National SCIENCE Challenges

Briefing to the Incoming Minister: SfTI and BNZIC

SEPTEMBER 2023
VERSION 4.0

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Illustration designed by Tyler Dixon, Waikato-Maniapoto, Ngāti Porou, Ngāi Tūhoe, Ngāi Tahu depicts a Mangopare (Hammerhead shark). It symbolises the strength in duality to be found in uniting Māori knowledge with western science.

FOREWORD

Dear Minister Collins

Congratulations on your appointment, and welcome to the Science, Innovation and Technology portfolio.

A strong economy works for every New Zealander, lifting incomes and creating opportunity. New Zealand's Research, Innovation and Science (RSI) system plays a vital part in our economy – and it has potential to play an even greater part.

The Science for Technological Innovation (SfTI) National Science Challenge has been in place since 2015. Its mission is to enhance the capacity of New Zealand to use physical sciences and engineering for economic growth and prosperity. An important part of the SfTI is Building New Zealand's Innovation Capacity (BNZIC) – a spearhead project.

BNZIC looks not just at what the RSI system does, but how it is done. This matters because the 'how' of science contributes to its success, and therefore strengthens our RSI system. A strengthened RSI system in turn contributes to our economy, and to better lives for New Zealanders.

In this Briefing to the Incoming Minister, we explain what the SfTI National Science Challenge is. We outline the BNZIC research programme that is part of the SfTI, what it has shown about the 'how' of science, and what this could mean for strengthening the RSI system. We set out the way that SfTI has given effect to Vision Mātauranga – a policy framework intended to unlock the science and innovation potential of Māori knowledge, resources, and people. Finally, drawing on the BNZIC research programme, we consider what the future could look like.

We look forward to discussing your priorities for the RSI system.

Sally Davenport
Director,
Science for Technological Innovation

Dr Urs Daellenbach
SfTI Co-Theme Leader,
Building New Zealand's Innovation Capacity

Dr Katharina Ruckstuhl – Ngāi Tahu, Rangitāne
SfTI Theme Leader, Vision Mātauranga,
and Co-Theme Leader, Building New Zealand's Innovation Capacity

PURPOSE AND STRUCTURE OF THIS BIM

This Briefing to the Incoming Minister (BIM) is from the Science for Technological Innovation (SfTI) National Science Challenge, one of 11 National Science Challenges that have been underway since 2014. It explains the purpose and work of SfTI, which aims to enhance New Zealand's capacity to use physical sciences and engineering for economic growth and prosperity.

Since SfTI was established, we have been intentional in learning what works for how scientific research is done, not just focusing on the outputs of the research itself. We have seen the benefits of collaborative, problem-oriented scientific research – and we know that when we get this right, it has positive impacts for New Zealand, both domestically and on the world stage. Our insights have implications for the Research, Science, and Innovation (RSI) system.

As Minister responsible for the RSI system, we want to work with you to put into practice what we have learnt about the conditions of success for scientific research.

This BIM explains who we are, what we have been doing, how we are contributing to Māori prosperity through physical sciences and engineering, and how our research can guide the next steps for change to New Zealand's RSI system. Throughout, we outline which things are working, what we think we need more of, and what the future could look like. The structure of this BIM is:

1. **Part one: Who are we?** This section explains what the SfTI National Science Challenge is, and one of its spearhead projects - Building New Zealand's Innovation Capacity (BNZIC) – which is about the how of doing science projects. It explains how SfTI fits within the broader RSI system of New Zealand.
2. **Part two: What have we been doing?** This section explains how SfTI has improved RSI in New Zealand – specifically, the processes that support high-tech science research in New Zealand. We are able to understand this improvement using the real-time findings of the BNZIC research programme. This part shows the benefits that could be achieved by implementing our mission-led approach to research across other areas of the RSI system.
3. **Part three: How we are contributing to Māori prosperity through physical sciences and engineering.** This part explains how SfTI has put the Vision Mātauranga innovation policy (in place since 2005) into action across SfTI projects, and the success SfTI has seen as a result. This part shows that our approach has worked well, and what can be learnt.
4. **Part four: How our research can guide the next steps for change to New Zealand's RSI system.** This section advises you about three areas the BNZIC research programme has indicated as potential priorities for the RSI system: developing new, non-technical skills in our researchers (workforce development), taking a collaborative approach to establishing and implementing new national research priorities, and making sure that Māori innovation flourishes in the RSI system to improve science outcomes.

We look forward to working with you.

Future directions for the RSI system

To achieve greater economic growth and prosperity for New Zealand through physical sciences and engineering, we think it is important to consider how research is done through the RSI system. Drawing on the BNZIC research programme, we think there are three main areas where change could be considered.

Workforce development

BNZIC found that growing and expanding the human and relational skills of the RSI workforce has tangible benefits for the quality of science and the likelihood of high-tech research having an impact on New Zealand. To do this better, a future focus could include:

- developing national programmes to encourage the development of human and relational capabilities of the RSI workforce, such as leadership and entrepreneurial skills
- investing in professional support and development for the RSI workforce, such as science-led innovation leadership coaching.

Establishing research projects and national research priorities in collaboration with business and the wider research sector

BNZIC observed that science outcomes improve when there is 'buy-in' from stakeholders, partners, business, and the research sector. It found that the best way to get buy-in is to set research priorities in a collaborative and transparent way with industry, Māori organisations, and the community – SfTI's mission lab and mission design processes were particularly successful at doing this. Taking a collaborative approach to governing, managing, and doing research creates more flexibility and resilience than current competitive approaches.

This formal, collaborative mission lab and mission design approach could provide a direction for the future, when establishing the new national research priorities and the projects under them. It could help to ensure that there is genuine 'buy-in' from industry, Māori organisations, community, and researchers.

Embedding Māori innovation processes

BNZIC found that embedding Māori innovation processes in research improves science outcomes with flow on benefits for economic growth and prosperity. Doing this requires authentic R&D relationships with Māori organisations and te ao Māori expertise in the RSI workforce. However, Māori researchers are under-represented in the RSI system, and the system does not perform well in growing and retaining Māori researchers.

To address these issues, a future focus could consider:

- funding community and stakeholder engagement roles for Māori researchers as part of grants to build relationships and partner with Māori innovators (in addition to what is already provided)
- additional, specific funding to build te ao Māori innovation capabilities of non-Māori researchers
- specific funding to develop Māori researchers' cultural innovation capacity, including specific support for early career Māori researchers. Activities that were beneficial for SfTI researchers during the challenge, and therefore the impact of their research, were mentoring, tuakana-teina relationships with senior researchers, and research and development support activities.

We would like to meet with you to talk about our ongoing work, understand your priorities, and discuss how we can best work together to drive change across the RSI system.

PART ONE: WHO ARE WE?

The diagram on the following page outlines the structure and work of SfTI – the Science for Technological Innovation Challenge. SfTI has a work programme of 97 projects researching and seeking the commercialisation of high-tech science (such as robotics and hi-tech manufacturing) in New Zealand.

First, some brief context on the RSI system in New Zealand to explain how SfTI and the Building New Zealand's Innovation Capacity (BNZIC) project fit into this broader context.

- New Zealand's RSI system consists of people, institutions, and infrastructure, working in research, science, and innovation. There are approximately 20,000 FTE researchers, 4,000 research and development performing businesses (with many more businesses innovating), eight universities, seven Crown Research Institutes, and many independent research organisations, business accelerators and incubators, and other support functions.[1]
- In 2014, the National Science Challenges were established by the Hon Steven Joyce, Science and Innovation Minister in the previous National government. Their aim is to tackle the biggest science-based issues and opportunities facing New Zealand. The challenges are an important part of the RSI system and bring together the country's top scientists to work collaboratively across disciplines, institutions, and borders. SfTI is one of 11 challenges.
- Vision Mātauranga is important to understanding the work of SfTI. Vision Mātauranga has been government policy since 2005, with a mission of unlocking the innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future. Vision Mātauranga:
  - guides what MBIE chooses to fund and invest in
  - has a capability fund held by MBIE which can be accessed by researchers to increase capability of people within the RSI system to support the mission of Vision Mātauranga
  - requires Crown Research Institutes to enable the innovation potential of Māori knowledge, resources and people in accordance with the Vision Mātauranga framework
  - guides how SfTI conducts research and what research it conducts, as well as looking into the effects and benefits of having mātauranga Māori underpin high-tech research.
- It is clear from the performance of the current system that New Zealand's RSI system requires a series of substantial reforms to enable it to perform better for New Zealanders, and for New Zealand's economy. This was outlined in Te Ara Paerangi – Future Pathways White Paper published in December last year by MBIE.

1. November 2020 Briefing to the Incoming Minister of Research, Science and Innovation from the Ministry of Business, Innovation and Employment.

The work of SfTI – the Science for Technological Innovation National Science Challenge

11 NATIONAL SCIENCE CHALLENGES

SCIENCE FOR TECHNOLOGICAL INNOVATION | SFTI
KIA KOTAHI MAI – TE AO PŪTAIAO ME TE AO HANGARAU

"Our mission is to enhance the capacity of Aotearoa New Zealand to use physical sciences and engineering for economic growth and prosperity"

Launched in September 2015
Up to $106 million over 10 years

Kāhui Māori Advisory Group

SfTI Board
Tō mātou poari

SfTI Leadership Team
Rōpū ārahitanga

SfTI Programme Office
Tari hōtaka

The SfTI challenge is hosted by Callaghan Innovation

SfTI RESEARCH ACROSS FOUR THEMES

11 SPEARHEAD PROJECTS
Multi-disciplinary projects across 3+ years, up to $1 million per year

86 SEED PROJECTS
Small, technically complex, higher-risk projects across 2 years, up to $200,000 in total

BUILDING NEW ZEALAND'S INNOVATION CAPACITY | BNZIC
A longitudinal research programme across SfTI projects and one of SfTI's 11 spearhead projects

Vision Mātauranga

Sensors, robotics, and automation
Ngā Pūoko, karetao me te aunoatanga

Materials, manufacturing technology, and design
Ngā matū, te whakanao me te hoahoa

Data science and digital technologies
Hangarau Mōhiohio, te tātari raraunga me te whakatauira

SfTI is a 10-year programme of government-funded research with the following Mission:

To enhance the capacity of New Zealand to use physical sciences and engineering for economic growth.

To enhance	Increase, intensify, improve, accelerate
the capacity	knowledge, ability, skill, talent, capability, power
of New Zealand	researchers, scientists, Māori, businesses, communities and government
to use	harness, design, develop, progress, implement, produce
the physical sciences and engineering	physics, chemistry, mathematics, materials, manufacturing, data, analytics, robotics, sensing, technology, Mātauranga Māori
for economic growth	for prosperity, wellness, wealth, oranga tangata

SfTI is a networked community of people across the country, having supported 687 researchers across 41 organisations in the four research areas outlined below.

Vision Mātauranga

Vision Mātauranga guides researchers on how science and mātauranga Māori (knowledge) interface to develop research and development (R&D) solutions for a prosperous, technology-driven economy.

Sensors, robotics, and automation | Ngā Pūoko, karetao me te aunoatanga

This theme aims to develop robotics and automation for use in a range of products and applications. The focus is on cost reduction, improved efficiencies, and safety.

Data science and digital technologies | Hangarau Mōhiohio, te tātari raraunga me te whakatauira

This theme aims to develop innovative algorithms, models, methods, tools and practices that could underpin new or enhanced business processes, hardware components, systems and software applications.

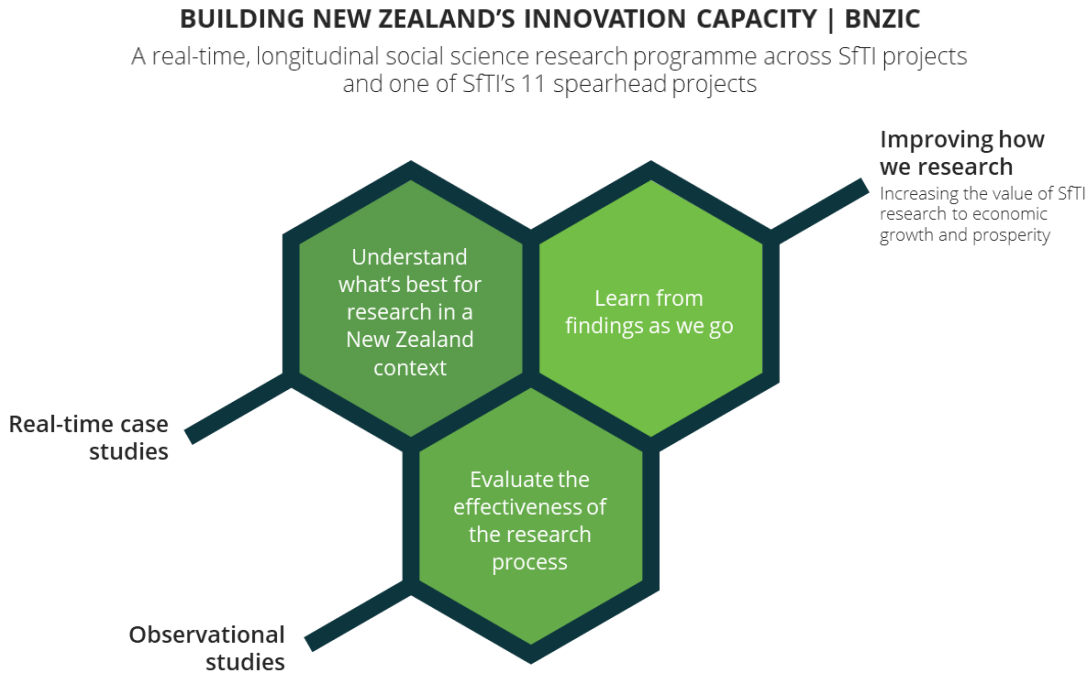
Materials, manufacturing technology and design | Ngā matū, te whakanao me te hoahoa

New Zealand has a small, vibrant high-tech processing and manufacturing sector. This theme aims to advance the sector's reputation as a leader in smart, green, manufacturing processes and materials.

To achieve its mission, SfTI aims to develop world-leading science and technology relevant to New Zealand, with a focus on building enduring partnerships between researchers, Māori organisations and industry. SfTI focuses on high-tech research that is likely to make a strong contribution to New Zealand's economic growth, conducting research across the four themes described above.

BNZIC – Building New Zealand's Innovation Capacity longitudinal research programme

Co-led by Associate Professor Katharina Ruckstuhl, Ngāi Tahu, Rangitāne (University of Otago) and Professor Urs Daellenbach (Victoria University of Wellington)



Building New Zealand's Innovation Capacity (BNZIC) is one of SfTI's spearhead projects. Embedded in the challenge, BNZIC conducts 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 is best done.

BNZIC is the first long-term study of its kind in New Zealand. It is an unprecedented effort to understand how researchers, industry, and Māori organisations work together to innovate – and it uses the insights to change how research projects are conducted immediately. Underpinning the how of research, is that BNZIC has examined how te ao Māori capacity and capability in science research has benefited the RSI system, and how it can be built on to have even greater positive impacts.

BNZIC investigates two areas of how high-tech research is done:

- **human capacity** – which includes the skills and abilities for activities such as leadership, entrepreneurship, innovation, or turning research into commercial value, as well as how cultural capacity can enhance human capacity to conduct impactful research.
- **relational capacity** – which is about how scientists connect and communicate with the broader ecosystem (other scientists, industry, Māori, policy makers, government decision makers) for maximum impact.

BNZIC has published two insight reports on its research project findings and contributed to another report focussed specifically on SfTI's capability development programme.[2] The researchers identified four elements that accelerate science-based innovation:

- collaboration between scientists and non-scientists, particularly though mission-led approaches to research team design and the use of 'innovation intermediaries' that connect people through the innovation journey
- shifting from traditional and competitive closed research practices to collaborative research approaches that encourage open innovation and information sharing
- opening the science system to mātauranga Māori and Māori scientists
- supporting scientists to develop the skills and capacity to collaborate with industry and end users to ensure their scientific findings can be taken to market and create economic growth.

2. *SfTI Spearhead 1: Building New Zealand's Innovation Capacity. Phase 1 Insights*. April 2020. (SfTI-BNZIC-Phase-One-Insights-Report.pdf (sftichallenge.govt.nz))

   He hiringa hangarau, he oranga tangata Building New Zealand's Capacity for Science-based Open Innovation (BNZIC2022-FINAL-VERSION-09122022.pdf (sftichallenge.govt.nz)

   Accelerating Science Innovation through Human and Relational Skills Development, June 2022 (https://www.sftichallenge.govt.nz/assets/Uploads/SfTI-Interim-Capacity-Dev-Report-June-2022.pdf)

SfTI wants to get New Zealand's innovation ecosystem firing by improving the way New Zealand carries out high-tech science research. Lessons from the approach SfTI has taken in its spearhead research projects (the how of the research, as opposed to the what) have implications for how New Zealand can make better decisions about forming, structuring and operating research project teams, growing the skills of our researchers, and achieving the outcomes of Vision Mātauranga.

SfTI takes a mission-led approach to forming research teams

High-tech research and innovation is key to creating a vibrant and prosperous technology- driven economy; however, it remains difficult to get the best practical and commercial value from our high-tech research. SfTI's position is that, while our current approach to high-tech research has strengths, it cannot tackle complex social, environmental, or economic challenges effectively. This is because of the competitive approach to funding siloed disciplinary teams, the lack of connection with industry needs, lack of focus on commercialisation, and disconnection from the real-world impacts of its research.

Moving forward and doing research differently requires different sets of attitudes, skills, tools, and practices, not only at an individual level but also in the way research teams are constructed.

SfTI has moved beyond traditional science approaches through the way it sets up its research projects, which is described in the diagram on this page. We think that change and investment is desirable across the RSI system for the benefits SfTI has found in these approaches to be realised across other areas.

STEP 1

Decide on the high-level mission

"Mission labs" bring together leaders from industry and Māori oganisations to decide on the high-level mission for SfTI research to pursue

STEP 2

Scope the mission research topic

SfTI works in partnership with the research community, industry, and Māori organisations to fully scope the mission topic

STEP 3

Assemble the research team

SfTI calls for interested researchers who attend a facilitated mission design workshop with the original thought leaders who devised the mission. Some of these people then form the project's leadership team

STEP 4

Develop project specifics

The project's leadership team, under the mentorship of the SfTI leadership team, put together a proposal for the SfTI Board. Once agreed by the Board, the leadership team sets activities and milestones for the project, and stays engaged with leaders from industry and Māori organisations

SfTI invests in researchers' skills and capability

"For me, SfTI's biggest legacy is going to be what we've done around capacity development. We invest in people, not just projects, because the project can't do itself, nor the IP commercialise itself. So, we put a lot of emphasis on supporting the individual scientists that we fund, offering professional development opportunities, science leadership training, and enabling them to go through KiwiNet's Emerging Innovator Program."

ENRICO TRONCHIN, PREVIOUS COMMERCIALISATION DEVELOPMENT MANAGER FOR SFTI

As well as mission-led processes for establishing projects, a central element of SfTI's approach is to invest in the capability of our researchers. In addition to their technical capability, SfTI specifically seeks to invest in their human and relational capacity.

When researchers become members of the SfTI community, they benefit from wrap-around support for capacity development to build their relational and networking skills, support and advice about Māori R&D knowledge and its place in their work, and research mentoring. Examples of the types of capacity development undertaken include cultural capacity training, workshops about R&D application of mātauranga, media training, leadership training and mentoring, networking, pitch video training, and commercialisation mentoring.

After project completion, SfTI encourages researchers to remain part of the SfTI collaborative community, by becoming involved in further research, collaborating with other teams, joining evaluation panels for new projects, or participating in capacity development events.

"The SfTI capacity development opportunities I have had around communication and commercialisation, and especially the input my team received from [SfTI's Commercialisation Development Manager], has taught me you can't change the world from the lab. You need to always come back to what your science means for humans and how to communicate that in an engaging way. Thinking more about this has been groundbreaking for me."

DR LEONIE JONES - NGĀPUHI, NGĀTI KAHUNGUNU KI WAIRARAPA (PROJECT LEAD FOR THE NITRATE SENSOR ARRAYS SEED PROJECT).

The BNZIC research found significant benefits to these new approaches

The mission-led process described above departs from the current approach to research in a number of ways, and has implications for other parts of the RSI system. The ways it differs from the current approach are as follows:

- Instead of a contestable process where a team bids for funding to research something they want to do, it seeks to form the best team, with the right capability, around a subject that needs to be researched as a priority for New Zealand.
- The potential commercial or societal impacts of the research are considered from the outset, meaning that all relevant partners can be engaged in the full process.
- Effort is directed towards ensuring industry and Māori expertise is involved in the project team, from the beginning.
- The process focuses on relationships and requires funding upfront to invest in that relationship building. Funding this type of relationship building is not usually integrated into research projects.
- A Commercialisation Development Manager works alongside the project throughout, providing advice on how to commercialise the results of the research.

> "What I find really exciting is our process of working early with industry and Māori to decide on our high-level missions, then going through a joint mission design process with everyone still in the room. It's about bringing capability to the table to form something new, not current projects. Most of the research community seems keen to step up and try out this early engagement with industry and Māori (especially with the Federation of Māori Authorities) and it seems to be working. As our Māori business researchers are finding, our work with Māori in the innovation space is world leading for inclusive innovation with first nations people."
>
> **DR SALLY DAVENPORT, SFTI DIRECTOR.**

As referred to in Part One, the BNZIC research programme has published three reports detailing the benefits of SfTI's new way of conducting research and SfTI's commitment to capability development as part of the challenge. In summary, BNZIC found that these approaches led to better science outcomes, more effective R&D relationships with industry and Māori, and a diversification of the skills of scientific researchers.

Better science outcomes

BNZIC has found that these new approaches lead to better science outcomes than previous approaches.

- Evidence from a range of SfTI projects indicates that broader external collaboration (and supporting the skills to do this collaboration) provides a market and end user perspective to developing technology and generates further partnership and funding opportunities, improving research.
- The use of innovation intermediaries provides useful and required translation between research findings and commercialisation. This leads to increased investment in research. Innovation intermediaries are either individuals or organisations who champion the project with those who may benefit from the outcomes of the research, with the purpose of involving them in it.
- Planned collaborations offer greater value where they take account of the differing values, views, day-to-day priorities and demands of scientists and non-science partners.
- Spending time with stakeholders in the locations they are based develops trust and is critical to understanding their needs and values. It also allows researchers to generate practical scientific insights more rapidly.

More effective relationships with Māori business and organisations

- BNZIC has found that these new approaches deepen and increase the effectiveness of researchers' relationships with Māori businesses and organisations.
- Financial and time investment in relationships at the beginning of a mission has led to meaningful engagement throughout the research process, and authentic long-term connections that have multiple benefits. SfTI researchers' knowledge about mātauranga Māori R&D processes, which they can take into all of their scientific work, is substantially increased through the approach taken by SfTI.

Diversification of the skills of scientific researchers

- BNZIC has found that, through the work of SfTI, scientific researchers have developed more diverse skills.
- We consider that these diverse skills will lead to greater impact (mainly through commercialisation) of their research. Collaboration skills built through the capability programmes will, over time, reduce the chance of science being left 'stranded in the lab'.

SNAPSHOT

Precision farming technologies for aquaculture spearhead project

Led by Dr Chris Cornelisen (Cawthron Institute)

Aquaculture is one of New Zealand's fastest growing export industries, with our Greenshell™ Mussels, King Salmon, and Pacific Oysters in demand all over the world. Māori are significant owners and investors in the industry. Innovation is needed to enable the industry to reach and exceed its ambitious Government target of $3 billion in revenue by 2035.

This spearhead project is developing sensors and data communication tools alongside data analytics that will enable aquaculture farmers to monitor their ocean farms remotely on their mobile phones or home computers. A key aim is to produce cost-effective sensors that can be easily deployed and maintained in large numbers across multiple farms.

Spearhead researchers are working closely with aquaculture farmers to ensure technologies are fit-for-purpose by continually trialling equipment on marine farms. SfTI estimate that the benefits for New Zealand shellfish aquaculture are up to $100 million per annum by 2025, and that the sale of the infrastructure and sensors will generate more than $20 million per year.

SNAPSHOT

Disruptive MedTech

Led by Distinguished Professor Geoff Chase (University of Canterbury, Faculty of Engineering)

Diabetes and equity of access to diabetes care are worldwide problems, particularly for Indigenous peoples. Nationally and internationally, Type 2 diabetes accounts for around 1 percent of GDP spend and this is expected to double in the next 10-15 years. This amounts to around $3 billion in direct and related costs today.

The Disruptive MedTech project, which grew out of SfTI's home and community-based care spearhead project, is developing technology to increase patient-led care and reduce costs, improving independence and health outcomes for people with Type 2 diabetes.

The project team has developed three new technologies for the management of Type 2 diabetes.

- **Non-invasive monitoring** of glucose and insulin levels. This is crucial to a person's ability to control the disease. The team's unique needle-free, light-based glucose sensors allow quick and accurate blood glucose readings to be taken in the home.
- **Novel delivery of insulin** to patients as part of their treatment. This has traditionally required regular injections, but researchers have invented a jet system that delivers a burst of insulin through the skin for single doses. They have also developed ultra-low-cost insulin pumps for those requiring regular insulin. This pump is the first of its kind in the world and is phone-driven and easy to use.
- **Personalised dosing regimens and treatment plans.** Researchers have developed computer models using patient-specific data that accurately suggest personalised dosing regimens and treatment plans. This allows better tailoring of drug or treatment dosing to the individual. Results are very promising, and the hardware developed will remove many of the financial constraints to measuring insulin. At present, the hardware costs between $50-$100 per week. The hardware from this project will have a total, one-off cost of $100. This was achieved by harnessing novel design, smartphones, and wearable devices.

The research team has been working with their university and an industry impact advisor to prepare to raise capital for the next step of commercialisation, including potentially with Māori partners.

PART THREE: HOW WE ARE CONTRIBUTING TO MĀORI PROSPERITY THROUGH PHYSICAL SCIENCES AND ENGINEERING

Mātauranga Māori, Māori science, and Māori researchers are increasingly drawn on to reframe how we understand science and innovation

Māori are increasingly demanding more from the RSI system. SfTI and BNZIC research has confirmed that Māori are under-represented in this system, particularly in the physical sciences and engineering, and that the system does not perform well in growing and retaining Māori researchers. We know that mātauranga Māori as a key R&D component has been under–recognised and underinvested in, hampering Māori innovation, with flow on impacts for the wider New Zealand economy.

Māori who are in the RSI system tend to be stretched because they are often implicitly expected to also fulfil the role of cultural advisors in addition to their research roles (creating aronga takirua, or cultural double-shift), particularly as demand grows for Māori researchers and engagement with Māori communities.

Vision Mātauranga, as introduced in Part One, has been the government response to these issues since 2005. While Vision Mātauranga is specific to New Zealand, it reflects a global trend to reflect Indigenous knowledge in science and technology systems.

SfTI projects bring Vision Mātauranga to life, and the BNZIC research programme has found this has significant benefits for research and science outcomes

Vision Mātauranga is one of the four research themes of the SfTI challenge. As one of these themes, Vision Mātauranga provides strategic direction for SfTI researchers on how to interface science and engineering with Mātauranga Māori to explore new opportunities to build a prosperous, technology-driven economy. Vision Mātauranga drives our research across disciplines, spanning all of the different applications and industry sectors.

We have actively prioritised Māori-led research, investing a quarter to a third of our funding into projects that are led by Māori researchers and/or research in partnership with Māori industry and community. SfTI projects under our Vision Mātauranga theme undergo a rigorous process to ensure that both SfTI's science quality threshold and Māori R&D aspirations for the work are met. Projects are carefully reviewed by leading Māori experts in the field and are overseen by an experienced Māori academic mentor. All SfTI projects, under all themes, strongly encourage Māori leadership. Where this is not possible, Māori partnership is essential.

For example, two of our large spearhead projects, 'Ātea' and 'Te Tātari Raraunga – Analytics to identify and connect successors to whenua', are Māori led or co-led by and are dedicated to creating tangible benefits through R&D.

SNAPSHOT

Te Tātari Raraunga – Analytics to identify and connect successors to whenua

Associate Professor Andrew Mason (University of Auckland), Dr Sydney Shep (Te Herenga Waka – Victoria University of Wellington, and Puna Wano-Bryant (Parininihi ki Waitotara)

This project is a three-way partnership with Parininihi ki Waitotara (PKW) Incorporation Ltd, a business representing the interests of more than 10,000 Māori shareholders in Taranaki, Te Herenga Waka – Victoria University of Wellington, and the University of Auckland. PKW needs to find around 7,000 missing shareholders in order to distribute more than $4.8 million in unclaimed dividends.

Working closely with PKW (as a full research partner), researchers are identifying potentially useful information sources – including often overlooked community-owned and undigitised historical data – and developing innovative big data mining techniques to identify Māori with iwi and whānau connections and link them to whenua. The technology will enable iwi, hapū and other Māori organisations to work collaboratively to find missing members while protecting confidential and taonga information.

The project draws on data discovery and modelling technologies and methodologies to create a more accurate picture of land ownership and succession, which can be quickly accessed and visualised. The work embodies tikanga, reflecting the culturally embedded nature of this task and attaching information to real people, rather than simply assembling databases of information. The project's work is open source, framed by a kaitiakitanga (guardianship) licensing protocol, which means iwi and hapū across the country as well as indigenous communities around the globe could benefit from it.

PART FOUR: HOW CAN OUR RESEARCH INFORM THE STEPS FOR CHANGE TO NEW ZEALAND'S RSI SYSTEM?

SfTI and BNZIC research have shown that the current system does not set up researchers and innovators for success. This hampers commercialisation and reduces the benefits we can get from our high-tech research. We know we can do better. There are three areas that SfTI, based on the BNZIC research, has identified as potential future directions for progressing how New Zealand does science. These are developing the RSI workforce's skills to increase the long-term impact of the results of scientific research; putting in place a mission-led process for establishing research projects and the national research priorities; and embedding Māori innovation processes into the RSI system.

1. Workforce development

To grow and expand the skills of the RSI workforce, future directions could be:

- developing national programmes to encourage the development of human and relational capabilities of the RSI workforce, such as leadership and entrepreneurial skills
- investing in professional support and development for the RSI workforce, such as leadership coaching.

BNZIC has found that it is critical for New Zealand to nurture scientists' technical, human, and relational skills, across sectors, to enhance New Zealand's high-tech innovation capability. BNZIC found that if professional support and development is provided to enhance researchers' entrepreneurial capabilities, their research is likely to have greater impact. A national-level approach to developing scientists' human and relational skills, as well as providing support for embedding Māori innovation processes, would have benefit, over and above any individual institutional-level programme.

2. Taking a collaborative approach to establishing research projects and national research priorities

In mid-August, MBIE announced the members of the Independent Strategic Panel set up to recommend new national research priorities.[3] The Panel will consider advice from a cross-agency working group that has been engaging with Treaty of Waitangi partners and specific stakeholder groups, before making recommendations to the incoming government for new national research priorities later in 2023.

SfTI supports this approach to developing the new national research priorities and the research projects that sit underneath them. Our observations are that there has been more 'buy-in' from stakeholders, partners, and the research sector when priorities are set by the community (particularly industry and Māori businesses) in collaboration with researchers.

To ensure that these new national research priorities will contribute usefully to advancing the significant challenges faced by New Zealand, we think it would be useful for engagement for each priority to use a formalised methodology that is clearly articulated to stakeholders and partners from the start. SfTI's mission lab and mission-design process, outlined earlier, is a tested model for priority-setting that we recommend is used.

3. Embedding Māori innovation

SfTI has implemented previous commitments to increase funding for specifically mātauranga Māori R&D research. Based on the findings of the BNZIC programme, potential future directions could be:

- funding community and stakeholder engagement roles for Māori researchers as part of grants to build relationships and partner with Māori innovators (in addition to what is already provided)
- additional, specific funding to build te ao Māori innovation capabilities of non-Māori researchers
- specific funding to develop Māori researchers' cultural innovation capacity, including dedicated support for early career Māori researchers. Activities that were beneficial for SfTI researchers during the challenge, and therefore the impact of their research, were mentoring, tuakana-teina relationships with senior researchers, and R&D support activities.

We understand that work has been undertaken to formally protect mātauranga Māori as part of New Zealand's intellectual property framework in response to Wai 262.[4] Depending on the future direction of this work, you may wish to meet with your Ministerial colleague responsible for Māori Development to discuss how this work would apply in the research, science, and innovation context.

3. Panel appointed to recommend National Research Priorities | Ministry of Business, Innovation & Employment (mbie.govt.nz)

4. Wai 262 is commonly known as the Fauna, Flora, and Intellectual Property Rights claim, which sought the protection of taonga Māori by tāngata Māori (protection, conservation, management, treatment, propagation, sale, dispersal, utilisation, and restriction on the use of and transmission of the knowledge of New Zealand Indigenous Flora and Fauna and their resources).

CONCLUSION

Changes are required to augment how research is done by the RSI system to achieve greater economic growth and prosperity for New Zealand through physical science and engineering. SfTI, using its findings from the BNZIC research, demonstrates how to make these changes. By focusing on workforce development, taking a collaborative approach to establishing research projects and national research priorities, and embedding Māori innovation, we think that there is an opportunity for you, your ministerial colleagues, and your agency officials to make real change and drive improvements across the RSI system.

We want to work with you to put into practice what we have learnt, to achieve greater impact, economic growth, and prosperity for New Zealand. We would like to meet with you to talk about our ongoing work, understand your priorities, and discuss how we can best support you to drive change across the RSI system.