflections on enhanced Māori capacity

Maria Amoamo and Katharina Ruckstuhl

We start this section with an anecdote from one of the senior Māori leaders of SfTI. As we have seen in previous sections, whanaungatanga and ongoing relationships amongst the various groups that formed the SfTI programme – leaders, researchers, partners, whānau – is identified as one of the key outcomes. In this case, it is the relationship amongst researchers that has been impactful.

But what of relationships with Māori businesses and community organisations? Have Māori relational capacity and networks been enhanced? Do Māori now have increased technical capabilities and capacities to access and develop advanced tools and technologies? Have Māori concerns around mātauranga Māori and Intellectual Property been addressed so that the handling of IP is now fit for purpose? And finally, why were these considered areas that needed addressing?

To get some insight into this, we briefly provide reflections from the Kāhui Māori and senior programme leaders.

Barriers and enablers

Scientists didn't know how to engage with Māori, they were not comfortable dealing with ambiguity. Māori partners were sceptical too… there was a duality of ambiguity and uncertainty from both sides. Living with and working through ambiguity was one of the big learnings for me.

Vision Mātauranga has been a government policy since 2007. But, as this quote expresses, how to effect it in at the start of the National Science Challenges was ambiguous and raised issues of discomfort, uncertainty and Māori scepticism.

Why was there ambiguity and scepticism? SfTI leaders identified a range of barriers that impeded VM's policy aims of 'indigenous innovation'.

Table 8: Barriers for Māori of science-based innovation

Barriers for Māori to science-based innovation	Barrier
Technical	• Few Māori in physical sciences and engineering. • Innovation tools not designed with Māori in mind.
Relational	• Inability to influence/lead/design direction of science innovation. • Disconnect and lack of understanding between research organisation protocols and Māori organisation tikanga. • Lack of Māori in science innovation networks. • Unclear benefit sharing processes.
Human	• Science-based innovation not seen as an area of opportunity for Māori individuals or organisations. • Few Māori with science technology capabilities in Māori organisations.
System	• Inequity. • Science system not valuing Māori participation. • Lack of funding dedicated to Māori. • Mātauranga not protected. • Māori not seen as a partner due to contracting rules.

Table 9: Enablers for Māori of science-based innovation

Barrier	SfTI Enablers
Technical	• Active inclusion and mentoring of early career Māori. • Technology developed through Māori protocols.
Relational	• Shared understanding of tikanga through Māori sites of collaboration (e.g., marae, natural environment). • Use of Māori collaboration processes e.g., wānanga. • SfTI relational co-ordinators dedicated to Māori to connect across innovation system. • Māori-specific projects -led by Māori researchers/community partners. • Large projects required to co-design with Māori.
Human	• Partnership with FoMA with support of SfTI technical advisor/rangatahi scientist. • Inclusion of Māori 'thought-leaders' in development of research priorities.
System	• Māori co-Chair of Board. • Kāhui Māori. • Dedicated funding for Māori via large and small projects. • Specific project assessment criteria to take into account Māori relevance, participation, mātauranga. • IP clauses developed to protect mātauranga. • Contracts to recognise equal partnership with Māori organisations. • Sovereignty control of Māori data.

Given this long list of barriers, 'changing some of the standard practices in our system' was needed, with SfTI putting in place several enabling practices.

Ngā hua: Impact

From SfTI leaders' perspectives, there have been many positive changes. For scientists this has meant getting 'out of the lab' to better understand Māori community needs and a more integrated approach to projects. Scientists have had to 'start to get dirty . . . (and to) stop trying to control everything'. It has also meant that scientists were exposed to the aspirational thinking and worldview Māori, such as being in a room with '300-400 Māori business leaders, which they otherwise wouldn't get access to.'

Both these relational and human capacities are necessary if, as one leader stated, the intention is for the science to 'actually work in practice'.

For the science sector, SfTI leaders viewed that there was an increased presence of Māori 'at the table and in the science system', with SfTI having 'given tangible effect to Te Tiriti'. Another leader stated that the science sector 'has a willingness and desire for access to Māori knowledge (VM) and to deliver for everybody' with MBIE (the government's science policy and implementation arm) learning from SfTI how relationships with Māori might be done in 'a safe and engaging way.'

Māori sector technical capacity has also increased, from "only two or three of us (at the start) to a list of about eight or nine physicists at PhD level". In turn, this has seen a shift in technical capability, with increased numbers of research applications demonstrating expertise across both Māori and science technology fields of knowledge.

As one SfTI leader noted, this has also meant that Māori science sector careers were 'moving ahead', with SfTI offering 'some extra support around our cohort to ensure our 'potential exemplars' did not burn out' due to 'aronga takirua' or 'cultural double shift' which imposes substantial strain, tension, and impedes Māori academic careers.[25]

For Māori, SfTI leaders saw a shift in awareness, with Māori connected into technology networks. SfTI leaders assessed that several Māori corporations had been involved with SfTI projects that prior to SfTI 'would not have had the exposure to either the people capability in SfTI or the tech in terms of access.'

Consequently, as one leader assessed, there were greater options to 'building networks and tools that helped Maori progress' as the following quotation reveals:

it's not so much the case anymore that if we want to do research on the environment, we have to get the CRI people in or if we want to do research on trees we have to go to Scion.

This can be seen in how there are now processes for Māori to be 'research partners' not just stakeholders with the ability to develop and lead technology projects through processes, protocols and principles that align with kawa and tikanga. Several projects embodied this. (For examples, see end of Report.)

Conclusion

From a SfTI organisation and leadership perspective there have been many positive shifts between 2014 and 2024. Māori are now part of science and technology networks with additional skills and confidence to not only participate but drive innovation. Greater capacity has been built across the science sector – both on the Māori and technical scientist side – because, as one SfTI leader said, "I came to realise it's important to have non-Māori involved in Māori research too."

There are new tools and processes – for example, IP plans and funding arrangements – along with a deeper appreciation of how mātauranga Māori and technical science might enmesh without diminishing the value of either knowledge system.

From a 'mission accomplished' perspective, SfTI has contributed to many of the conditions necessary for Māori prosperity through science-based innovation. However, challenges remain for Māori and the science sector more generally. In the last section, we consider which parts of SfTI's mission are unfinished and what this suggests about the future.

25 Haar, J., & Martin, W. J. (2022). He aronga takirua: Cultural double-shift of Māori scientists. *Human Relations*, 75(6), 1001-1027.



> We had a message from (a) Māori Land Trust saying - 'Just read your paper your journal article – really keen to meet with you – can we do something – we've got x-number of shareholders that we're looking to find – can you help us?' So, there will be some legacy aspects of it that will carry the project into the future.

Conclusion: Mission accomplished?

In this conclusion, we provide a set of nine outcomes that we consider are SfTI's 'legacy aspects' that might help Māori identify new R&D and innovation processes and directions for the future.

Research relationships and engagement with R&D providers

There is enhanced individual and organisational technical capacity and capability. Māori recognise the need to build capability within their organisations and communities, with access to high-tech expertise, both globally and domestically, advancing this agenda. Māori increasingly demand to be at the cutting-edge of science-based innovation – as leaders, co-designers and producers, and users. SfTI projects enabled many of the participants to accelerate their understanding and uptake of specific science-based innovations.

Many participants used projects to upskill their members, especially rangatahi, and to spread science-based innovation knowledge more widely to whānau, hapū, other Māori and non-Māori communities. This particularly supported Māori organisations in rural locations where access to science technology resources was limited or non-existent. This ripple effect has led to impact beyond the project itself.

While for some organisations commercialisation is important, this should be in balance with Māori values and protection of mātauranga Māori. Even where a commercial outcome may derive from a project relationship, for most of the participants involved in SfTI projects this has not been their priority. For all participants, making things better for their constituencies or environments has been the over-riding concern.

Outcome 1

Māori have become more demanding and confident in relation to R&D research relationships. Research organisations should expect this demand to increase, requiring new processes that recognise the equal nature of a science-innovation partnership. This will build trust (the 'currency' of a functional relationship) and hence the likelihood of greater economic impact/prosperity.

Outcome 2

R&D projects provide accelerated technological capabilities into Māori organisations with knowledge and practice multipliers into Māori and non-Māori communities.

Outcome 3

Mātauranga Māori protection continues to be a key concern for Māori. This need not impede R&D development but requires specific considerations in IP contracting relationships.

Commercialisation and taonga species

Some Māori entities and entrepreneurs are interested in exploring commercialising taonga species alongside research organisations. There is agreement that taonga species have value in and of themselves beyond any human relationship, and that Māori have a duty to both protect and preserve the species for future generations and to support Māori communities that act as the kaitiaki of a particular species.

This is in line with recommendations from the Waitangi Tribunal's Wai 262 report. There is also awareness that, if undertaken with due consideration to Māori concerns, there may be benefits to Māori communities and entrepreneurs.

There is acknowledgment that current IP regimes and the state of knowledge about taonga species create tensions and challenges requiring balance amongst a range of competing values, priorities and contexts: current vs future benefits; cultural and environmental vs economic considerations; single whānau/hapu/iwi relationships to particular taonga species vs multiple Māori or non-Māori groups' claims to a relationship; current national and international laws and protocols to acknowledge Indigenous traditional knowledge vs potential for innovation in legal and extra-legal protections.

Therefore, there is a call for greater certainty and clarity about the conditions and boundaries to allow for commercialisation. This includes, amongst other things, the need for national policy and legislative reform to meet the recommendations of Wai 262; institutional research frameworks and guidelines (including around data management of knowledge of taonga species); guidelines and workshops to build capacity for Māori and share knowledge and practice.

Outcome 4

Māori are not averse to commercialisation of taonga species. However, this needs to be undertaken from a holistic perspective that takes into account mātauranga Māori, kaitiaki and intergenerational relationships, sustainability, values, ethics and benefit sharing.

Outcome 5

There is a need for national and institutional policy, and potentially legislation, to clarify the conditions and boundaries of taonga species commercialisation. Kaitiaki themselves must lead these developments.

Outcome 6

Lessons about taonga species commercialisation and examples of best practice should be shared across Māori organisations.

Economic benefits of R&D

More Māori firms reported engaging in more R&D partnerships than general New Zealand firms. Māori firms are increasingly engaging with sci-tech innovation outside their organisations with Māori firms 'innovating New Zealand firms' on various factors of product/service.

That said, Māori firms faced many challenges similar to non-Māori business owners such as staffing recruitment, quality and retention of employees. Only a small number of Māori businesses were working with universities but this was still greater proportionately than general New Zealand firms. Mostly engagement was to access technical expertise or equipment, and to lend credibility when seeking funding.

Some also noted the more positive environment for Māori due to the VM policy being enacted.

Outcome 7

Regardless of size, businesses should be encouraged to reach out to universities to see what types of services and help can be provided. Our results highlighted that many small businesses were working with universities with significant effect. You don't need to be a large organisation to form a relationship. This was particularly true for Māori businesses as many universities are interested and helping small Māori businesses thrive.

Outcome 8

Many of the larger organisations used to have connections with the university through graduate programmes, but these had fallen by the wayside. Businesses and universities should be encouraged to reform these relationships to provide a steady pathway of employees to the sector. From here, businesses and universities can form better relationships and discuss potential innovation and development pathways.

Outcome 9

Universities will need to show what they have to offer as many businesses felt that there was a lack of relevancy. This will be even more important as traditional funding models for universities change, and they will be required to work more and more with business.

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Science-based innovation and Māori futures

There is no doubt that as science-based innovation accelerates, Māori and physical scientists and engineers must continue to collaborate to take advantage of its potential, to share in benefits and to avoid the risks and pitfalls that arise from novel technologies. Science and technology often move at a pace that governments, the general public and Māori find difficult to keep up with.

This is particularly the case in relation to data and the online digital world. Conversely, many science discoveries can take years before they reach maturity and become useful. We see this particularly in the area of biologically-based innovations, many of which derive from native flora. Over the 10 years of the SfTI challenge, Māori were involved in projects that dealt with both ends of the innovation development spectrum and many more in-between.

We have seen that by scientists opening doors to Māori and by Māori opening doors to scientists, shared issues can be tackled and hence solutions proposed using science-innovation. As one interviewee aptly stated, 'rather than being exclusive – just . . . open it up a little bit'.

From an economic perspective, Māori businesses are innovating at a similar level to other businesses, and there is a small, but perhaps growing recognition that R&D providers such as Universities can be useful sources of information and collaboration to point business towards new development pathways. We cannot claim that this positive trend is directly because of the science-sector's more open stance to knowledge sharing.

However we have seen that consciously designing the parameters for science-based innovation with Māori to remove roadblocks and facilitate interaction can create new 'constellations' of science-technology open innovation practice. The aim of such constellations is to create individual and organisational conditions to accelerate, share and transmit learnings and insights that can then be applied to create novel solutions, products and services for future Māori development.

Can such positive developments be sustained when external conditions change? We are confident that Māori have the resilience, networks, capabilities and knowledge to take advantage of science-based technological innovation. We leave the last word to one of our informants.

Our people aren't afraid of the unknown or a bit of uncertainty, because that's what we've been living in for the last 150-200 years.

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SfTI R&D projects led by, focused on, or partnered with Māori

SPEARHEAD PROJECTS

Spearheads projects were large Aotearoa New Zealand-relevant research projects that spanned over three or more years, funded up to $1M per annum. They were predominantly developed in partnership with Māori and industry representatives through Mission Labs and involved multi-disciplinary research groups.

Project	Leader/s	University/Company	Year/ Funding	Theme
Ātea	The aim is to preserve and share knowledge, language, and culture in the digital realm. Ātea is described in te reo as space, a wide expanse, or something that is clear and free from obstruction.			
	Professor Hēmi Whaanga (Ngāti Kahungunu, Ngāi Tahu, Ngāti Mamoe, Waitaha)	Waikato University/ Massey University	2018 $4.2 million	Data Science and digital technologies/Vision Mātauranga
Te Tātari Raraunga – Analytics to identify and connect successors to whenua	This Spearhead project is creating smart data analytics tools to help track down rightful Māori shareholders to connect them to their land.			
	Associate Professor Andrew Mason Dr Sydney Shep Puna Wano-Bryant (Taranaki, Te Atiawa)	University of Auckland Victoria University of Wellington Parininihi ki Waitotara (PKW) Incorporation	2016 $4.4 million	Data Science and digital technologies/Vision Mātauranga
Clean Water Technology for restoring Te Mana o te Wai	A team of multi-disciplinary researchers, in partnership with Māori, iwi, councils and industry are developing new technology for treating wastewater, with a mission to improve freshwater quality and restore the health of our awa (rivers) and streams.			
	Associate Professor Aisling O'Sullivan Craig Pauling (Ngāi Tahu Kāti Mamoe, Waitaha and Ngāti Mutunga)	University of Canterbury Boffa Miskell	2021 $3 million	Materials, manufacturing technology and design/ Vision Mātauranga
Precision farming technologies for aquaculture	This Spearhead project is developing underwater sensors and data communication tools, alongside data analytics to let farmers monitor their ocean farms from their home base.			
	Dr Chris Cornelisen Heni Unwin (Ngāti Tūwharetoa, Ngāti Kahungunu ki Wairoa, Rongomaiwahine, Ngāi Tūhoe, Te Atihaunui-a-Papaarangi)	Cawthron Institute	2017 $5 million	Data science and digital technologies / Vision Mātauranga
Biosecurity Technology	This Spearhead builds on science in the areas of sensors and robotics to create a swarm of smart sensors that can work together in rugged landscapes to identify the last remaining predators in New Zealand's vast landscapes. The project will use wānanga to explore ways in which Mātauranga Māori can inform the development of the technology.			
	Dr Katerina Taškova Dr Tara Strand	Auckland University Scion	2021 $3 million	Data science and digital technologies/Vision Mātauranga

SEED PROJECTS

Seed projects were funded $200,000 for up to two years. They were small and technically complex investigator-led projects. Projects listed here were led by or involved Māori researchers or partnered with a Māori entity.

Project	Leader/s	University/Company	Year/ Funding	Theme
Developing a Reo Turi (Māori Deaf Language) Interpreter for Ngāti Turi, the Māori Deaf Community	Sophie Tauwehe Tamati (Ngāti Maniapoto, Tūhoe/Ngati Ruapani, Ngāti Tūwharetoa) Ho Seok Ahn	University of Auckland	2021 $200,000	Data science and digital technologies / Sensors, robotics and automation / Vision Mātauranga
Developing culturally congruent emotional speech recognition framework for te reo Māori	Dr Jesin James Dr Sally Akevai (Ake) Nicholas (Ngāti Te'akatauira and Papa'ā Niu Tireni) Dr Gianna Leoni (Ngāi Takoto, Ngāti Kurī and Te Aupōuri)	University of Auckland Te Hiku Media	2021 $200,000	Data science and digital technologies / Vision Mātauranga
Protecting taonga in the commercialisation of Te Tauihu bioactive ingredients	Dr Meika Foster (Te Ātiawa and Ngāti Mutunga) Dr Jeff Nijsse	Edible Research Ltd/ AuOra Ltd Auckland University of Technology	2021 $200,000	Data science and digital technologies / Vision Mātauranga
Te Kapahaka Pūnaha Taupanga (The kapahaka software judging system)	Kevin Shedlock (Ngāpuhi, Ngāti Porou, Whakatōhea)	Victoria University of Wellington	2021 $199,999	Data science and digital technologies / Vision Mātauranga
Te Muka Taura – A site-based exploration of harakeke for dye extraction and muka colouration	Angela Kilford (Te Whānau A Kai, Ngāti Porou, Ngāti Kahungunu)	Massey University	2021 $197,384	Materials, manufacturing technology and design / Vision Mātauranga
Unlocking the unique engineering potential of auxetics in kōwhaiwhai design	Dr Eli Gray-Stuart Maihi Pōtaka (Ngāti Hauiti Te Ātihaunui-a-Pāpārangi and Ngāti Manawa)	Massey University	2021 $200,000	Materials, manufacturing technology and design / Vision Mātauranga
Domain adaptation to support Polynesian language technologies	Dr Jonathan Dunn	University of Canterbury	2020 $200,000	Data science and digital technologies / Vision Mātauranga
Ngā taonga o nehe rā me te heke mai: treasures of the past and future	Professor Steve Reeves	University of Waikato	2020 $199,992	Data science and digital technologies / Vision Mātauranga
Physical activity promotion chatbot for youth wellbeing	Dr Sarah Hopkins	University of Auckland	2020 $200,000	Data science and digital technologies / Sensors, robotics and automation / Vision Mātauranga
Unlocking Mātauranga Māori in historic survey maps	Dr Stuart Mead	University of Auckland	2020 $200,000	Data science and digital technologies / Vision Mātauranga
Weaving Maori culture into natural fibre reinforced composites	Dr Tim Huber	University of Canterbury	2020 $173,879	Materials, manufacturing technology and design / Vision Mātauranga
A platform device for vision testing applications	Dr Jason Turuwhenua (Ngāti Porou, Ngāi Tūhoe)	University of Auckland	2019 $200,000	Data science and digital technologies / Vision Mātauranga
Artery heterograft development	Professor Chris Cunningham (Ngāti Toa, Ngāti Raukawa) Professor Richard Haverkamp	Massey University	2019 $200,000 2018 $100,000	Materials, manufacturing technology and design / Vision Mātauranga

Project	Leader/s	University/Company	Year/ Funding	Theme
Building a clinically validated AI classifier to assist the national Diabetic Eye Screening program	Dr Ehsan Vaghefi	University of Auckland	2019 $200,000	Data science and digital technologies / Vision Mātauranga
Consolidating Cordyline for Green Composites	Dr Nancy Garrity (Ngāti Makirangi, Ngāti Pāoa, Ngāti Hine)	Scion	2019 $173,906	Materials, manufacturing technology and design / Vision Mātauranga
Developing real-time lab-on-chip device and biosystems for personalised cancer medicine	Dr Maran Muthiah	University of Auckland	2019 $200,000, 2018 $100,000	Materials, manufacturing technology and design / Vision Mātauranga
Envionmental sensors	Associate Professor Ashton Partridge Dr Leonie Jones (Ngāpuhi, Ngāti Kahungunu ki Wairarapa)	Digital Sensing Limited	2019 $200,000	Sensors, robotics and automation / Vision Mātauranga
Molecular biosensors to detect and monitor toxins from harmful algal blooms	Dr Balam Jimenez	Victoria University of Wellington	2019 $199,900	Sensors, robotics and automation / Vision Mātauranga
Electricity demand flexibility on New Zealand farms	Dr Janet Stephenson	University of Otago	2018 $98,601	Data science and digital technologies / Vision Mātauranga
Distance and direction estimation for acoustic bird monitoring	Professor Stephen Marsland	Massey University	2017 $200,011	Data science and digital technologies / Vision Mātauranga
Landscape-scale augmented reality: enhancing public understanding of our cultural heritage	Professor Neil Dodgson	Victoria University of Wellington	2017 $199,586	Data science and digital technologies / Vision Mātauranga
Secure, shared and collaborative: treasure in the block chain	Professor Steve Reeves	University of Waikato	2017 $198,860	Data science and digital technologies / Vision Mātauranga
Womb with a view	Dr Harvey Ho	University of Auckland	2017 $199,921	Data science and digital technologies / Vision Mātauranga
Algae-derived food supplement	Dr Phil Novis	Manaaki Whenua Landcare Research, University of Canterbury	2016 $295,000	Materials, manufacturing technology and design / Vision Mātauranga
Nitrate sensor arrays	Dr Leonie Jones (Ngāpuhi, Ngāti Kahungunu ki Wairarapa)	Digital Sensing Limited	2016 $295,000	Vision Mātauranga / Materials, manufacturing technology and design
Te Tāhū o te Pātaka Whakairinga Kōrero: Next generation indigenous knowledge	Dr Hēmi Whaanga	University of Waikato	2016 $106,250	Vision Mātauranga / Data science and digital technologies

ENDING WITH IMPACT PROJECTS

Successors to the research-intensive Spearhead projects, Ending with Impact projects (EWIPs) were those workstreams that demonstrated the greatest potential impact as well as strong collaboration with industry and sector partners, and where possible further SfTI's commitment to Vision Mātauranga.

Project	Leader/s	University/Company	Year/ Funding	Theme
Disruptive MedTech	This project will develop low-cost insulin pumps and sensors to provide equitable health outcomes for diabetes patients.			
	Professor Geoff Chase Jake Campbell (Te Rarawa)	University of Canterbury	2022 $1,641,070	Data science and digital technologies / Materials, manufacturing technology and design / Sensors, robotics and automation
Ātea NLP Platform	This project will develop Māori-designed and governed systems to enable whānau, hapū and iwi to interact with their data using te reo Māori.			
	Professor Hēmi Whaanga (Ngāti Kahungunu, Ngāi Tahu, Ngāti Mamoe, Waitaha) Tiriana Anderson (Ngāti Maniapoto) Corey Bragg (Kāi Tahu, Kāti Mamoe, Waitaha, Ngāti Kahungunu)	Massey University Awarua Rūnanga	2022 $1,264,907	Vision Mātauranga / Data science and digital technologies
Virtual Immersive Wānanga	This project will develop a flexible system that enables individuals and groups to meet virtually and discuss issues via low- and high-tech tools			
	Professor Hēmi Whaanga (Ngāti Kahungunu, Ngāi Tahu, Ngāti Mamoe, Waitaha) Tiriana Anderson (Ngāti Maniapoto) Corey Bragg (Kāi Tahu, Kāti Mamoe, Waitaha, Ngāti Kahungunu)	Massey University Awarua Rūnanga	2022 $2,005,564	Vision Mātauranga / Data science and digital technologies
Ocean Intelligence	Ocean Intelligence EWIP is combining customised sensors and data analytics to enable large-scale ocean farm management. It DocuSign Envelope ID: 2F8E72CF-8BB7-41EA-9A72-3051C52AD64C 4 aims to significantly advance its business case and attract investment while maximising impact in the form of greater access to data-driven knowledge by end users, including marine farmers and iwi.			
	Dr Chris Cornelisen Heni Unwin (Ngāti Tūwharetoa, Ngāti Kahungunu ki Wairoa, Rongomaiwahine, Ngāi Tūhoe, Te Atihaunui-a-Papaarangi)	Cawthron Institute Cawthron Institute	2022 $1,404,350	Data science and digital technologies / Sensors, robotics and automation / Vision Mātauranga
Te Pā Tūwatawata	Te Pā Tūwatawata is to be an iwi Māori designed, owned and operated repository network that creates security of the highest level, with programming that reflects traditional Māori methods of data repository models (holding protocols and principles that align with kawa and tikanga for respective datasets depending on the levels of sensitivity or tapu), as well as underlying programming and coding that reflects a collective framework set and tested by the iwi cohort participating in the research.			
	Kirikowhai Mikaere	Te Kāhui Raraunga Charitable Trust	2023 $600,000	Data science and digital technologies / Vision Mātauranga
Rongowai Flood Resilience Sensor Framework	The project aims to develop an integrated observation-driven data assimilation framework where an open data platform can be provided to the public. This framework will enable the assessment of environmental impacts of land use and climate 4 impacts on land, starting with inundation and flood impacts in rural catchments within high flood-risk regions.			
	Dr Delwyn Moller Mike Taitoko (Ngāti Maniapoto)	ReSTORe Lab Takiwā	2023 $300,000	Data science and digital technologies/Vision Mātauranga

EARLY CAREER RESEARCHER BOLT-ON PROJECTS

These projects were designed to enable researchers either studying towards higher level degrees or just beginning their careers to design, lead and deliver on a project that enhances the capacity of the team members. Projects listed here were either led by or involved Māori researchers or partnered with Māori entities.

Project	Leader/s	University/Company	Year/ Funding	Theme
Clinical Usability Analysis to Optimise Innovation Uptake: Developing Training for the Trainers and the Patients	Dr Grace Walker (Ngati Kahungunu, Ngāruahine) Taylor Pearson	Think Analytics University of Canterbury	2023 $150,000	Sensors, robotics and automation / Vision Mātauranga
Matariki Hunga nui. Mixed Reality Experience	Kris Tong Noel Park	University of Canterbury University of Otago	2023 $150,000	Data science and digital technologies / Vision Mātauranga

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