Sara Walton and Trudie Walters

The Practice of Science for Technological Innovation

learnings and implications for Te Ara Paerangi

Abstract

An effective science system needs to provide expertise and knowledge to respond to societal issues in Aotearoa New Zealand. In 2022 the government released the white paper *Te Ara Paerangi: future pathways* to outline a vision for a future science system. This research explores how mission-led science has operated through the National Science Challenges, using Science for Technological Innovation as a case study. In the context of Te Ara Paerangi, the research examines the elements of Science for Technological Innovation's practice and offers implications for future mission-oriented science programmes that will be relevant to government policymakers, universities, Crown Research Institutes and science leaders.

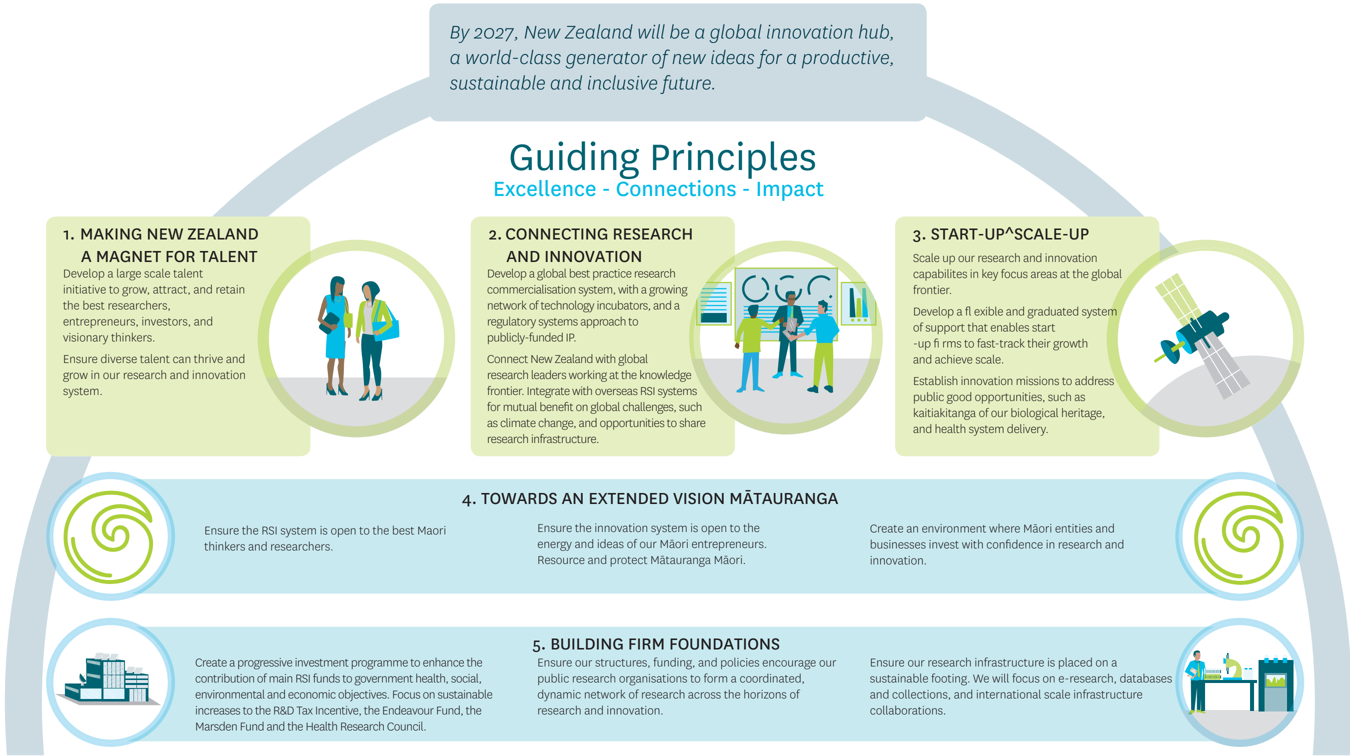
Keywords mission-oriented science, Te Ara Paerangi, National Science Challenge, Science for Technological Innovation, social practice theory

Sara Walton is a professor in the Department of Management at the University of Otago and has been part of Science for Technological Innovation since the early days, as a social science researcher and lately as part of the Building New Zealand's Innovation Capacity research team. **Trudie Walters** is a qualitative social researcher. Most recently she has carried out evaluation, research and consultancy projects for a wide variety of clients, including central government ministries and industry organisations.

The white paper *Te Ara Paerangi: future pathways* (Ministry of Business, Innovation and Employment, 2022) outlines the government's direction for the future of the research, science and innovation system in Aotearoa New Zealand. There are numerous goals associated with these future pathways, and some of these future directions continue with current models – for example, there are still going to be mission-oriented science programmes. As such, aligning current and past ways of operating with how the future will look is essential. Acknowledging the whakapapa of where we have come from, the kaupapa of what it all means, and then how it works moving forward is essential as these ambitious goals are operationalised. There have been many learnings from the current programmes that it makes sense to capture and develop in these future pathways.

In this article we focus on mission-oriented science practices, and on one National Science Challenge, Science for

Figure 1: Research, science and innovation strategy



Source: Ministry of Business, Innovation and Employment, 2019, p.3

Technological Innovation (SfTI), to ask: what are the key learnings from the practice of Science for Technological Innovation that are relevant for Te Ara Paerangi, the future of the science system in Aotearoa New Zealand? In order to address this question, we begin by asking, what is the practice of SfTI? We then examine what aspects of the practice of SfTI are relevant and useful for the future science system in Aotearoa.

Background

Research, science and innovation is considered to be the building block of a 'modern economy' (Ministry of Business, Innovation and Employment, 2019). Made up of several different parts, institutions and actors, the proposed research, science and innovation system for Aotearoa New Zealand is depicted in Figure 1.

The white paper *Te Ara Paerangi: future pathways* envisages an 'RSI system that supports wellbeing for all current and future New Zealanders, a high-wage low emissions economy, and a thriving, protected environment through excellent and impactful research, science and innovation' (Ministry of Business, Innovation and Employment, 2022, p.7). The white paper signals large-scale change that is called 'transformational', and is organised into areas of:

- connections between researchers, industry and other end-users;
- delivering impact for Māori and Pasifika people;
- attracting international investment and overseas investment;
- a better resourced system;
- attracting a skilled workforce (key to greater productivity and living standards).

These are all relevant and useful visioning statements for a proposed national research, science and innovation system. Part of the infrastructure and funding proposed in this new system are mission-oriented science programmes that are generally understood to have the objective of establishing a high-income, environmentally sustainable economy. These are part of the innovation infrastructure and funding opportunities for science in Aotearoa and sit alongside traditional, more diffusion-oriented platforms. Over the past nine years there have been 11 such mission-oriented science programmes, in the form of the National Science Challenges.

National Science Challenge system in Aotearoa New Zealand

Since 2014 National Science Challenges have operated in the research, science and innovation system to produce mission-oriented science that is for the benefit of society. They were designed to 'bring together the country's top scientists to work collaboratively across disciplines, institutions and borders to achieve their objectives' (Ministry of Business, Innovation and Employment, n.d.). The topics or missions chosen include healthier lives, sustainable seas, high-value nutrition, biological heritage and building resilience to nature's challenges. The total funding pool allocated across the National Science Challenges was $680 million over ten years. Each challenge was overseen by the Ministry of Business, Innovation and Employment but hosted by a specific university, Crown research institute or other entity, and was required to create a governance board and structure.

The National Science Challenges were guided by five high-level principles:

- mission-led;
- science quality;
- best team collaboration;

- stakeholder engagement and public participation;
- Māori involvement and mātauranga.

They were designed to disrupt the business-as-usual approach within Aotearoa New Zealand's science system. They did this through a few mechanisms, including by having a longer funding period than often provided for science platforms, which enabled the challenges to invest in more science and develop longer term partnerships from the start of the research. They also achieve this by having explicit engagement with the Vision Mātauranga policy, which created a conscious weaving of indigenous and mainstream science traditions (Ministry of Research, Science and Technology, 2007). Furthermore, the challenges needed to address the most important issues for Aotearoa New Zealand and deliver excellent science with an excellent team resulting in mutual benefits being more than the sum of parts – called 'additionality'.

Science for Technological Innovation has the aim to 'enhance the capacity of New Zealand to use physical sciences and engineering for economic growth' (Science for Technological Innovation, 2018, p.2). SfTI involves approximately 285 researchers across 36 organisations, with ten larger, 'spearhead' projects and 32 smaller seed projects. Here we report on research exploring the practice of SfTI to explore one example of how mission-led science has operated in Aotearoa New Zealand, and to develop learnings for future mission-oriented programmes in the research, science and innovation system.

Mission-oriented science programmes

Mission-oriented programmes create academic research agendas that are responsive to societal demands. They aim to encourage the development of capabilities crucial to addressing complex 'grand challenges', such as climate change, global food security and demographics (Ulnicane, 2016). Two key assumptions underlie mission-oriented thinking. The first is that major concerns may be addressed through creative processes rather than, for example, changes in consumer habits or significant regulatory and legal actions (Mazzucato, 2018). The second accepts that academic creativity is a significant lever for triggering larger social innovation processes.

> To understand mission-oriented practice, and as Te Ara Paerangi moves to the next level, it is useful to understand the practices of current mission-oriented science operating in Aotearoa New Zealand – in this case, by focusing on Science for Technological Innovation.

Mission-oriented innovation policy is often contrasted with other innovation policies, such as diffusion-oriented policies (Brown, 2021, p.743) that opt for a more 'experimental, interactive and relational approach', or even more traditional technology-oriented mission approaches which have a focus just on the technology without including any of the societal impacts and effects (Wanzenböck et al., 2020).

Mission-oriented innovation is not new, but has recently been popularised in innovation and science systems by Mariana Mazzucato, positioning it as a new way to frame 'how we might do capitalism "differently"' (Mazzucato, 2021). According to Mazzucato, a mission-oriented approach refers to governing policies that employ big science to meet big problems. She adapted the notion of a mission from reflections on the Apollo space mission and uses that metaphor to think about missions for current societal challenges (ibid.). As in the mission to the moon, the public sector sets the mission, integrates the efforts and gives stakeholders directions. In such an approach, the government occupies the driving seat and works closely with several sectors to solve hundreds of individual problems.

There are a number of concerns regarding science programmes based on mission-oriented innovation policies. These include concerns about their lack of clarity and specificity (Janssen et al., 2021), especially considering that some of the original mission programmes that set the agenda for missions are not relevant models for current challenges (Foray et al., 2012). Other concerns are that mission-oriented science can have the potential to have adverse effects on innovation and societal challenges because the research agendas could be shaped by vested interests (Janssen et al., 2021). Finally, Brown (2021) also notes the opaque nature of mission-oriented policy, which further highlights the need for careful design of practices in the implementation of mission-oriented policies to ensure their success.

Mission-oriented thinking as described above has been used to shape the National Science Challenges in the Aotearoa New Zealand science system. The 11 challenges were developed by asking the public what they saw as the key challenges that scientists need to be working on for societal benefit. Called the 'Great New Zealand Science Project', the call was for ideas and then submissions on the chosen challenges. The aim was for the challenges to 'tackle the biggest science-based issues and opportunities facing New Zealand' (Ministry of Business, Innovation and Employment, n.d.). The outcomes of the challenges needed to be of benefit to Aoteraoa New Zealand through their scale and scope, delivering impact and engaging the public and appropriate end-users (Ministry of Business, Innovation and Employment, 2013).

Summing up

Te Ara Paerangi: future pathways has outlined potential structural changes for a future research, science and innovation system. However, to bring about transformation, moving beyond structural changes will be necessary to embed change. We suggest that transformation must also be at the level of operation or practice. To understand mission-oriented practice, and as Te Ara Paerangi moves to the next level, it is useful to understand the practices of current mission-oriented science operating in Aotearoa New Zealand – in this case, by focusing on Science for Technological Innovation.

Research methods

To explore how mission-led science is practised in the National Science Challenges, a qualitative mixed-method approach was taken using SfTI as a case study. Data was collected via participant observation (at workshops and leadership team meetings), semi-structured interviews (with one past and five current members of the leadership team) and secondary sources (such as website information and annual reports), which allowed triangulation of the data. This triangulation of data, where all three forms of data were compared and contrasted, helped ensure the credibility and dependability of the findings (Lincoln, Lynman and Guba, 2011; Krefting, 1991).

A qualitative case study approach was chosen primarily because it enables aspects that Strauss and Corbin have identified as inherent within qualitative research, such as:

> needing to get out into the field to discover what is really going on … complexity and variability of the phenomena and of human action … the understanding that meaning is defined and redefined through interaction … and an awareness of the inter-relationships among conditions (structures), action (process), and consequences. (Strauss and Corbin, 1998, p.10)

Talking to and observing people enables such data to be generated which can speak to the practices involved in SfTI.

The first phase of the research involved observations of one of the larger (spearhead) project teams. This project, Building New Zealand's Innovation Capacity (BNZIC), largely employed social scientists to 'evaluat[e] how Science for Technological Innovation (SfTI) researchers and external stakeholders collaborate on projects with the resulting insights capable of boosting innovation performance' (National Science Challenges, n.d.). These BNZIC team has approximately 12 researchers, who attend quarterly meetings. Each meeting was observed over a two-year period and notes were taken from the meetings that constitute the observational data for this study.

Participant observation is a method whereby the researcher is involved in the field of study, rather than an outsider talking to someone or having someone reflect on their experience through a survey. Indeed, the researcher becomes the research instrument and as such is placed in the social milieu or social situation of study and immersed in that environment (Brannan and Oultram, 2012). It is a method commonly used by social scientists to understand how people see the world (Silverman, 2006), and in this case it was able to generate key insights from the start. The first author was known to the group and had an intimate understanding of both the National Science Challenges and SfTI; this 'insider' status meant that they had to negotiate the dual roles of being a team member and studying the team at the same time. Being a member of the BNZIC team meant that acceptance into the group and understanding group norms were not key concerns. It did, however, mean that this author was very close to the research, and interpretation of the data might then become more of an issue than access and understanding. We found that triangulating the participant observation data with interviews and secondary data, along with the critical outsider perspective of the second author, who had no involvement with (and minimal knowledge of) the National Science Challenges, enabled a triple check on the findings (Lofland et al., 2006).

The BNZIC team met quarterly via Zoom video call for two hours and twice a year had two-day face-to-face meetings for updates, discussing findings and deciding on future directions. A selection of the approximately 12 researchers in the BNZIC team would attend each meeting, and the observations included every researcher at some point over the two years. Every meeting was observed over that time. While participating in these meetings, the first author took notes, focusing on two key facets: the outcomes of the meeting, and how the SfTI process was operating.

These notes became extensive over time and, as she reflected on them, she began to identify recurring patterns and organised them into key areas. She found that social practice theory was a very useful tool for framing notes and capturing what was being discussed in the meetings. After approximately a year of observations, the social practice theory framework was presented to the BNZIC team, along with the data analysis to date. The team supported the findings and the use of the framework as a useful theoretical tool to make sense of the practice of SfTI as a mission-oriented science programme. After this, observations of the meetings were continued until the point of data saturation was reached (Guest, Bunce and Johnson, 2006); this occurred after two years of observations.

The authors carried out the interviews in a face-to-face format, either in person or

Participant observation is a method whereby the researcher is involved in the field of study, rather than an outsider talking to someone or having someone reflect on their experience through a survey.

Table 1: SfTI interview subjects

SfTI position/role
Director
Past chair of the SfTI board
Theme leader x3
Deputy director x2

via Zoom, and interviews averaged around 60 minutes. They were digitally recorded with permission and transcribed using Otter software. The transcripts were subsequently checked against the recordings by the second author and errors corrected. Ethical approval was obtained for the study and consultation with Ngāi Tahu conducted through the Māori Development Office at the university level before potential participants were contacted by email, at which point an information sheet and a consent form were provided. Interviews were conducted with all six members of the SfTI leadership team across a range of roles/levels (Table 1), some of whom had been involved since its inception. The leadership team were the ones making the key decisions regarding the operations and practice of the challenge and, as such, it made sense to interview them all for this study on the practice of mission-oriented science.

Using a semi-structured interview approach, questions were asked to gain as much participant voice and understanding as possible. The interviews began with an open question asking participants for their story of SfTI. Using a narrative approach enabled participants to tell their own story at the level of detail they were comfortable with (Kvale, 1996); it also allowed flexibility for the participant to mention aspects that were important and had meaning to them while also enabling probing from the interviewer (King, Horrocks and Brooks, 2018). The rest of the interview questions were focused on the three elements of practice theory – understanding the infrastructure, the skills and competencies, and the meanings and values of the SfTI science challenge. The questions were designed to identify what, from the participant's perspective, were the key elements they see operating in the challenge.

Finally, secondary data was collected to ensure that all potential relevant sources of information were covered. The SfTI annual reports, 2016–20 to the Ministry of Business, Innovation and Employment were made available to the research team. These reports followed a template developed by the ministry, with set headings and maximum word counts per section, in order to standardise reporting across all National Science Challenges. The documents were used as a way to validate information generated from the interviews and observations.

> ... leadership team consciously sought to create a science programme that meets its mission through practices that cut across science disciplines and mātauranga Māori, enabling people to work together across iwi, industry, community and researcher roles.

Analysis – social practice theory

Social practice theory was used as the analytical framework to make sense of the data set. By its inherent nature, practice is a social activity (Reckwitz, 2002), encompassing collective agreements on 'how things are done'. Practice theory examines human activities that contribute to the organisation, creation and alteration of social existence (Schatzki, 2001, p.10). According to Reckwitz, a practice is a habitualised form of conduct comprising multiple interconnected elements. These elements encompass tangible objects, cognitive processes, knowledge and comprehension, practical skills and emotional states (Reckwitz, 2002, p.249). While individuals enact practices, these are inherently social actions, thus embodying both individual agency and the contextual framework within which they operate.[1]

There are many different ways in which we could make sense of the way SfTI operates. We could have adopted a strategic management approach and focused on the structures and strategic competencies, or a more behavioural approach that would highlight the behaviour of the scientists involved in the SfTI challenge. Instead, we have drawn on social practice theory to place the focus on practice, an approach that combines the material, human and discursive to understand how practices form established routines and create the ways in which things get done. Social practice theory is often used in energy studies to make sense of the ways in which people consume energy through normalised everyday practices. It is drawn on in energy studies to show how policy can shape the way in which practices are formed, particularly as policy can often provide the infrastructure of the practice itself (Hampton and Adams, 2018).

A framework developed by Shove and Pantzar (2005) to analyse the practice of Nordic walking was utilised. This framework recognises practices as compositions of concepts (meanings, symbols), skills and competencies (skills, procedures) and materials (infrastructure, technology, materials and processes) that combine to form a social practice through regular and repetitive activity. Practices constitute the recurring habits individuals engage in; they signify patterns and sequences of daily existence (Watson, 2012). Viewing practices as routine activities within a mission-oriented science programme offers a useful approach to make sense of how they operate.

Findings

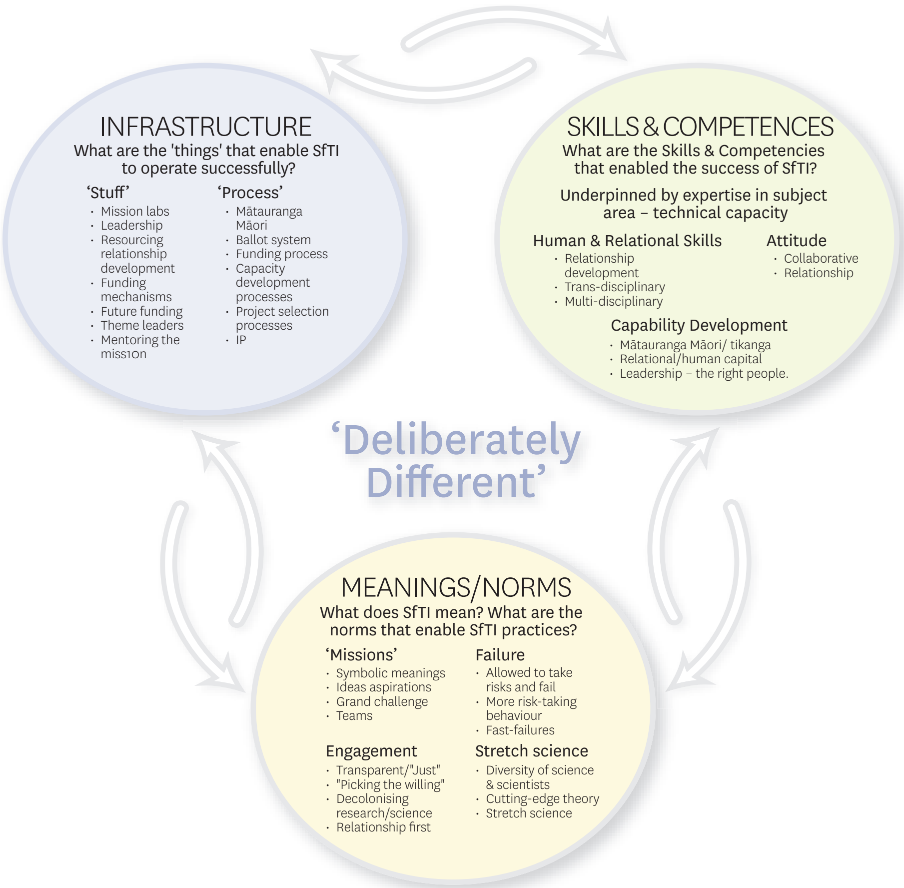
We found that Science for Technological Innovation, to meet the requirements of a mission-oriented science programme, adopted a 'deliberately different' practice. Its leadership team consciously sought to create a science programme that meets its mission through practices that cut across science disciplines and mātauranga Māori, enabling people to work together across iwi, industry, community and researcher roles. They also acknowledged that capacity development would be needed to develop the skills across the SfTI team to support the goals of the programme. Across the practices developed as part of SfTI there seems to be recognition that changing science programmes does not just happen organically, but requires making conscious decisions to be 'deliberately different'.

In analysing SfTI as 'deliberately different', we identified the following key elements:

- an inter- or multidisciplinary approach to research and knowledge, including mātauranga Māori;
- resourcing, supporting and facilitating relationship development across teams;
- funding capacity development (beyond the researchers' technical skills);
- funding 'mission labs' to bring various people together, which meant working across sectors, knowledges (e.g., indigenous and Western) and disciplines on key issues;
- having an ethos of cutting-edge and risk taking;
- working with 'open' people who are willing to engage in something deliberately different.

Drawing on social practice theory, the following model illustrates the practice of SfTI as a combination of material 'stuff', skills and competencies, and meanings. Together these three elements constitute the practice of the SfTI programme.

Figure 2: The Deliberately Different Social Practice of The SfTI Science Challenge



Key learnings

There are a number of successful practices embedded in the SfTI programme that can be taken as key learnings for mission-oriented science in the Te Ara Paerangi programme. We outline the main ones here.

Providing appropriate infrastructure for 'stretchy' and 'sticky' science

SfTI defined both early on and these were important goalposts for scientific endeavour. 'Sticky' science is described by SfTI as research that is relevant for New Zealand, while the stretchy is about encouraging researchers to look five to ten years into the future and to target novel technologies, rather than something that is already being developed, either here or overseas (Science for Technological Innovation, 2018). As such, science ideas need to be generated initially from a bi-cultural co-development framing, including a mix of industry, Treaty partners, stakeholders and scientists. A collaborative approach is needed to identify the science that is required for the challenges Aotearoa New Zealand faces, and this needs to be continuously evolving and adequately resourced as part of the science system.

Te Ara Paerangi policy direction 1.2 is to 'accelerate innovation, diversify and scale up impact'. The aim is for 'seamless mobilisation of knowledge between research organisations, research partners, next-users and end-users' (Ministry of Business, Innovation and Employment, 2022, p.39). This policy direction assumes stretchy and sticky science. Therefore, it will need the development of successful collaborations that cross disciplinary boundaries, research institutions, iwi, industry and end-users in order for there to be transformation of the research, science and innovation system. The white paper mentions building on initiatives already underway and we would agree that there are National Science Challenge system learnings on how best to bring together various interests to develop new and novel collaborations.

One of the key SfTI transformative practices to be deliberately different and mission-led are the mission labs. These provide an example of how relationships were successfully developed at the start of the project, with the appropriate funding. Mission labs were created to bring people together to develop further projects under the SfTI umbrella. One participant described the mission labs as being 'about forming one best team with capability from across the country', the aim being for people to bring their capability to 'mission design workshops', rather than individually coming up with their best idea for a project. The workshops aimed to get partners and stakeholders of a particular issue identified as important to work together to both identify the issues and solutions and form a research team.[2] During the workshops, a writer was provided to help develop a proposal, so it 'wasn't about "go away write a proposal and we'll fund it", it was actually a collaborative venture'. Another participant described the labs as a

> very open brainstorming process, that identifies those high-level mission areas – intelligent oceans, hazardous farming, you know, what things do we think are going to be important. And then we keep those people involved. So, as we start to frame up our mission, we test that with those people, and we form industry advisory groups that are for SfTI as well as for the projects.

Implications for future mission-oriented science

Crucial relationships in the science system often need infrastructure and support to be successful. Drawing on the practice of SfTI, we suggest that processes to develop 'seamless mobilisation of knowledge' in the science system need to be resourced and facilitated professionally to effectively create the type of relationships needed to be successful. Processes like mission labs show different ways of creating science projects that can successfully provide effective science in Aotearoa New Zealand.

Skills and competencies: people are at the heart of any mission-led science programme

As such, relationships in the science ecosystem need to be created, supported and valued, and the skills and competencies of people need to be developed to meet the needs of the science system.

The reforms to the science system outlined in the white paper will, it states, 'establish and grow connections between research, industry and other end-users to help take research through to impact' (Ministry of Business, Innovation and Employment, 2022, p.7). The proposed reforms also rely on the skills and competencies of those involved in the science system to be able to meet the needs of this future transformed system. If Te Ara Paerangi is to create a new science system for Aotearoa New Zealand, there needs to be an acknowledgement that new practices will need to emerge, and that these practices will need new skills and competencies from the actors in the system.

The mission-oriented science that is part of Te Ara Paerangi seems set to continue, with the aim of addressing the needs and challenges of Aotearoa New Zealand through scientific knowledge.

In addition, to increase the mobility of the research, science and innovation workforce (policy direction 1.2), capacity development will be essential. Furthermore, policy direction 3.1 outlines what will be done to attract, develop and retain talented people, but seems to rely on new fellowship schemes, broadening careers, addressing contracts and establishing expectations. Adding capacity development to understanding the attraction, development and retention of people would also be essential.

The practice of SfTI being deliberately different was also founded on skills and competencies to enable a different science practice. As one of the participants mentioned, 'we're not just interested in funding science, we're also interested in the person'. This comment was in relation to the perception that human and relational capital, as well as technical skills, are important when working in multidisciplinary science teams for mission-oriented research. The participants in the research recognised that for the challenge to be successful there needed to be capacity development programmes to learn and develop these skills and competencies. These capacity development opportunities were strongly encouraged for all researchers involved in SfTI. The programme was managed by a SfTI team member and opportunities were developed specifically for SfTi researchers.[3]

As such, while recognising the technical excellence of its people, the practice of SfTI involved capacity training and mentoring being offered to all team members to develop leadership skills, relational capital and, thus, impactful scientists.

Implications for future mission-oriented science

All projects or programmes in the research, science and innovation system involve some elements of capacity development for all people involved. This will depend on the practice being developed in the programmes. Based on the experience of SfTI, people involved in mission-oriented science programmes should be offered capacity development to build human and relational capacity alongside their technical expertise.

Meanings and norms: the opportunity to take risks should be part of the norms across the mission-oriented science programmes

To foster innovation in such programmes, it is important that risks are taken in both the organisation of the research and the research itself. If we are asking for a transformation to the research, science and innovation system, then the teams need to know that they may be different, and therefore test different ways of doing things to be innovative. The element of risk is largely missed in the white paper, yet it would seem to be essential to developing mission-oriented science.

It was noted by the participants in this research that being able to experiment with the practice of the challenge – the different ways of developing projects, and particularly research teams – is important to the practice of being deliberately different. Like the business world's 'fail fast' and pivoting, SfTI learnt to change and adapt, which enabled it to take risks and undergo experiments with the running of the programme as part of creating the 'deliberately different' practice needed to meet the mission.

Current research funding approval is often largely around minimising risk, which is done through understanding science excellence and team track record. To transform the current system as suggested there is a need to find ways to understand and build in risk, including in the way in which funding is allocated. The notion of 'risk' needs to be part of the culture or set of meanings in the mission-oriented science system. Creating norms and understandings whereby people are comfortable with taking risks is important. Having leadership that can understand the parameters involved in enabling risk will also be necessary. In addition, infrastructure and systems to deal with the evaluation of risk in science, and particularly funding, will be essential. This will not happen without deliberate practices to enable a level of risk needed to transform mission-oriented science systems.

Implications for future mission-oriented science

We suggest that guidelines and parameters are developed to enable actors in the mission-oriented research, science and innovation system to embrace, evaluate and manage appropriate risk in projects.

Being deliberately different: the leadership of research priorities or challenges needs to be carefully considered

We would advocate for a partnership approach, drawing on mātauranga Māori and multiple knowledge sets. The leadership team should also incorporate the diversity of knowledge, disciplines and impact appropriate for each challenge.

We see that this is being incorporated in Te Ara Paerangi. We recommend reading BNZIC work in this area (see, for example, Building New Zealand's Innovation Capacity, 2022): this research shows the increasing value placed on mātauranga Māori in the research, science and innovation system over the past nine years of the National Science Challenges.

Implications for future mission-oriented science

Partnership and rangatiratanga underpin all research, science and innovation system practices to honour te Tiriti o Waitangi; see research produced by BNZIC focusing on mātauranga Māori and science for technological innovation.

Conclusion

This article is based on an analysis of the social practice of the Science for Technological Innovation National Science Challenge, undertaken by a small group of researchers within the challenge itself. The research has specifically focused on the question, what are the key learnings from the practice of SfTI that are relevant for Te Ara Paerangi, the future of the science system in Aotearoa New Zealand? It advocates for the four key learnings identified here to be recognised and adopted as part of the next stage of developing Te Ara Paerangi. It is hoped that future research will explore more of the learnings – both successful and not so successful – to broaden this somewhat limited research article.

The mission-oriented science that is part of Te Ara Paerangi seems set to continue, with the aim of addressing the needs and challenges of Aotearoa New Zealand through scientific knowledge. Therefore, successful aspects of the current mission-oriented projects should be considered in the future of this type of science funding. The past ten years of science challenges have involved steep learning in the development of what might be 'new' science practices in Aotearoa. We argue, therefore, for the next stages of Te Ara Paerangi to learn from the past ten years – to understand what has worked, the barriers to successful implementation, the fails, and, importantly, the notion of mission-oriented science in the context of Aotearoa New Zealand.

While we have focused on Te Ara Paerangi and the practices of Science for Technological Innovation, we suggest that these learnings can be incorporated into many science practices in Aotearoa New Zealand to enable impactful science to meet the many 'grand challenges' that an increasingly complex and interconnected global world presents for our society.

1 The theoretical framework of social practice, as advocated by Shove and collaborators (e.g., Shove and Pantzar, 2005; Shove, Watson and Spurling, 2015; Shove and Walker, 2010), extensively draws from Giddens' structuration theory (1984), as well as the ideas presented by Bourdieu and Wacquant (1992a, 1992b) to formulate the concept of a practice.

2 For more information on mission labs at SfTI, see https://www.sftichallenge.govt.nz/about-us/documents-and-reports/.

3 For more information and examples, see https://www.sftichallenge.govt.nz/for-researchers/professional-development/.

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