Cultural Reciprocity in Deep Knowledge Co-Production

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Contents

Glossary

hapū – *sub-tribe*

hau – *essence*

hui - *meeting*

iwi – *tribe*

kaitiakitanga – *guardianship/stewardship*

kaupapa – *purpose*

kaupapa Māori – *for Māori by Māori*

kawa – *principles*

kōrero tuku iho – *histories/narratives from the past*

kupu – *words*

mahinga kai – *traditional foods*

mana – *power/authority*

mana whenua – *those with authority in relation to land*

manaaki ki te tangata – *to care for people*

manaakitanga – *hospitality/support*

Māori motuhake – *Māori exclusive*

mātauranga Māori – *Māori knowledge*

matawhānui - *visionary*

moana – *ocean*

pānui – *message*

pūrakau – *stories*

rangatiratanga - *leadership*

rāranga – *weaving*

raupatu – *land confiscations*

tākoha – *gift of responsibility*

taha Māori – *Māori perspectives*

tangata whenua – *people of the land*

taonga – *precious objects*

tapu – *sacred/regulated*

taumata kaumatua – *council of elders*

te ao Māori – *the Māori world*

te reo Māori – *Māori language*

Te Tiriti o Waitangi – *The Treaty of Waitangi*

tika – *right/correct*

tikanga Māori – *Māori protocols*

tira – *group*

tohunga - *expert*

waka – *traditional seafaring vessel*

wānanga – *workshops*

whakaaro – *ideas/thoughts*

whakapapa – *genealogies*

whakatauki – *proverbs*

whānau - *family*

whānaungatanga – *relationality*

whenua - *land*

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He Rāranga Whakaaro

Raranga mai ai ki runga
Raranga mai ai ki raro
Raranga mai ai ki roto
Raranga mai ai ki waho
Rarangatia mai te whenua ki te whenua
Rarangatia mai te ewe ki te ūkaipō
Tīkina te rangatahi kia rangatira ai
Taku ohinga, he ohinga tipua, he ohinga taiohi

He honore, he kororia ki te atua
He maungarongo ki te whenua
He whakaaro pai ki ngā tangata katoa
Tihei mauri ora

Tuatahi, me mihi ki te atua, te timatanga me te whakamutunga o ngā mea katoa
Tuarua, ki te Kuini Māori, Ngāwai Hono ki te Po Pōtatau Te Wherowhero te Tuawaru, pai marire ki te Whare Ariki
Tuatoru, ki ngā tini mate, o te kainga, o te motu, o te ao, haere, haere, haere atu rā
Tuawha, ki ngā maunga tapu, ki ngā wai ora o tēnā rohe, o tēnā rohe, tēnā koutou
Tuarima, ki ngā ihi, ki ngā wehi, ngā Rangatira o te motu,
Tēnā koutou, Tēnā koutou, Tēnā koutou katoa.

Ehara taku toa i te toa takitahi engari he toa takitini[1]. This thesis is not possible with the support and contributions of a huge number of people. This work honours and respects the influence that different whānau have had on my life, the kaupapa we shared, and the pathways we walked.

Different whānau provided lots of support throughout my life encouraging me to explore the world and engage in different activities. My father, Ruka Hudson, was a constant source of stability for my siblings and I, and a caring papa for my own children, Kōare, Te Āmai, and Rākaea as well as their cousins. My mother, Jacqui Pokino, who instilled the importance of education in me at a young age. The Stafford whānau including Brandi, Lynne and Rore, the Anderson whānau, the Carr-Cuff whānau, the Mataia whanau, and the Jefferies whānau. The Te Ataarangi whānau including Hohepa Delamere and Hine Taumaunu. The AUT whānau including Kate Haswell and Mihi Ratima. The ESR whānau including Val Orchard, Annabel Ahuriri-Driscoll, and Zack Bishara. Cultural mentors including Moe Milne and Khyla Russell. The SING Aotearoa whānau including Phil Wilcox, Kimiora Henare, and Katharina Ruckstuhl. The Indigenous Genomics whānau around the world. The Te Mana Raraunga whānau including Tahu Kukutai and Andrew Sporle. The GIDA whānau including Stephanie Carroll and Riley Taitingfong. All the different research whānau including Tikanga in Technology, CBIKS, Tauhokohoko, Ngā Tohu o te Taiao, Science for Technological Innovation, and others as well as the people I worked with on various projects as researchers, participants, or stakeholders. The Local Contexts whānau including Jane Anderson, Corrie Roe, Ashley Rojas, Janette Hamilton-Pearce, and Diana Lovette. The Whakatōhea Māori Trust Board whānau including Robert Edwards, Te Kahautu Maxwell, Dickie Farrar, and Danny Paruru. The Whakatōhea Presettlement Claims Trust whānau including Graeme Reisterer, Arihia Tuoro, and Gina Smith, as well as the Taumata Kaumatua and Te Roopu Awhina. The Te Kotahi Research Institute whānau including Tuti Nikora, Natalie Kusabs, Maia Gardiner, KatieLee Riddle, Rogena Sterling, Mitchell Head, Xavier Forde, Manu Caddie, Wallis Malcolm,

[1] My strength is not mine alone, it comes from the collective

Kimberley Maxwell, and others. The Te Kotahi Research Institute Board members including Chris Insley, Kepa Morgan, and Nanaia Mahuta. Colleagues at Te Pua Wānanga ki te Ao Faculty of Māori and Indigenous Studies including Tom Roa, Haki Tuaupiki, and Sandy Morrison. My supervisory whānau initially Linda Smith and Vince Diaz and then Sarah Jane Tiakiwai and Stephanie Carroll who provided guidance and direction. Finally, my partner Maria who walked with me through the process of reflecting on this body of work and writing the thesis.

Positionality Statement

My path into academia and the research sector is a non-traditional one but I'm sure shares features with other Indigenous academics who enter the sector later in life. The back story is interesting in its own right featuring different cross-cultural encounters between my Māori ancestors and my Pākeha (*non-Māori*) ones who crossed paths during the formative years of Aotearoa New Zealand's existence following the signing of the Te Tiriti o Waitangi (*The Treaty of Waitangi*). Different strands of my whakapapa (*genealogy*) were woven together amid the turbulent times of the New Zealand wars, raupatu whenua (*land confiscations*), ngā pakanga o te ao (*world wars*), and a range of social justice movements. These events shaped the context and experiences of my great grandparents, my grandparents, my parents and ultimately me as well. My upbringing was a microcosm of the time, both similar to others and unique in its own way. A Māori father, banned from speaking te reo Māori (*Māori language*) at school, was part of the urban drift (from Ōpotiki to Wellington) and eventually joined the army and went to Vietnam. He lost his legs after standing on a landmine and while recuperating back in New Zealand married my Pākeha mother. Her mother was Scottish and came to Aotearoa New Zealand with her husband after serving in the Navy and spending four years in a Prisoner of War camp during the second world war. His grandparents had emigrated from England settling in the Nelson region before started the Newman coachlines.

We moved around a lot growing up and I went to four primary schools and three high schools in different places between Ōpotiki, where my Māori grandparents lived, and Auckland, where my Pākeha grandparents lived. Although I did well at school my primary interest was sport and it was probably that which led me to studying physiotherapy at AIT. There are two particular 'Māori' experiences which I remember from my upbringing. I took the Māori language elective at Ōpotiki College but spent most of the class watching videos with relieving teachers, while the te reo Māori teacher was doing oral exams for School Certificate. This put me off doing Māori language at high school but I was inspired to do a Te Ataarangi course between completing the physiotherapy degree and heading overseas for work. This came about because my father was himself on his te reo Māori journey having started Te Ataarangi while I was finishing high school and had continued while I was at University. The other experience was attending a Treaty workshop at Tapu Te Ranga marae in Wellington and meeting Moana Jackson during my final year of high school. That was the first time I remember talking about the Treaty of Waitangi and issues of decolonisation.

My life's course took me overseas, first to Sault Saint Marie in Michigan on the border with Canada, and then to England, and I gained experience as a physiotherapist and explored different parts of the world. While there was a First Nations community based in Sault Saint Marie I didn't engage with either the people or their culture while living there. I returned to New Zealand after three years abroad, primarily for a holiday with the view to heading overseas again but found Aotearoa in the midst of a cultural resurgence. While still early days the interest in Māori issues was palpable, following on from the early treaty settlements and the growing te reo Māori revitalisation efforts including kohanga reo (*language nest*) and kura kaupapa Māori (*Māori immersion school*). I joined my father's te reo Māori

class in Ōpotiki spending 20 hours a week with him and 20 hours a week as a physiotherapist working at Whakatane Hospital and visiting clients throughout the Eastern Bay of Plenty. After completing a year of Te Ataarangi I headed to Auckland to continue learning through Te Ataarangi as part of a programme based at Waitech. While in Auckland I also had a role supporting Māori students enrolled in the physiotherapy degree and during this time helped establish Taeora Tinana, the Māori Physiotherapists Network. The Te Ataarangi programme was for second chance learners and while I didn't formally qualify the tutors, Hine Taumanu and Hohepa Delamere, let me attend the Rakeitanga and Puaotanga classes as an unofficial student. They were both practising healers who shared Indigenous knowledge throughout the formal parts of the language course as well as frequent external wānanga (workshops) and practical sessions. The time in these classes left an indelible mark on my understanding and orientation towards mātauranga Māori (*Māori knowledge*). First, the knowledge shared in the classes demonstrated a depth of understanding that far exceeded my expectations. Coupled with the practical experience of seeing healers in action and my Western understanding of physiotherapy practice I was forced to rethink assumptions and foundational values from my previous training. Second, the tutors had an openness to engaging with other knowledges, something I think emerged from the confidence they had in their own mātauranga. Third, the open way in which the tutors shared knowledge and encouraged students to do the same, mātauranga was only useful if it was being used, so sharing was an important part of the process. This is not to say some information wasn't held back but only when necessary to protect people. Fourth, the traditional healing practices were available to people of all backgrounds and ethnicities demonstrating the utility of mātauranga Māori beyond just Māori communities.

As I married and started a family these experiences influenced the roles I adopted and decisions I made. After three years in wānanga I had to decide whether to begin an apprenticeship working alongside the healers or return to university and do post-graduate studies. I chose the latter and entered the postgraduate course on healthcare ethics. I had been pondering why medical professions could get paid by the healthcare system and healers couldn't. The rhetoric of evidence-based practice was prevalent at the time and was predicated on research-based evidence. Despite tangible evidence from patients, traditional healers would never get resources without robust research evidence supporting their practices. This is something I would come back to as a researcher, but it influenced my choice to do ethics as you need to get approval from an ethics committee before you can conduct research, that and it was one of the few non-clinical postgraduate options for a physiotherapist. I joined a Health and Disability Ethics Committee and gained more practical experience assessing research applications which led to my master's thesis topic exploring 'He Matatika Māori - Māori views on Ethical Review of Health Research' (Hudson, 2004a). I took on a Māori Development role at the Institute for Environmental Science and Research which propelled me into the research world and the interface between science and mātauranga Māori.

Initially the exploration of this interface focused at the level of Māori values and over time involved projects that led to the development of guideline documents like Te Ara Tika Guidelines for Māori Research Ethics (Hudson et al, 2010a), Te Mata Ira Guidelines for Genomic Research with Māori (Hudson et al, 2016c), He Tangata Kei Tua Guidelines for Biobanking with Māori (Hudson et al, 2016d), Te Nohonga Kaitiaki Guidelines for Genomic Research with Taonga Species (Hudson et al, 2021), and He Tohu Arahi Guidelines for Protecting Cultural Intellectual Property in Research and Innovation (Riddle et al, 2024). This work expanded internationally, and I became involved in Indigenous networks focused on Indigenous genomics and Indigenous data sovereignty becoming a co-author of the CARE Principles for Indigenous Data Governance (Carroll et al, 2020) and a Co-Director of Local Contexts. This work complemented other research projects that focused on Māori economic development, health, environment, and new technologies. Across all these domains it was possible to explore the

interface of mātauranga Māori and science, as well as address Māori data sovereignty challenges. While this work is inextricably linked to issues of Indigenous rights my focus has leaned towards the development of practical mechanisms that help both Indigenous communities and scientists navigate the cultural interface. That said my primary motivation has always been to enable greater benefits for Māori/Indigenous communities from actively engaging in these spaces through capacity building (e.g. SING Aotearoa, Indigidata Aotearoa) and more recently opportunities for benefit sharing. I have had numerous opportunities to engage with other Indigenous researchers and communities and share stories and learnings from projects, most recently through CBIKS, the Centre for Braiding Indigenous Knowledge and Sciences. Many Indigenous communities have dealt with similar experiences through colonisation, capitalism, and globalisation and face similar challenges as they look to become more self-determining and resilient in the future.

This thesis is a reflection on my journey through research as I grappled with the aim of demonstrating the contemporary relevance of mātauranga Māori to our society. I have always had diverse interests and a dual focus on both traditional practices and new technologies using each to inform the other. Similarly, I also developed a mix of local and global networks which informed both research and development projects. I'm an optimist by nature and working on multiple projects across these different axes built a certain kind of strategic pragmatism into the way I approach them. I started making contributions to te ao Māori by working on Māori focused kaupapa alongside groups like Taeora Tinana (Māori Physiotherapists Network) and Pūtaiora (Māori members of ethics committees) and conducting research with traditional Māori healers, mātauranga Māori knowledge holders, and Māori scientists. I also started getting involved with Whakatōhea, representing my hapū Ngāi Tamahaua on the Whakatōhea Māori Trust Board, and this led to working with them on research as well as development projects. The opportunity to both represent my iwi and do research with them was not lost on me, and I was able to harness the experiences of both into my role as a negotiator for the Whakatōhea Treaty Settlement. The privilege of having an important role in such a defining moment of our iwi's history is one that I will never forget.

As I looked more closely at the body of work that I had been a part of over the past decade the key message was one of reciprocity, that there was great value in working together for a better future. The revitalisation of mātauranga Māori/Indigenous knowledge impacted on resurgence initiatives focusing on self-determination and strengthening cultural practices, as well as the extension and application to addressing challenges with new technologies and contemporary contexts. In the same way that my whakapapa is shaped by a wide range of backgrounds and familial connections, but I choose the parts which I culturally identify with, so too is knowledge created from diverse sources and shaped through the worldview and cultural lens of the community. Useful ideas and technologies are incorporated and others replaced or rejected contributing the utility and continuity of Indigenous knowledges.

Chapter 1: Outline of the Thesis

Introduction

My approach to completing this PhD by publication did not follow a standard process and as such the thesis has a different structure. This is related in part to my circumstances and the length of time to conclude this thesis, the evolving nature of my research projects, and the movement of discourse over that period of time. What this thesis represents is a body of research that I have been fortunate to be a part of over the past ten years. All of the projects were collaborative activities, and all involved the integration of both western and Māori bodies of knowledge. Each project has its own methodological approach and methods although most drew predominantly on kaupapa Māori methodology.

The introduction provides a general summary and positionality statement to orient the reader to my background and motivations. Chapter One provides an outline to the structure of the thesis including the research question, methodological approach, and methods for the construction of the thesis. Chapter Two is a literature review exploring the cultural interface between Indigenous knowledge and science, and the challenge of braiding these bodies of knowledge within research projects. Chapter Three describes the foundations of cultural reciprocity and the dimensions and attributes that comprise the Cultural Reciprocity Framework. This represents the primary new output of the thesis, woven together from the literature review and the learnings that emerged from the published papers. Chapters 4 – 15 represent selected papers/project outputs for which a general description is provided as well as a Cultural Reciprocity Framework assessment. These chapters are structured into three parts, locally focused projects (4-6), nationally focused projects (7-12), and internationally focused projects (13-15). Chapter 16 is the discussion section exploring what the use of the Cultural Reciprocity Framework indicates and how it might be used to encourage a deeper and more substantive approach to the braiding of Indigenous knowledge and science in research or what I think of as 'deep knowledge co-production'.

Research question

The primary research question for this thesis evolved over time. I had always wanted to explore how mātauranga Māori, or Indigenous knowledge more generally, might be integrated more substantively into research projects and policy development. Initially I framed the research question around the place of Indigenous knowledge in post-normal science, specifically:

a) What is the place of Indigenous knowledge in post-normal science environment?
b) How can Indigenous knowledge contribute to policy development for complex science related issues?
c) What are the challenges in applying Indigenous knowledge to new contexts within a colonial setting?

In post-modern times science philosophers have come to develop more critical understandings of science. Thomas Kuhn (1970) considered scientific development as a social process that was influenced by the worldviews of scientists. He coined the idea of 'paradigms' or a frame of presumptions that inform the reality observed by scientists (Rouse 2003). Further to this, Paul Feyerabend (1975) demystified the elitist position of scientists and asserted that objective science is an illusion, as all observation, perception and interpretation is based on deficient instruments and theories. The logical empirical foundation of science began to be challenged by assertions that scientific knowledge approximates the truth (Popper, 1983). The emergence of 'post-normal science' as an approach to problem-solving complex science-related issues is based on the notion that uncertainty, value loading

and the plurality of legitimate perspectives is an integral part of the context for policy making (Funtowitz & Ravetz, 1993), particularly in the domains of health and the environment. Post-normal science refers to strategies that involve the inclusion of extended peer communities in dialogue regarding decisions to be made on science issues in which the facts are uncertain, values are in dispute, the stakes are high and decisions urgent (Small, 2011). At a theoretical level it links epistemology and governance by recognising the plurality of legitimate perspectives/knowledges and the need for inclusive processes of dialogue that foster mutual respect and learning (Ravetz, 2006). The reconceptualization of the relationships between science, society and policy have resonated with emerging discourse around 'transdisciplinarity' which stresses the need to project scientific knowledge production beyond its disciplines (Rist et al, 2007). They also suggest that sustainability will be supported by shifting the focus from management to governance of natural resources through transdisciplinary work, a process of joint production of knowledge.

As I engaged in different research projects that brought together mātauranga Māori and science I started to think more deeply about the impact of the projects, the contributions they could make to development for Māori communities, and the pathways to implementation. This coincided with a general shift in the policy environment in Aotearoa towards an acceptance of Māori participation in policy development and inclusion of mātauranga Māori. As such my primary focus shifted from making an argument for why Indigenous knowledge should be included in research and policy to understanding the role of mātauranga Māori in decision-making, specifically:

a) What is the role of mātauranga Māori in decision-making?
b) How should mātauranga Māori be applied in policy contexts?

The repositioning of science from the dominant discourse to one of many – albeit important form of knowledge - is being sustained by a shift in how science is perceived in society. Society is much more aware that science can be both the solution and cause of problems (Beck, 1996). The public's relationship and level of institutional and interpersonal trust in science and scientists is also transitioning from an acceptance of expert authority to a demonstration of public credibility (Brown & Michael, 2003; John & Lewens, 2010). The 'legitimacy crisis' emerged from the politicisation of scientific knowledge, and the increasing uncertainty and contestability of expert advice. It provides the impetus for a 'civic science' which explores more democratic and accountable approaches to the production, validation and application of scientific knowledge (Bäckstrand, 2004). The shift from facts to values becomes evident when the facts of a situation become more uncertain, at this point dialogue on the values in dispute becomes more important (Funtowitz & Ravetz, 1993). Dialogue is not just important as a matter of multicultural diplomacy but as a way of enhancing scientific explanation itself (Whitely-Binder, 2002). Negotiating this interface between politics and science, epistemology and governance requires continuous dialogue and transparency between the scientific community, policy makers, and the rest of society (Mayumi & Giampietro, 2006). It is also acknowledged that new types of knowledge production are required that bridge scientific and other knowledges, particularly in the context of sustainable development (Rist et al, 2011). The emerging recognition of other knowledges creates a significant challenge for both researchers and policy makers who are tasked with the analysis, synthesis, and interpretation of knowledge derived from communities which share different epistemological, normative, eco-cognitive and aesthetic foundations (Rist et al, 2011).

The recognition of different values and the legitimacy of different perspectives find support in Indigenous critiques of science which also challenge its dominant position in a range of policy making contexts. Indigeneity can be conceptualised as a state of fusion between Indigenous peoples and their accustomed environments and arising from that fusion a system of knowledge developed, along with clear understandings about territoriality, politics, and governance (Durie, 2004). Contests between

Indigenous peoples and states have been fought in a variety of sites, most obviously around territorial lands and waterways but they are increasingly shifting to intellectual and cultural sites. Here the contests are about the terms under which Indigenous knowledge is acknowledged and used in the modern context (Durie, 2004). In common with other Indigenous epistemologies the Māori worldview focuses on relationships between human communities and the natural world, the interconnectedness and relationship of individuals with all living things, and that both physical and nonphysical realms as reality including the notion that reality cannot always be quantified (Cajete, 2004; Royal, 2009). Knowledge is sourced from different vantage points over time (empirical observation), recollection and recall (traditional teachings) and from the spirit world and ancestors in the form of dreams, visions and intuition (revelation) (Cajete, 2004). In response to the process of colonisation, Indigenous peoples have also created boundaries to protect the marginal status of their knowledge systems from hegemonic spaces, to ensure the integrity of their own knowledge spaces and the wisdom they provide is maintained. Smith (2006) discusses this and the benefits of the "wisdom of the survival of the margins." Indigenous knowledge holders and practitioners often make a choice to reject Western scientific practices or knowledge and continue with knowledge and practices that have been culturally inherited and are embedded in traditional educational institutions and Indigenous languages. (Deloria, 1999).

As I delved more deeply into the literature around mātauranga Māori and science it was clear that significant attention has been given to this relationship through an increasing number of collaborations at the cultural interface. My involvement in a new National Science Foundation funded Center for Braiding Indigenous Knowledge and Science (CBIKS)[2] also prompted me to reflect on the impact of the research projects I had been a part of and reconsider the research questions to explore the quality of the research collaborations and the impact of their outputs. The result was a refining of focus towards the quality of braiding between Indigenous knowledge and science, in essence the depth and quality of the knowledge co-production process. This also involved the expanding of scope from mātauranga Māori to Indigenous knowledge creating more possibilities for the lessons learnt here in Aotearoa to add value to a broader Indigenous research community.

The research question that this PhD by publication attempts to answer is:

1. What factors enhance the braiding of Indigenous knowledge and science within research contexts?

Methodology

A kaupapa Māori methodology was adopted for the PhD to center the issues of power and epistemology that inform the context for collaboration at a cultural interface and the exercise of braiding Indigenous knowledge and science. The kaupapa Māori approach resembles post-normal science in focusing attention on the role of knowledge and governance as key sites of challenge for Māori communities in their engagement with both the crown and the science community. The nexus of these issues sits at the core of many Treaty claims and provides the basis for Māori aspirations of partnership and participation around the nation's development agenda. They are also key tenets of kaupapa Māori which has been an important strategy in Aotearoa New Zealand for positioning mātauranga Māori as a valid and legitimate form of knowledge, and the right for Māori community members to reclaim, regenerate, revitalize, remember, and re-imagine their cultural understandings, self-confidence, and development agendas (Smith, 1999; Pihama et al, 2002; Bishop, 2011).

[2] https://www.umass.edu/gateway/research/Indigenous-knowledges

Negotiating spaces to dialogue about epistemological differences and the development of inclusive governance options span a variety of sectors and require the reconceptualising of mātauranga Māori and its relationship with science in this post-normal context.

Kaupapa Māori methodology is employed for consistency with Māori worldviews and its focus on supporting Māori-inspired and led developments. Kaupapa Māori can be described as a best practice approach to research with Māori which maintains Māori control of the research process, aligns with Māori ethics and development aspirations, and values Māori protocols within the research design (Cram et al, 2002; Cram et al, 2004; Hudson, 2004b; Hudson et al, 2010a; Smith, 1999). Key to kaupapa Māori is the focus on transformation by challenging systems and structures that limit opportunities for Māori development (Eketone, 2008; Smith, 1997). Kaupapa Māori also privileges Māori concepts, values, understandings, and knowledge. This does not limit the ability to question or challenge the information shared and ideas generated within a project, however through kaupapa Māori this is done in such a way that the mana and integrity of participants and their views are maintained. There are a variety of contexts where Māori have engaged in discussions about enhancing participation in decision-making and greater inclusion of Māori knowledge and values. However, the conceptualizing of the interface between mātauranga Māori and science and how these fit within the broader context of bicultural relationships in Aotearoa as well as the development of processes that support dialogue and negotiation across this space are becoming embedded in research and policy environments. Enabling creative interdisciplinary knowledge spaces that promote the recognition, revitalisation, and continued evolution of mātauranga Māori contribute both to Māori development and create positive outcomes for society. Enhancing interaction across knowledge systems creates opportunities for knowledge exchange and supports Māori communities to engage with technological developments in the knowledge economy.

Methods

This PhD by publication provides a meta-analysis of a series of different research projects that engaged topics at the cultural interface and co-produced outputs in the form of papers or guidelines that integrated aspects of mātauranga Māori and science. The papers form chapters and are utilised both as sources of information for the development of the Cultural Reciprocity Framework, and as case studies for examining the dimensions and attributes of cultural reciprocity. The methods used in the writing of this thesis were:

1. A literature review exploring the interface between mātauranga Māori, the cultural interface, braiding Indigenous knowledge and science, and knowledge co-production which was used to frame the development of the Cultural Reciprocity Framework (Chapter 2-3).
2. Testing the Cultural Reciprocity Framework against a range of projects (Chapters 4-15) and concluding with a summary of key findings and suggestions for future directions (Chapter 16).

Before assessing the projects, I discussed the framework with Māori and Indigenous colleagues as well as my supervisors to get feedback on the logic and potential value of the framework. While they raised specific questions about the use of specific terms like cultural, respect, and/or veracity, they were generally enthusiastic about the direction and could see value in developing it further. The input of these Māori, Indigenous, and non-Indigenous colleagues was invaluable in refining the ideas and language. Whether done formally in wānanga or informally through discussions this process of aligning different discourses and collaborative sense-making has been adopted and used in many of the projects I've been a part of (Hudson et al, 2016a; Hudson et al, 2016b; Hudson et al, 2016c; Hudson et al, 2023; Oetzel et al, 2017).

It was important to me that the Cultural Reciprocity Framework for Deep Knowledge Co-Production had value beyond my own reflections, and that it might add value to other researchers and/or communities. I shared the framework with members of my iwi, Whakatōhea, as they explore the possibility of establishing an iwi research centre. A key component of Indigenous knowledge is its locally grounded nature and relationship to place. Kaupapa Māori research promotes the importance of community centered research and I have been fortunate to work directly with Whakatōhea across a series of research projects. I have been an insider in terms of this community, not only as a member of Whakatōhea but also a representative of the Whakatōhea Māori Trust Board from 2012 to 2024. In that capacity I facilitated Whakatōhea's participation in research with both a local, national, and international focus and continue to support these efforts.

I shared the draft framework with the CEO and Chair of the Whakatōhea Māori Trust Board as well as the Iwi Development Manager, who has been the person responsible for facilitating Whakatōhea's involvement in research over the past decade. The framework resonated with them in terms of the areas that it covered and the focus on reciprocity which they could see having direct application to an iwi research context. They have found it challenging to maintain equitable research relationship when partnering with scientific institutions and felt the need for more reciprocity in those collaborations. They could see how they could use the framework to guide the co-design of research projects, and as an evaluation framework both during the project and after its completion. The CEO could also see applications beyond research and wanted to use it to inform discussions about cultural informed governance within the context of the new Post Settlement Governance Entity (PSGE), Te Tāwharau o Te Whakatōhea.

Testing the Cultural Reciprocity Framework

The dimensions and attributes associated with cultural reciprocity can be used to reflexively assess the commitment of the collaboration to building deeper forms of knowledge co-production. This process can be part of the development of a project or as mid-project or project end review which provide an opportunity to identify areas where dimensions of reciprocity could have been enhanced with a view to improving processes and behaviours in subsequent projects. Post project reviews are also worthwhile as the responsibility for generating outcomes often extends beyond the project, and impact is often measured through downstream activities. Impact evolves over time as the project contributes to additional downstream activities. For this study I used a five-point scale to assess the impact of each of the projects based on its contribution towards positive outcomes as Negligible, Limited, Moderate, Significant, Major.

The usefulness of the Cultural Reciprocity Framework was tested at different scales by assessing outputs from iwi (tribally) focused, Māori focused or Indigenous focused projects. The assessment process itself is intended to be a self-reflective one and it was completed for each of the projects as a post project review. For each of the chapters that follow I provide a summary of the project, a completed Cultural Reciprocity Assessment using the Framework template (Appendix 1), as well as the published article or output.

a. Iwi Focused Projects

i. Whakatipu rawa ma ngā uri whakatipu: Optimising the Māori in Māori economic development (Awatere et al, 2017)
ii. Whakatōhea Transformation Framework: Whakatōhea Treaty Settlement (Te Arawhiti, 2023)
iii. Film: E Kore Au e Ngaro as part of Te Puni Kōkiri funded Aotearoa Local Contexts Pilot (Burgess et al, 2023)

b. Māori Focused Projects

i. Māori Research Ethics: The development of guidelines for Indigenous research ethics in Aotearoa/New Zealand, (Hudson et al, 2016a)
ii. Māori Genomics: Te Mata Ira—Faces of the Gene: Developing a cultural foundation for biobanking and genomic research involving Māori, (Hudson et al, 2016b)
iii. Māori Data: He Matapihi ki te Ao Raraunga – Conceptualising Big Data through a Māori Lens (Hudson et al, 2017)
iv. Mātauranga Māori and Freshwater: Integrating Indigenous Knowledge into Freshwater Management: An Aotearoa/New Zealand case study (Hudson et al, 2015)
v. Māori & Gene Editing: Identifying Māori perspectives on gene editing in Aotearoa New Zealand (Clark et al, 2024)
vi. Vision Mātauranga & the Moana Project: lessons learned from a national scale transdisciplinary research project (D'Sousa et al, 2023)

c. Indigenous Focused Projects

i. Indigenous Data Governance: The CARE Principles for Indigenous Data Governance (Carroll et al, 2020)
ii. Indigenous Genomics: Rights, Interests, & Expectations: Indigenous perspectives on unrestricted access to genomic data (Hudson et al, 2020a)
iii. Indigenous Data Sovereignty: Indigenous Peoples' Rights in Data: a contribution toward Indigenous Research Sovereignty (Hudson et al, 2023)

Ethics

Ethics approval was gained from the necessary committees for each individual projects which cover the respective publications that form chapters within this thesis.

Chapter 2: Mātauranga Māori and Science

Introduction

Māori are recognised as the Indigenous peoples of Aotearoa New Zealand and mātauranga Māori *(Indigenous knowledge)* as a unique and holistic knowledge system based on the distinct culture and identity of Māori grounded in the biophysical environment of Aotearoa. The burgeoning interest in mātauranga Māori is a result of concerted efforts over the past 50 years to gain recognition for Te Tiriti o Waitangi *(The Treaty of Waitangi)*, promote te ao Māori *(the Māori world),* and advance Māori self-determination within Aotearoa New Zealand. Māori have worked hard to shift the orientation towards te ao Māori from an othering via a focus on taha Māori *(Māori perspectives)* to a centering of Māori aspirations through the establishment of kaupapa Māori initiatives *(by Māori for Māori)* supported by cultural revitalisation efforts to strengthen the use of te reo Māori *(Māori language)*, tikanga Māori *(Māori protocols)*, and mātauranga Māori (*Māori knowledge)*. The Waitangi Tribunal and Treaty Settlements have played a part in surfacing inequities arising from Crown (in)actions and providing sites for negotiating new relational frameworks and modes of bicultural interaction between iwi and the Crown. Treaty settlements also contribute to the growing Māori economy alongside Māori land trusts, Māori businesses, and Māori entrepreneurs to form a diverse network of actors promoting Māori values and leveraging cultural assets to benefit their communities. Increasing engagement with the Research and Innovation sectors, shaped over the past two decades by the Vision Mātauranga policy to harness the 'innovation potential of Māori knowledge, people and resources', has developed an evidence base supporting Māori initiatives across multiple domains, and generated opportunities for Māori participation in new technologies and the new knowledge economy (Ministry of Research, Science and Technology, 2007; Rauika Māngai, 2020). The success of these efforts is evident in the advances Māori have made across many sectors of society, the increased presence of Māori in national and international affairs, the adoption of Māori words into a general New Zealand lexicon, the adoption of bicultural practices across a variety of professions, and the growing prominence of mātauranga Māori in policy and practice. While mātauranga Māori is highly adaptable in the manner in which it can be applied, issues of authority and integrity permeate its use in non-traditional spaces, and concerns about misappropriation have been heightened by the open data sharing practices within digital environments.

What is Mātauranga Māori? (Indigenous Knowledge)

In its simplest form mātauranga Māori refers to Māori knowledge (Mead 2022). However broader descriptions of mātauranga Māori emphasise a range of different characteristics. First and foremost mātauranga Māori in a body of knowledge (Smith et al,2013; Hikuroa, 2017; Mika et al, 2022; Moewaka-Barnes, 2022; Moko-Painting et al, 2023), comprising various forms such as te reo, tikanga, whakapapa *(genealogies)* (Tau, 2001; Roberts, 2013; Mahuika, 2019; McAllister et al, 2023), kōrero tuku iho *(histories, narratives from the past)* and pūrākau *(stories)* (Hikuroa, 2017; Forster, 2022; Mead, 2022; Moko-Painting et al, 2023), encompassing Māori philosophy, (Lilley, 2018; McAllister et al, 2019), Māori epistemology (Smith et al, 2016; Moko-Painting et al, 2023), Māori ontology (Smith et al 2016), Māori pedagogy including practices and traditions specific to places and communities (Muru-Lanning 2022) that represents a continuum of ancestral knowledge (Royal, 2009; Muru-Lanning, 2022) emerging primarily from an Indigenous knowledge system (McAllister et al 2019), but evolving and adapting through research (Hudson et al, 2010b; Lilley, 2018; Moewaka-Barnes, 2022; Mead, 2022; Shedlock & Hudson, 2022) and knowledge co-opted from other systems (Mead 2022) to describe te ao Māori (Royal, 2012; Mead, 2022) and provide insight into understanding the existence of and relationship between all animate and inanimate things (Royal, 2003; Roberts & Fairweather, 2004), and apply this insight in the pursuit of wellness for people and the environment (Haami & Roberts,

2002; Heke et al, 2019; McAllister et al, 2019). Te Ahukaramu Charles Royal (2012) notes mātauranga Māori is a modern phrase representing a body of knowledge with Polynesian origins which survives today albeit in fragmentary form. Whaanga et al (2017) provide an expansive definition, *"Mātauranga Māori is the intellectual capital generated by whānau, hapū and Iwi over multiple generations. It is a shared-community knowledge that is embedded in lived experience and carried in stories, song, place names, dance, ceremonies, genealogies, memories, visions, prophesies, teachings and original instructions, as and learnt through observation and copying of other community members. It is a holistic system of orally passed knowledge, concepts, beliefs and practice. Mātauranga Māori, mātauranga ā-iwi, mātauranga ā-hapū, and mātauranga ā-whānau are dynamic, innovative, and generative systems of knowledge"* (Whaanga et al, 2017:4).

In this regard, the term mātauranga Māori is descriptive of both the knowledge (content that has been created), the knowledge system (the ways in which content is created), ways of knowing (how content makes sense), and knowledge practices (how content is utilised). As Smith et al (2016:134-135) describe *"encompassed within mātauranga are theories, practices and protocols for being in the world, ideas about what it means to know something and how knowledge is organised, about classification systems, about what counts as reality or truth, about education, about power and about how experts are trained and validated. These ideas traverse western philosophical concepts of metaphysical, ontological and epistemological ways of knowing."*

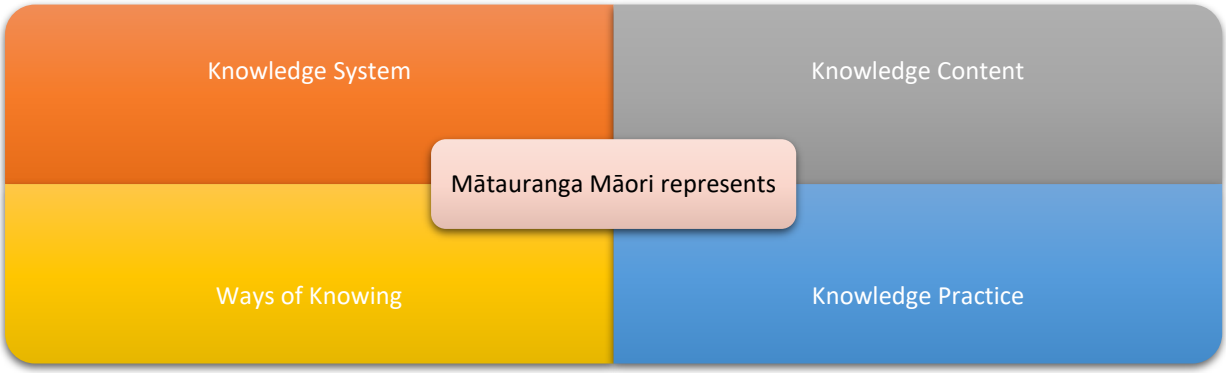

Fig 1: Descriptions of mātauranga Māori

Each of the descriptions provide a way to both differentiate mātauranga from science and show the similarities between mātauranga and science. They also become sites of contest where the validity or usefulness of mātauranga has been challenged. Content is described as myth, ways of knowing are framed as subjective rather than objective, practices are differentiated as local traditions rather than universal truths, and knowledge systems are subjected to colonisation and structural racism.

Relationship between Indigenous Knowledge and Science

While the word 'science' is associated with facts and knowing it has also become a term that describes the knowledge system that evolved in Western Europe in the 16th Century from a foundation of Arabic, Indian, Chinese, Islamic and Greek knowledges. Science has also become synonymous with the scientific process, constructing hypotheses and predictions which can be subjected to rational empirical testing (Crawford 2009), and open to peer and public review (Tsuji & Ho, 2002). While philosophers of science (Kuhn, 1970; Feyerabend, 1975; Popper, 1983) have challenged the logical empirical foundations of science, and Māori researchers argue that science is equally 'culturally bound' (Roberts, 2012; MacFarlane & MacFarlane, 2019), this remains one of its key distinguishing characteristics. Given the dominant positioning of Western knowledge over other knowledge systems both here in Aotearoa and around the globe, the scientific approach becomes a reference point for

comparison (Berkes et al, 1994; Harris & Mercier, 2006; Mercier et al, 2012; Bohensky & Maru, 2011; Ubisi et al, 2019; Wheeler & Root-Bernstein, 2020). Science is often seen to be reductionist, naturalistic, and isolationist (Harris & Mercier, 2006) as opposed to the holistic, supernaturalistic, and relational nature of Indigenous knowledge. Hikuroa (2017) identifies some differences between mātauranga Māori and science in the table reproduced below.

Mātauranga Māori	*Science*
Participatory 'experiencers' of systems	*Detached 'observers' of systems*
Explicit intrinsic values	*Implicit instrumental values*
Knowledge as belonging	*Knowledge for control*
Intuition as method	*Intuition rarely acknowledged*
Inclusion of facts and values	*Facts and values separated*
Everything is interconnected	*Everything physical is interconnected*

Table 1. Some differences between mātauranga Māori and science.

However, dichotomising Indigenous knowledge and science as singular entities contributes to the perception of incompatibility or incommensurability when both have multiple forms and dimensions, some more similar than others (Bohensky & Maru, 2011; Mercier, 2018). There is a deep body of work providing definitions and describing the similarities and differences between Indigenous knowledge, traditional knowledge, local knowledge, traditional ecological knowledge, Indigenous science, and science and the relative usefulness of each (Agrawal, 2002; Aikenhead & Ogawa, 2007; Berkes & Berkes, 2009; Jesson et al, 2021).

Latulippe (2015:118), provided a useful typology of the literature on traditional knowledge (TK) divided into four orientations noting these categories are not fixed or mutually exclusive, but "*operate under differing sets of assumptions and towards particular ends*".

Traditional Knowledge Orientations	**Description**
Ecological	TK supplements western science, offering unique insights into ecological processes
Critical	TK is embedded in uneven, colonial relations of power
Relational	TK emphasises the relationship between knowledge, place and practice recognising the kin centric relationship with the natural world
Collaborative	TK holds a position of empowerment for Indigenous peoples that enable Indigenous peoples to create conversations, spaces, institutions, and mechanisms across knowledge systems in order to protect their own knowledge systems

Table 2: Typology of traditional knowledge orientations (Latulippe, 2015)

From an ecological perspective, the value of mātauranga Māori/Indigenous knowledge as a supplement to science, particularly in fields of ecology, environmental and resource management has been illustrated in numerous publications (Cram et al, 2002; Bohensky & Maru, 2011; Whaanga et al, 2017; Lyver et al, 2018; McAllister et al, 2019; Maxwell et al, 2020; Stevens et al, 2020; Wheeler & Root-Bernstein, 2020; McAllister et al, 2023) where the benefits of local knowledge are seen to provide access to information at spatial or temporal scales that are normally inaccessible to scientists or beyond the capabilities of technologies or resources of the project (Wheeler & Root-Bernstein, 2020).

In this sense the methods of Indigenous knowledge and science can be complementary or operate in parallel (Davis 2006). Moller et al (2004) identified five specific areas where embracing differences can contribute to a more complete understanding of the environmental context (e.g. customary harvesting).

Science

- Science is diachronic, i.e., tends to collect short-term data over large areas
- Foci on averages
- Quantitative
- Improved tests of mechanisms
- Objectivity

Traditional Knowledge

- TK is synchronic, i.e., tends to collect information over long time periods
- Foci on extremes
- Qualitative
- Improved hypotheses
- Subjectivity

However, by reducing Indigenous knowledge to a series of facts, observations, and practices this orientation can obscure the accompanying socio-political and spiritual dimensions (Whyte, 2013) and risk "*privileging the priorities, interests, and paradigms of non-Indigenous peoples and institutions"* (Latulippe, 2015:121), we risk the "*scientification of the non-scientific epistemology*" (Mazzocchi, 2018:20).

From a critical perspective, Indigenous knowledge is subject to the same processes of colonisation as Indigenous peoples. The effects of dispossession of Indigenous lands, suppression of Indigenous systems of knowledge production, and marginalisation of Indigenous knowledge are seen in the fragmented nature of Indigenous knowledge retained in those communities. This is compounded by uneven relations of power, systemic imbalances and resource inequities facing Indigenous communities (Latulippe, 2015; Ataria et al, 2018). As Broughton et al (2015) state "*The ongoing privileging of one knowledge system and suppression of the other has left Western epistemology so dominant that it can now seem like the only possible framework*" (p.84). The impact is that Indigenous knowledge is then treated within the research environment as supplementary to real knowledge '*relevant only to the extent that they have something to offer existing theories and discourses'* (Kuokkanen, 2007 p.72). Knowledge generation has been seriously depleted through colonization and the marginalization of Indigenous knowledge systems such as mātauranga has had a negative impact on the motivation and quality of engagement between parties (Tiakiwai et al. 2017). Addressing the colonised and coloniser dynamic is important before open engagement can be effective (Smith et al, 2013). Efforts to position Indigenous knowledge as a contributor towards innovation creates tension between a critical view of appropriation within a neoliberal agenda (McCormack, 2011; Smith et al, 2016) and a more liberating self-determining approach that creates synergies that benefit Māori and the nation (Ruckstuhl et al, 2019a; Ruckstuhl et al, 2019b).

From a relational perspective, Indigenous ways of knowing and understanding the world can be described with more emotional and spiritual clarity (Kimmerer 2002). Creation stories, histories and other teachings provide foundational values and knowledge that form the basis for the cultural logics (Hudson et al, 2016b; Lyver et al, 2018; Ataria et al, 2019) that create meaning and guide decision-making (McGregor, 2004; Borrows, 2010). The interconnected web of relationships (Wilson, 2008), or whakapapa in Māori terms (Roberts, 2012; Roberts, 2013; Mahuika, 2019), provides a skeletal structure for Māori (Indigenous) epistemology (Tau, 2001) which encompasses the moral universe in which humans are an integral part of nature (Haami & Roberts, 2002). The moral dimension brings lore and ethics into the frame through operating instructions (Battiste & Henderson, 2000), moral codes (Johnson, 1992), responsibilities (McGregor, 2014), or tikanga Māori (Hudson et al, 2010b; Mead, 2016) which mediate and sustain relationships through the practice and experience of an ethic of

restoration (Smith et al, 2016; Jackson et al, 2020). From this perspective knowledge and people are inseparable and the use of Indigenous knowledge within research and other decision-making forum cannot be divorced from discussions about participation and governance (Hepi & Foote, 2013; Hudson et al, 2016a; Ataria et al, 2018).

From a collaborative perspective, the opportunity for empowerment or self-determination frames the active deployment of Indigenous knowledge with and alongside non-Indigenous institutions and knowledges in ways that benefit Indigenous communities and the environment (Cram et al, 2002; McAllister et al, 2023). The focus here is on the conditions which allow traditional knowledge to be appropriately expressed in cross cultural and cross situational collaborations (Whyte, 2013; Latulippe, 2015). As cultural diversity corresponds to epistemic diversity (Mazzocchi, 2018) the overarching aim of the collaborative perspective is to create epistemic communities, with key intercultural knowledge brokers (Bohensky & Maru, 2011; Science for Technological Innovation, 2020), capable of bridging distinct epistemologies (Latulippe, 2015) in a manner that is responsive to issues of Indigenous identity, rights, and sovereignty (Smith et al, 2013; Hudson et al, 2023; Garba et al, 2023). Cross cultural engagement is represented as an important aspect of the development of knowledge generally, (Smith et al, 2013) however, acknowledging the potential difficulties of engagement is necessary for successful collaboration. Miss-matched mindsets (Ataria et al, 2018), being cognizance of social context (Bohensky & Maru, 2011), decontextualising Indigenous knowledge (Mazzocchi, 2018), ontological pluralism (Berkes, 2012), knowledge co-production (Latulippe, 2015), and measuring success (Wheeler & Root-Bernstein, 2020) are all factors that need to be addressed. Cross-cultural engagement occurs at the cultural interface, the spaces where different peoples engage with each other and exchange knowledge and ideas, with the aim of increasing understanding, finding solutions to challenges, and creating opportunities for innovation.

Chapter 3: Cultural Reciprocity in Deep Knowledge Co-Production

Tuia ki runga, Tuia ki raro, Tuia ki roto, Tuia ki waho,

Tuia te here tangata, Ka rongo te pō, Ka rongo te ao, tihei mauri ora.

The Cultural Interface

Knowledge co-production occurs at the cultural interface, a theoretical space where Indigenous knowledges and cultures interact with other cultures and ways of being including the intersection between traditional knowledge and western science (Durie, 2004; Nakata, 2010). The cultural interface is "*a multi-layered and multi-dimensional space of dynamic relations constituted by the intersections of time, place, distance, different systems of thought, competing and contesting discourses within and between different knowledge traditions, and different systems of social, economic and political organisation*" (Nakata, 2007:199). The cultural interface can be both a source of innovation and confusion due to the complex interwoven, competing, and conflicting discourses (Durie, 2004; Smith et al, 2013; Smith et al, 2016; Arago-Kemp & Hong, 2018; MacFarlane & MacFarlane, 2018). Being open to a greater 'ecology of knowledges' does not require a discrediting of scientific knowledge or western ideas of rationality (Santos, 2014; Mazzocchi, 2018) but an appreciation of the value of each (Moller et al, 2004; Hudson et al, 2012). Debates about the similarities and differences between mātauranga Māori and science highlight their relationality, the fact that regardless of their epistemological foundations they occupy overlapping social and intellectual spaces. Contact, diversity, exchange, communication, and learning among different knowledge systems is a normal function of knowledge production as the vitality of a culture is the ability to deal with new knowledge and changing environments (Hudson et al, 2012; Smith et al, 2013). The cultural interface is a place that simultaneously emphasises similarities and differences with the aim of drawing on the strengths of both through processes of collaboration and co-production. Science is an overarching domain under which sits a series of different disciplines, all with their own theories, methods, and content. Similarly, Indigenous knowledge encompasses a range of different specialist areas of knowledge including elements aligned to philosophy, ethics, and religion, as well as aspects of language, culture, history, environment, and heritage. Therefore, there will be places where science and Indigenous knowledge align and connect, and places where the knowledges are incommensurable. In this regard the cultural interface is really a metaphorical representation of the multiple points of contact that arise between different knowledges from the political to the ethical, the moral to the practical (Hudson et al, 2012).

The idea of a cultural interface representing the connection between Indigenous and other ways of knowing has been visualised in several different ways (Mercier, 2018). Winiata (2005) uses a Partnership Model with distinct spaces for Māori and non-Māori and a third house for dialogue or decision-making. Maxwell et al (2020) present a Waka Taurua model with two hulls representing the tools of different knowledge systems which can be accessed from the deck that spans between them. Similarly, a Waka Hourua partnership approach is used as part of the mātauranga work programme of the Environmental Protection Agency to weave two knowledge systems into decision-making (Jones et al, 2020). MacFarlane et al (2011) present He Awa Whiria Braided Rivers Approach where each side of the main tributary represents each knowledge system within which a complex system of channels is constantly shifting creating different ways of connecting one side to the other (Arago-Kemp & Hong, 2018; Martel et al, 2022). This concept of 'two ways of knowing' (Deloria, 1999) is also represented in the Indigenous philosophy of Two-eyed seeing, where one eye focuses on the strengths of Indigenous knowledges, and the other eye considers the strengths of western knowledges (Reid et al, 2021).

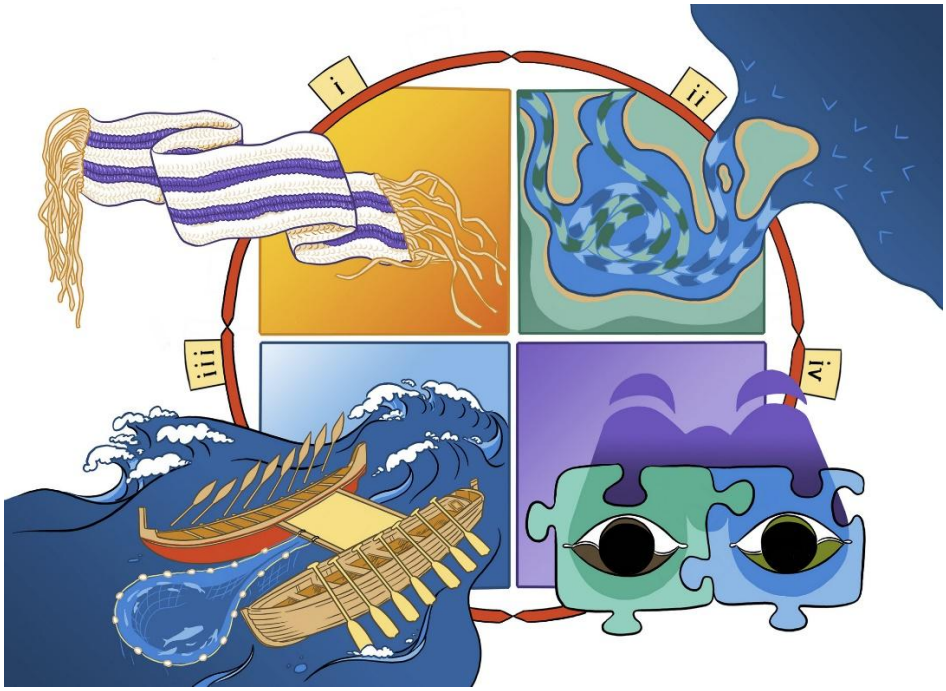

Figure 2: Indigenous conceptual frameworks for promoting knowledge coexistence: (i) the "Two Row Wampum" or Kaswentha in Haudenosaunee; (ii) the "Two Ways" or Ganma in Yolngu; (iii) the "Double-Canoe" or Waka-Taurua in Māori; and (iv) "Two-Eyed Seeing" or Etuaptmumk in Mi'kmaw. Artwork by Nicole Burton (Reid et al 2021)

Others have recognised that having dual access creates an important role for Indigenous researchers as brokers at the interface to ensure the integrity of both systems in the process of developing new knowledge (Durie, 2004; Hudson et al, 2010b; Bohensky & Maru, 2011; Smith et al, 2013; Ruckstuhl et al, 2023). A key component of two-eyed seeing involves "*engaging at the edges and boundaries of knowledge systems in order to work with multiple ways of knowing*" (Smith et al, 2023:123). These models are structural representations of what Ermine et al (2004) describes as an 'ethical space', a neutral zone to explore confluence, divergence and have critical conversations. Similarly, Smith et al (2013) explored dialogue at the cultural interface and theorised the 'negotiated space' as areas where ground rules provide an environment where expertise is acknowledged, people engage with respect, and there is openness to change and potential for transformation. The notion of reciprocity underpins the process of knowledge exchange where the parties that engage in the negotiated space generate ideas that can be incorporated into their respective bodies of knowledge. They suggest that effective engagement consists of reflexive and iterative dialogue because you are not only dealing with people and the relative power dynamics, but also different knowledges and different identities.

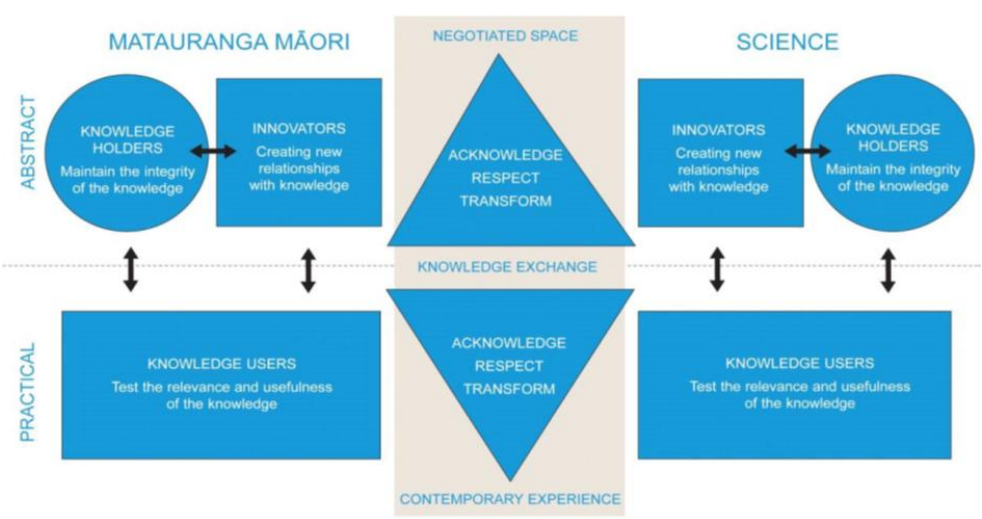

Figure 3: The Negotiated Space (Smith et al, 2013)

Braiding Indigenous Knowledge and Science

Research and policy making at the cultural interface inevitably requires engagement with Indigenous groups and Indigenous knowledge, preferably using processes of co-production and collaboration. Relationality is central to Indigenous understandings of the world and relationships are a key part to braiding Indigenous knowledge and science at the cultural interface. The challenge of competing interests permeates many contexts as communities balance the traditional with the contemporary and self-determination with collaboration. Relationality is important, not only in the context of power and the relationships between people, but also epistemology and the relationships between knowledge(s). Braiding Indigenous knowledge and science in the context of collaborative projects can happen at multiple levels and ideally occurs at each of them.

Level of Braiding	**Focus**
Indigenous aspirations	Led by Indigenous aspirations and contributes directly to Indigenous outcomes
Indigenous values & ethics	Utilises Indigenous values and protocols to guide engagement and actions
Indigenous knowledge content and language	Draws on Indigenous knowledge, concepts, and logics to inform development of models, frameworks, and outputs. Language translation of non-Indigenous concepts/content
Indigenous knowledge generation processes	Utilises Indigenous methods as part of data collection and analysis

Table 3: Level of braiding

The National Science Foundation funded Center for Braiding Indigenous knowledge and Science (CBIKS) uses the Anishinaabe (Ojibwe) framework of “braiding” to conceptualize and operationalize research at the cultural interface and recognise the plural co-existence of both knowledge systems. This contrasts with previous efforts to integrate Indigenous knowledge into science projects which resulted in erasure, reproduction of extractive colonial practices, and further marginalization of Indigenous knowledge (Nadasdy, 1999; McGregor, 2008; Liboiron, 2021; Reid, 2021; Sidik, 2022). The active nature of the braiding metaphor indicates the importance of action in the use of both Indigenous knowledge and science in research that addresses a shared problem for mutual benefit.

The strands of knowledge woven together within the braid retain their integrity and are stronger together. CBIKS aims to understand how to effectively and ethically braid Indigenous knowledge and science by studying place based practices and identifying generalisable and transferable methods to guide ethical and effective braiding of Indigenous knowledge and science in other locations.

Deep Knowledge Co-Production

Braiding is one of many metaphors that Indigenous peoples have used to describe encounters with different cultures and exchanges with different knowledges. Other terms like co-design, co-management, co-governance, and co-production are also used in similar contexts to reflect different groups working together with diverse rights, values, knowledges, and aspirations. Muhl et al (2023) defines knowledge co-production as "*the collaborative process of bringing a plurality of knowledge sources and types together to formulate and to address a defined problem and to build a systems-oriented understanding of that problem for an actionable outcome*". This is consistent with Strand et al (2024) who describe knowledge co-production as an iterative process of bringing together different knowledge systems to enhance, learn, and create new context-specific knowledge. Norström et al (2020) identified four principles of knowledge co-production as context-based; pluralistic; goal-oriented; and interactive. Deep knowledge co-production reflects a deeper level of engagement where the interaction transforms institutional relationships, power dynamics, and knowledge hierarchies. When this involves Indigenous communities, it necessarily traverses issues of colonisation, rights, governance, decision-making, values, and Indigenous knowledge sovereignty (Latulippe & Klenk, 2020).

The institutional drivers for integrating Indigenous knowledge into research, policy, and/or decision-making processes are framed by the responsibility associated with issues of equity and Indigenous rights on the one hand, as well as the potential for innovative solutions to increasingly complex social and environmental challenges on the other. Internationally, there is greater attention on the use of Indigenous knowledge in research, planning, and monitoring activities (UNESCO, 2023; Strand et al, 2024). As Indigenous communities encounter more opportunities for collaboration, and scientists aim to incorporate participatory and transdisciplinary approaches, co-production is an inevitable outcome (Miller & Wyborn, 2020; Nordström et al, 2020). However, the quality of these processes and impact of these actions is questionable as science and scientific tools (i.e., modelling) still dominates most co-production processes (Muhl et al, 2023). The inclusion of Indigenous knowledge should be done in ways that are respectful and acknowledge the past privileging of dominant systems of knowledge (Liboiron, 2021) otherwise an extractive approach to collaboration and knowledge exchange will make communities feel like their knowledges are being misused and misappropriated (Whaanga et al, 2017; Williams et al, 2017; Jesson et al, 2021). Acknowledging colonial forms of decision-making and certain logics of epistemology and capitalism is an initial step towards creating opportunities for a deeper form of co-production based on more meaningful engagement and reciprocity. If the intent of braiding Indigenous knowledge and science or knowledge co-production is to enhance knowledge exchange then the activity should be based on recognition, respect, and reciprocity.

Fundamental issues of power and epistemology underpin the challenges that are addressed in kaupapa Māori theory and reflected in frameworks describing different types of Indigenous engagement in research. David-Chavez & Gavin's (2018) spectrum of community engagement with scientific research highlights the difference between projects that are supportive of self-determination or more extractive in nature. The spectrum differentiates modes that have differing levels of Indigenous authority, participation, and use of Indigenous values and knowledge.

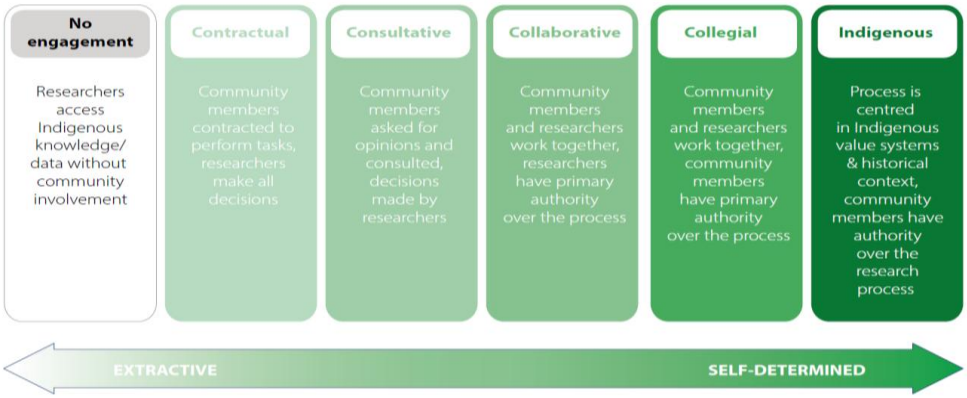

Figure 2.5. Spectrum of community engagement in scientific research. *Adapted from David-Chavez (2022), adapted from David-Chavez & Gavin (2018), Johnson et al. (2003) and Biggs (1989)**

Figure 4: Spectrum of community engagement in scientific research (UNESCO, 2023, adapted from David-Chavez & Gavin, 2018)

Hill et al (2012) also highlights issues of power, participation, and intercultural purpose when summarising the differences in types of Indigenous engagement in environmental management across four categories: Indigenous governed collaboration, Indigenous driven co-governance, agency driven co-governance, and agency governance. The level of power is expressed by the authority to make decisions, set rules, and decide on the value of resources. The level of participation highlights the prioritisation, or otherwise, of Indigenous peoples, organisations, and networks as participants within processes spanning from Indigenous institution building to stakeholder consultation. The level of intercultural purpose illustrates how the purpose of the project, the purpose of the Indigenous roles, the purpose of Indigenous development, and capacity building vary depending on the model of Indigenous engagement being applied.

	Indigenous-governed collaborations (IG)	Indigenous-driven co-governance (ICoG)	Agency-driven co-governance (ACoG)	Agency governance (AG)
Power sharing				
Decision making level and control	Decision making between Indigenous agencies; high Indigenous control	Decision making defined by Indigenous law and culture and partner requirements; substantial Indigenous control	Decision making by agency and Indigenous people according to agreed structures, typically committees; substantial agency control	Depends on specific project, usually agency controlled but local scale provides Indigenous input
Rules-definition	Rules defined by Indigenous organizations working together to shape contemporary Indigenous governance	Rules defined by Indigenous peoples as constrained by partner requirements	Rules defined by agency as constrained by legislative and policy recognition of Indigenous rights	Rules defined by agency constrained only by legally enforced Indigenous rights
Resource cultural values and property rights	Resources highly valued by Indigenous societies; rights may be defined/constrained but viewed as open to transformation	Resources of lesser value in industrial economy (hinterlands of first world economies); Indigenous property rights strong	Resources of contested value between industrial and Indigenous economies; Indigenous property rights defined and contained	Resources highly valued by industrial economy, e.g., water in heavily used systems; few Indigenous property rights
Participation				
Participatory processes and functions	Inclusivity that engages Indigenous people in new Indigenous institution building	Inclusivity that engages Indigenous people in new environmental institution building	Indigenous rights-based negotiation, e.g., for Native Title Acts, cultural heritage clearances	Participation through stakeholder mechanisms, e.g., committees, projects
Organizations engaged	Diverse Indigenous organizations at multiple scales	Diverse Indigenous and nonindigenous organizations at multiple scales	Government agencies and NGOs, with defined Indigenous roles, e.g., Land Councils	Government agencies and NGOs with defined environment management roles
Coordination	Cross-regional and cross-jurisdictional empowerment of Indigenous groups	Indigenous holistic place-based community empowerment	Whole-of-government coordination	"Silo", agency accountability for specific mandate
Intercultural purpose				
Environmental management project purposes	Overall purpose of strengthening Indigenous society through environmental management	Multiple purposes, reflecting Indigenous-centred holistic community planning	Multiple purposes, reflecting outcomes of negotiated agreements	Usually single or dual purpose, managing specific threats, species or areas
Purpose of Indigenous roles	Expression of inherent rights and responsibilities	Reconciliation, long-term, lasting resolution of issues	Equity plus recognition of specifically defined rights	Equity with other stakeholders in environmental management
Purpose of Indigenous development	Indigenous modernity, people resist, accommodate, and reshape interventions	Indigenous empowerment and community development	Human capability development, sustainable livelihoods through deployment of assets	Development as modernization and technology transfer
Capacity-building	Focus on building trust and relationships between diverse Indigenous groups	Focus on Indigenous and nonindigenous functionality in both Indigenous and settler society	Focus on Indigenous functionality in settler society and cross-cultural training for nonindigenous people	Focus on training Indigenous peoples to ensure functionality in settler-society

Table 4: Summaries of differences among types of Indigenous engagement in environmental management (Hill et al, 2012)

Te Kahui Raraunga (2021) differentiates levels of power and control along a Māori co-design continuum which has Māori motuhake *(Māori exclusive)* design at one end, Crown exclusive design at the other, and three different approaches to co-design in the middle. Across the continuum differences in characteristics associated with decision-making, process, resourcing, and risks are described. This is also reminiscent of the work of Cunningham (1999) which described differences between the characteristics of control, Māori participation, methods/tools, and analysis, across four types of research, science, and technology (research not involving Māori, research involving Māori, Māori centered research, kaupapa Māori research). Ruckstuhl & Martin (2019) addresses the issue of capacity building when collaborating at the innovation interface, where research, business, and Māori intersect. Using the underpinning model of absorptive capacity which highlights three key areas of skill development (technical capacity, human capacity, and relationship capacity), the team identified the types of knowledge and understanding scientists need to identify and apply in a manner that respects and resonates with Māori values and worldviews.

- The technical capacity to apply **mātauranga** *(Indigenous knowledge)* requires skilled recognition of the patterns of inter-relatedness to draw relevant understandings from Indigenous knowledge.
- The relational capacity to understand **tikanga** *(Indigenous protocols)* and guide the processes of interaction in culturally appropriate ways.

- The human capacity to support **kaupapa** *(Indigenous aspirations)* that Māori find relevant and align with broader social, cultural, environmental, economic, and spiritual outcomes.

This approach to capacity building was situated within a context that promoted Māori leadership in collaborative projects as a way to enhance Māori participation, Māori benefit, and the use of Māori knowledge (Ruckstuhl & Martin, 2019)

MĀTAURANGA [Technical capacity]	TIKANGA [Relational capacity]	KAUPAPA [Human capacity]
Recognise that	**Assimilate knowledge by**	**Apply knowledge to innovation kaupapa**
• Like science, mātauranga is a technically complex system that generates theories through practices and protocols. • Unlike science, mātauranga intertwines physical & metaphysical knowledge and the animate and inanimate in a system of relationality – **whakapapa** – that reflects and incorporates Māori **values and ethics** • Mātauranga pursues the esoteric (blue-skies) as in science, but its value is in the context of its eventual **collective utility** (within whānau, hapū, iwi).	• Incorporating Māori specialists (science and mātauranga specialists) in the upstream where possible/necessary and mid-stream development of the science • Utilising tikanga/protocols such as wānanga, use of te reo Māori, use of Māori places/spaces to develop/co-construct research and develop understanding of values/ethics • Ensuring that collectively-held knowledge/mātauranga/know-how is acknowledged and protected through formalised means (e.g. intellectual property clauses)	• Which will include Māori-identified commercial objectives alongside consideration of the social, cultural, environmental and spiritual impacts of the innovation • In a way that articulates entrepreneurial opportunities and risks from a Māori viewpoint • Acknowledging mātauranga as an opportunity to expand the set of options for novel science and innovation to benefit Māori

Table 5: A Māori perspective on absorptive capacity (Ruckstuhl & Martin, 2019)

The underlying importance of power, governance, and knowledge is also reiterated by Muhl et al (2023) when describing deep knowledge co-production in the context of coastal and marine systems. They identified five critical reflection points that create a deeper engagement and are "*a catalyst to shift the institutional relationships that govern power and knowledge*" (Muhl et al, 2023:14) through an analysis of international case studies where both Indigenous and scientific knowledge are used in research and partnerships to understand coastal and marine issues. First, recognizing diverse motivations that frame co-production processes, is an important step towards understanding how shared values and positive relationships support feelings of duty to the environment. Second, the way identities, positionality, and values influence and are influenced by governance contexts, will have an effect on the building of trust, relationships, and equitable governance arrangements. Third, highlighting governance capacity with respect to spatial and temporal constraints, as multifaceted tensions arise through the increased time and resources required for knowledge co-production. Fourth, institutional reforms necessary for knowledge co-production and the links to governance, highlight the value that formal legal or policy frameworks, political leverage points, and internalised learning bring to the exercise of knowledge co-production. Fifth, the relationship between information sharing, data sovereignty, and governance highlights how outputs enable and/or reinforce certain cultural discourses within governance settings, and care should be taken to balance the need to share information for learning and empowerment with the need for data sovereignty. The authors argue these five critical reflection points contribute towards building empowerment, equity, and a shared understanding of the system which leads to more effective outcomes.

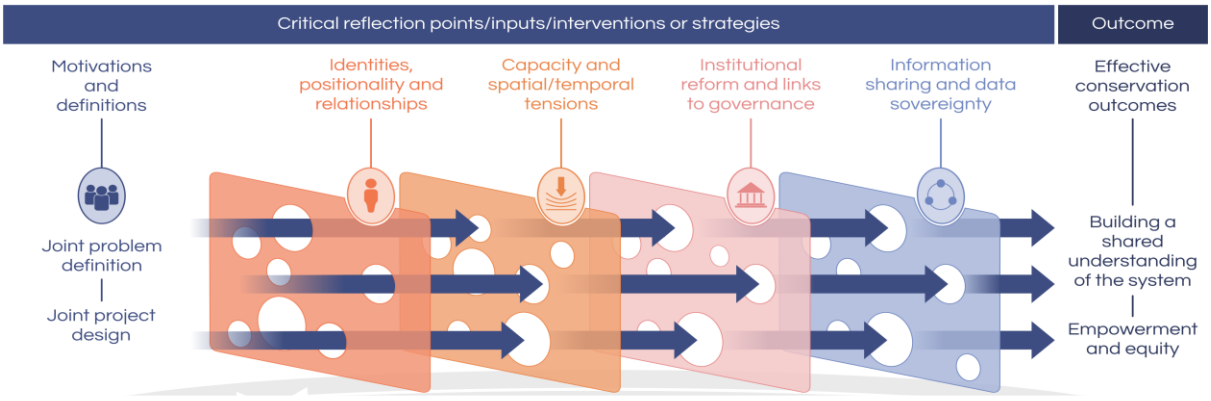

Figure 5: Critical reflection points and strategies for deep knowledge co-production (Muhl et al 2023)

While each of the examples above have been developed for different contexts, they all highlight features and characteristics you would associate with collaborative activities at the cultural interface which can contribute to more meaningful engagement and deep(er) knowledge co-production. The key point here is that the nature of the power dynamics between Indigenous groups and state agencies or research teams plays a critical factor in the way in which different activities and motivations can be expressed. It reinforces the notion that deep knowledge co-production, or the exercise of braiding Indigenous knowledge and science, is not a passive exercise in knowledge exchange but an active and shared engagement that also addresses issues of equity and empowerment. Keeping collaborative partners accountable is central to building trust and confidence as well as achieving positive outcomes. Addressing issues of authority, ensuring alignment, acting with integrity, and maintaining veracity will build trust and accountability between the partners, and reciprocity into the collaboration.

Reciprocity

Building trust, enhancing accountability, and improving equity are seen as important in the context of Indigenous peoples and the recognition and respect for their rights and relationships with data (Hudson et al, 2020a; Hudson et al, 2023). A report on Māori perspectives on public accountability identified four key factors associated with trust and confidence (Haemata Ltd, 2022):

- Trust is relational
- Trust is reciprocal
- Tikanga *(cultural protocol)* builds trust and confidence
- Power imbalances diminish trust

A relational science model for Indigenous research synthesizes Indigenous and community-based research protocols and frameworks for supporting Indigenous rights and reconciliation in research (David-Chavez et al, 2024). The core values promoted in the model are respect, integrity, humility, and reciprocity. The model identifies responsibilities, commitments and actionable methods, and resources aligned to these values that raise ethical standards and long-term relational accountability.

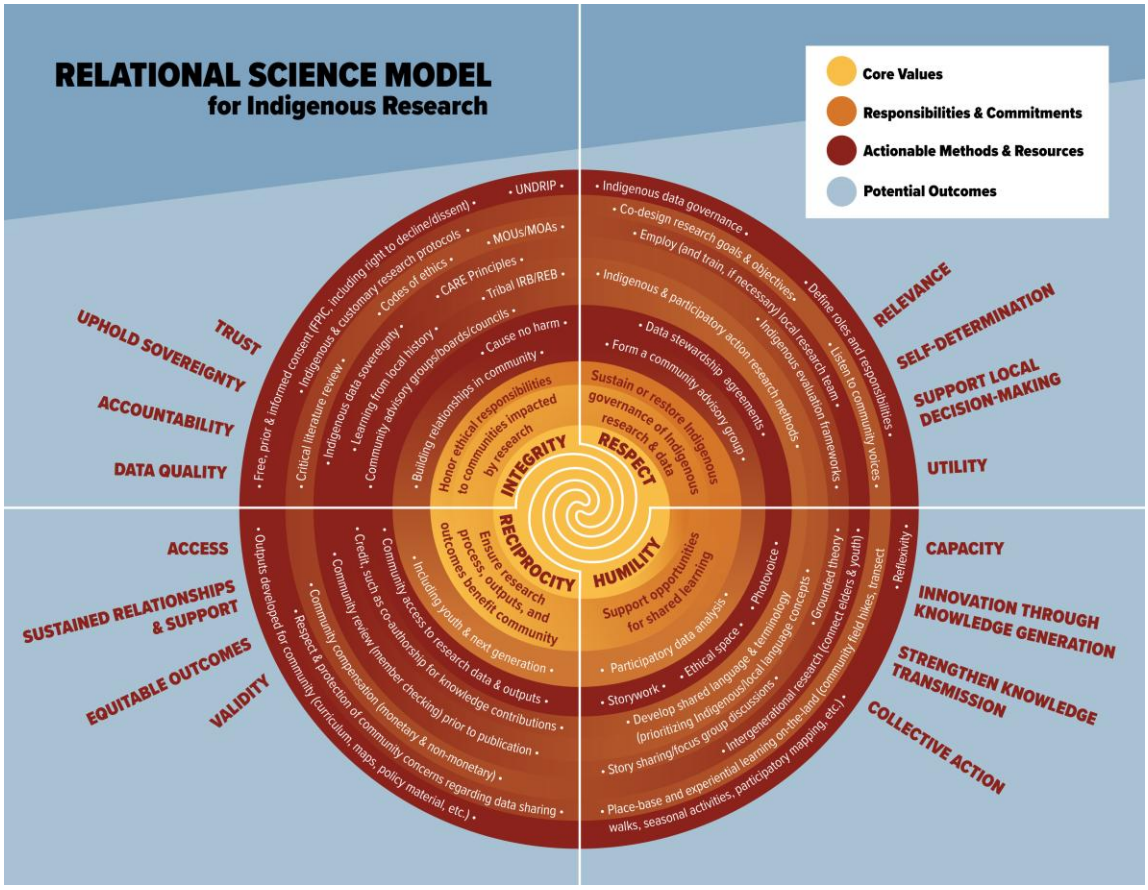

Fig 6: A relational science model (David-Chavez et al, 2024)

Reciprocity plays a vital role in maintaining balance and ensuring equity in the context of respectful relationships so provides a useful reference point for considering different facets of any collaboration. Respect, reciprocity, and relationality are reflected in a number of Indigenous philosophies (Wilson, 2008; Gould et al, 2023; David-Chavez et al, 2024; Menzies et al, 2024) including those of Māori, Kanaka Maoli, Lakota, and Ojibway (Lewis, 2023). Reciprocity implies a responsibility to do something in return over and above acknowledging the relationality or respecting different values and knowledges. Jacobs et al (2021; 2022) includes reciprocity as a key component of operationalising Indigenous values systems within marine conservation practices alongside relationship, responsibility, redistribution (merged with reconciliation), respect, relevancy, and rights. Reciprocity is deeply rooted in relationships and the responsibilities of humans to take care of one another and all lifeways (Jacobs et al, 2022). It is also reflected in contemporary endeavours, such as environmental projects and research collaborations, where reciprocal sharing of knowledges and shared learning practices between Indigenous and non-Indigenous peoples contribute to deeper relations between entities and individuals, enhance Indigenous participation, and the valuing of Indigenous knowledges (Corntassel, 2012).

The concept of reciprocity also has a deep history in European discourse particularly in the writings of the French sociologist Marcel Mauss (1925) about the nature of the gift which "*generated more debate, discussion, and ideas than any other work in anthropology*" (Graeber, 2001:152). Interestingly Mauss, who had socialist leanings, draws on the Māori concept of hau *(essence)* to frame his ideas about the entanglement between, gift-like properties of commodities and the commodity like properties of gifts, where exchange creates relationships with obligations requiring generosity and reciprocity. Graeber uses the terms open and closed reciprocity to reflect the expectations associated

with different types of exchange from open hospitality to careful accounting. Stewart (2017:1) provides a Māori critique of this as "*a clear example of Eurocentric appropriation of Indigenous knowledge: a concept extracted by social science from its authentic cultural context and re-inscribed within Western discourses of the modern academy*". She reexamines the source material, letters from Tamati Ranapiri to the cultural anthropologist Elsdon Best and concludes that Mauss read more into the interpretations than warranted, extrapolating specific elements of the concept for his purposes. This represents an interesting early example of braiding, attempting to blend Indigenous knowledge with socialist theory and philosophy, where the outcome provided significant contribution to academic discourse and ongoing reference to Mauss's 'the hau of the gift' but no real value to the Māori community. Te hau o te taonga has also been used in the context of Māori guidelines on genomic research which state "*Te hau o te taonga is concerned with the integrity of decisions about the use of the gift, ensuring respect for the spirit in which the gift was given and adhering to the parameters of consent*" (Hudson et al, 2016b:349). Here the sharing of biological samples and DNA is conveyed as the 'gifting of responsibility' with the receiver obliged to make decisions in accordance with the kawa *(principles)* and tikanga *(protocols)* outlined in the guidelines (Hudson et al, 2016c).

Cultural Reciprocity

The term cultural reciprocity has limited use primarily in the context of child and family behaviour to address issues of cultural diversity and generally describes the awareness of all levels of differences, addressing insensitivity to other cultures and processes of acculturation, and assuming a posture that allows professionals to more efficiently understand the needs of different cultures (Harry, 1997; Parette, 2005). It appears intermittently representing reciprocity and diversity of experiences in cross-cultural settings in other disciplines as diverse as professorial self-reflection (Lamont & Black-Branch, 1996) to Indigenous interactions with mining (Holcombe et al, 2022).

In the context of research and innovation, the term 'cultural reciprocity' describes a mutual commitment to the process of deep knowledge co-production. The dimensions of cultural reciprocity emerge from the Indigenous engagement factors which centre power, purpose, and participation (Hill et al 2012); the Māori absorptive capacities which focus on human, relational, and technical absorptive capacities (Ruckstuhl & Martin, 2019); and the core questions within the Te Ara Tika research ethics framework (Hudson et al, 2010a). Power is associated with control, purpose with motivation, and these can be related to the capacity to lead (rangatiratanga) and direct the intent or purpose of a project (kaupapa). Epistemology is associated with ethics and knowledge in particular the way in which communities are able to participate and make use of their own cultural protocols and knowledge within collaborations in ways that recognise the provenance of their contributions.

Indigenous Critical Theory	Indigenous Engagement Factors	Māori Absorptive Capacities	Te Ara Tika Questions	Dimensions of Cultural Reciprocity
Power	Power - Control	*Rangatiratanga - Leadership	Kei a wai te mana?	Cultural Authority
	Purpose - Motivation	Kaupapa – Human	He aha te whakapapa o te kaupapa?	Cultural Alignment
Epistemology	Participation - Ethics	Tikanga – Relational	Mā wai e manaaki?	Cultural Integrity
	*Provenance - Knowledge	Mātauranga - Technical	Me pehea e tika ai?	Cultural Veracity

Table 6: Foundations of cultural reciprocity

*These elements have been added to the original frameworks

It is envisaged that focusing on cultural reciprocity in the context of deep knowledge co-production will improve both the quality of engagement, through reflexive examination of power dynamics in the context of cultural authority and cultural alignment, and the quality of outcomes, by focusing on dimensions of cultural integrity and cultural veracity. The impact of increasing cultural reciprocity could be assessed through an increase in trust and accountability thereby increasing uptake and utility which enhances equity within society and contributes the vitality of Indigenous knowledge, reinforcing the principle of reciprocity and contributing to a virtuous cycle of knowledge exchange.

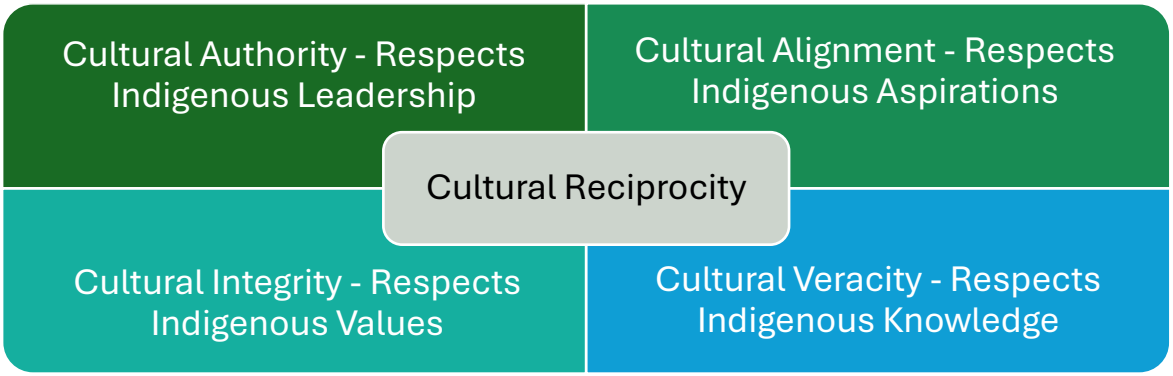

Figure 7: Dimensions of cultural reciprocity

Cultural Authority – Respects Indigenous Leadership

Ka rangaranga te muri, ka rangaranga te mua, nā Angaangarau, nā Tohearau[3]

Cultural authority refers to the recognition of the inherent rights and interests that Indigenous collectives have to be self-determining including in the use of Indigenous knowledge (IK) and Indigenous data. The recognition of cultural authority can be seen in the level of control and decision-making power, Indigenous governance of Indigenous resources including data, as well as rules and process definition. Free, Prior, Informed Consent (FPIC) is an important concept in this space and while it could be considered that permission has already been provided for collaborative initiatives there may be specific activities that also require forms of collective or individual consent. In a Māori context

[3] In front and from the rear we are united by the multitude of Chiefs of Whakatōhea

cultural authority relates to the question 'kei a wai te mana?[4]' which might be led by mana whenua *(those with authority over the land)* or iwi/hapū *(tribe/sub-tribe)* in some contexts, tangata whenua *(people of the land)* or Māori groups in others. Rangatiratanga has relevance in this context as leadership represents the act of rāranga *(weaving)* in relation to a tira *(group).* The key attributes of cultural authority at the cultural interface are project governance, resource governance, data governance, and rules/process definition.

Authority Attributes	Description
Project governance	Indigenous groups are actively involved in setting the agenda and directing the project through governance and decision-making roles. Project may be Indigenous led, Indigenous directed, researcher directed, or researcher led.
Resource governance	Indigenous groups are engaged/supported into positions that enable Indigenous control of Indigenous resources.
Data governance	Indigenous groups are actively involved in decisions about use of Indigenous knowledge and Indigenous data and have formal roles in data governance including how issues of Indigenous data sovereignty and intellectual property will be addressed.
Rules & process definition	Indigenous groups have the authority to define the parameters of the project including rules of engagement and operational processes.

Table 7: Cultural authority attributes

Cultural Alignment – Respects Indigenous Aspirations

He aha te mea nui o te ao, he tangata, he tangata, he tangata[5]

Cultural alignment relates to the establishment of a common purpose including the motivation to engage and produce beneficial outcomes for communities. Cultural alignment is present when the needs of various collaborative partners have been discussed and there is clarity about the shared kaupapa *(purpose)*, primary intercultural purpose as well as secondary outcomes. In a Māori context cultural alignment relates to the question 'He aha te whakapapa o te kaupapa?'[6] which highlights the genesis of the initiative and the intent to align the project's purpose to address issues of equity and empowerment. The key attributes of cultural alignment relate to defining the purpose of the project, the purpose of Indigenous roles, and clarity about the contribution of the project to Indigenous development and capacity building.

Alignment Attributes	Description
Project purpose	Project is led by Indigenous aspirations with clearly stated aims.
Indigenous roles	Project is clear about the roles of Indigenous members in governance and operations.
Indigenous development	Project contributes directly to Indigenous outcomes and development needs.
Indigenous capacity building	Project builds capacity of Indigenous participants and/or Indigenous institutions.

Table 8: Cultural alignment attributes

[4] Who has control?
[5] What is the most important thing in the world? It is people!
[6] What is the genesis of this project?

Cultural Integrity – Respects Indigenous Values

He kitenga tangata, he hokinga mahara, he koanga ngakau[7]

Cultural integrity relates to the ethics of engagement and the protocols established to maintain good relationships. Cultural integrity is evident when engagement processes at the interface are consistent with cultural protocols and support ethical expectations. This includes addressing issues like Indigenous data sovereignty, privacy, and security as well as protocols for appropriate acknowledgement, attribution, authorship, and access to data. In a Māori context cultural integrity relates to the question 'Ma wai e manaaki?'[8] which brings a focus to maintaining functional and productive relationships. The key cultural integrity attributes are community engagement, Indigenous ethics, data access and use, and recognition.

Integrity Attributes	**Description**
Community engagement	Ensures appropriate participation of Indigenous community members and Indigenous knowledge holders in research activities.
Indigenous ethics	Respects cultural protocols that enable culturally appropriate research practices and use of Indigenous methods.
Data access & use	Develops protocols that respect individual and collective privacy and ensure Indigenous knowledge and data are managed with appropriate care including who has the right to access and use Indigenous knowledge.
Recognition	Respects protocols that support appropriate acknowledgement, attribution, and authorship of Indigenous participants.

Table 9: Cultural integrity attributes

Cultural Veracity – Respects Indigenous Knowledge

Te tūturutanga mahi pono o te Māori mana motuhake[9]

Cultural veracity relates to how credible and trustworthy the outputs from collaborative activities or knowledge co-production are viewed. Cultural veracity is present when research outputs acknowledge the provenance of Indigenous knowledge, have a coherence with the foundational Indigenous worldview, are used in an appropriate context, and resonate with Indigenous communities. Issues of verification, disingenuity, appropriation, and provenance are important here and are primarily addressed by ensuring participation of communities when their Indigenous knowledge is used as an input in research. In a Māori context the words that most closely relate to veracity are tika or tōtika which can mean accurate or correct, pono which can be translated as truth, and tūturu, which can mean true and authentic. Cultural veracity can be associated with the question 'me pehea e tika ai?'[10] which interrogates the process of analysis and interpretation of Indigenous knowledge and transformation into new insights. The key cultural veracity attributes at the cultural interface relate to provenance, context, Indigenous logics and language, and Indigenous review.

[7] A familiar face stirs one's memories and emotions
[8] Who will look after the people?
[9] Let God be your spearhead and achievement will follow is true Māoridom in action
[10] How will it be done in a correct manner?

Veracity Attributes	Description
Provenance	Indigenous knowledge is gathered from the correct sources and the project is transparent about this and provides appropriate acknowledgement on outputs and in public settings.
Context	Indigenous knowledge is used in the right context for the right reason and is identified, analysed, and interpreted in an appropriate manner.
Indigenous logics & language	Project outputs make appropriate use of cultural logics and cultural cues when reporting findings and engaging in knowledge exchange activities.
Indigenous review	Project outputs have been sense-checked by Indigenous communities and the messages and language are appropriate.

Table 10: Cultural veracity attributes

Conclusion

The Cultural Reciprocity Framework is intended to enable deep knowledge co-production and support an improvement in the quality of engagement between researchers and Indigenous communities and the quality of outputs generated in research that braid Indigenous knowledge and science. The dimensions and attributes within the Cultural Reciprocity Framework are clearly aligned with the literature on Indigenous research and Indigenous engagement and the framework provides a structured format for evaluating specific projects. The dimensions of cultural authority and cultural alignment bring specific attention to the power dynamics in the collaboration. The dimensions of cultural integrity and cultural veracity focus attention on the epistemological lens that gets prioritised in the knowledge co-production process. As Hudson et al (2010b:54-55) state "*the resilience of a cultural knowledge system is dependent on its ability to respond to transformation and change, to adapt and explain new phenomena in a way that retains a sense of resonance and coherence with the existing philosophies and psychologies of their own system*".

Relationality and interconnectedness inform Indigenous understandings of the world and are also present in the social and political relationships between different groups, cultures, and societies. The cultural interface represents the site of engagement between the respective experts in Indigenous knowledge and science where the aim is to create more meaningful engagement and exchange through deep knowledge co-production when braiding Indigenous knowledge with scientific knowledge. A focus on cultural reciprocity builds trust and accountability thereby increasing the level of uptake and utility in the research outputs and contributing to broader outcomes to increase the vitality of Indigenous knowledge and equity in society.

Section 1: Locally Focused Projects

Chapter 4: Optimising the Māori in Māori Economic Development

This chapter focuses on a paper produced as part of the Ngā Pae o te Maramatanga funded project 'Whakatipu rawa ma ngā uri whakatipu: Optimising the Māori in Māori Economic Development' (Awatere et al, 2017). The project focused on identifying the characteristics that make a distinctive Māori approach to economic development. The Whakatōhea Māori Trust Board (WMTB) participated as one of the case study examples that the project explored. The Whakatōhea case study revolved around their investments in open ocean aquaculture and the role that iwi values have in the decision-making process.

In 2017 Whakatōhea was in the process of actioning a series of big visions designed to bring a brighter future to the iwi and the local community. First, Whakatōhea Mussels Ōpotiki Limited had been established to operationalise the 3800-hectare open ocean aquaculture space consented by Eastern Seafarms Ltd, a company majority owned by the WMTB. Second, Treaty Settlement negotiations had started again after a 20-year hiatus and had resulted in the signing of an Agreement in Principle (AIP) which included the reservation of an additional 5000 hectares of marine space to support Whakatōhea's aquaculture aspirations. Third, alongside the Ōpotiki District Council, the Whakatōhea Māori Trust Board was advocating for an Ōpotiki harbour development that would create an all-weather entrance into the river mouth. To realise the aquaculture opportunities provided by the consented space significant investment was required in both the mussel and harbour development projects. In the absence of investment capital, the Whakatōhea Māori Trust Board had to look for partners to lead these projects and identify ways to maintain influence over the direction of these projects.

The WMTB had experience of dealing with the outcomes of bad investments. Over many years legacy investments had been advanced by individuals without robust diligence or consideration of how it provided balance to the portfolio or aligned with the strategic direction of the board. This was compounded by the limited investment experience across the board's members and general reliance on advisors. This project interviewed members of the WMTB to explore how they thought the board's values influenced their decisions about investments. The project identified value level measures and investment level measures for each of the WMTB values (rangatiratanga, kaitiakitanga, manaaki ki te tangata, whānaungatanga, and matawhānui).

Value	***Value level measures***		***Investment level measures***	
Rangatiratanga	Cultural authenticity		Number of seats on Board	
	Influence		Equity position	
	Financial independence		Return on investment	
Kaitiakitanga	Sustainability		Eco-friendly infrastructure	
	Participation		Environmental monitoring	
Manaaki ki te tangata	Iwi/whānau benefit		Capability development	
	Hospitality		Social dividend	
Whānaungatanga	Relationships		Partnership agreements	

	Support		Equity & access	
Matawhānui	Intergenerational impacts		Long term forecasts	
	Social impact		Social impact analysis	

Table 11: Whakatōhea investment tool

How this project contributed to the development of the Cultural Reciprocity Framework

Developing the Whakatōhea Investment Tool required active engagement with board members and highlighted the importance of cultural authority and how their values helped to identify the different dimensions and attributes. Rangatiratanga reflected expectations around project governance, and kaitiakitanga is aligned to resource governance. Manaaki ki te tangata and whānaungatanga give importance to cultural alignment and cultural integrity particularly in relation to Indigenous development, Indigenous capacity building, community engagement and Indigenous ethics. Matawhānui informs aspects of data governance, access and use, as well as provenance. The exercise in identifying both value measures and investment measures highlighted the importance of rules definition as well as context and the use of Indigenous logics. The importance of attributes of cultural veracity were also reinforced through the Indigenous review process.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- As a science institution led project there was limited control over the project however the case study process had a higher degree of independence.
- Cultural authority was represented through control of the research process for the case study. Limited resources were available for the project.
- Cultural alignment was present across the purpose, the use of an iwi researcher, and the usefulness of the project for investment discussions taking place around aquaculture.
- Cultural integrity was addressed as the iwi researcher was able to use culturally appropriate protocols for engagement with the board and ensure recognition of contributing parties.
- Cultural veracity was an important part of making the investment tool relevant to the WMTB and this was reinforced by recognising provenance, applying iwi values to the context, and using Indigenous logics to inform the tool which was reviewed by the WMTB members and the CEO.

Project: Optimising the Māori in Māori economic development looked at Māori case studies of economic development including a focus on the emerging Whakatōhea aquaculture developments		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	N	Project was funded by Ngā Pae o te Maramatanga and led by Landcare Research. Whakatōhea was a case study site.
Resource governance	Y	The project looked at areas of aquaculture where Whakatōhea have development rights (Eastern Seafarms).
Data governance	N	The project didn't generate data but created a tool which Whakatōhea could use to guide decision-making.
Rules & process definition	M	Project was developed by Manaaki Whenua Landcare Research. Whakatōhea had some control over the focus and process used for the case study.
Cultural Alignment		
Project purpose	M	Whakatōhea had interest in supporting economic development in their rohe and aquaculture was one of the key platforms.
Indigenous roles	Y	Whakatōhea researcher led the Whakatōhea case study.
Indigenous development	M	Engaging WMTB governance members in this project prompted different kinds of discussions.
Indigenous capacity building	N	Beyond research activities there was no active capacity building.
Cultural Integrity		
Community engagement	Y	Direct engagement with the WMTB members and key stakeholders in the Whakatōhea aquaculture space.
Indigenous ethics	Y	Tikanga guided engagement and sharing of written outputs with the WMTB.
Data access & use	N	No data was generated through the project.
Recognition	M	WMTB was acknowledged in the report.
Cultural Veracity		
Provenance	M	Mātauranga used in the report was associated with Whakatōhea.
Context	Y	Whakatōhea values and their understanding of them was shared in the context of economic development.
Indigenous logics & language	Y	The investment decision-making tool utilises Whakatōhea values and provides a structured way to capture these discussions.
Indigenous review	M	The Whakatōhea Investment Tool was reviewed by the WMTB governance group and management team.
Impact: Moderate - Academic interest in the tool through the paper that was written. Some use within the Whakatōhea Māori Trust Board but they had limited opportunities for investment which is about to change through the 2024 Treaty Settlement. Opportunities to utilise more meaningfully in the post settlement phase.		

Table 12: Cultural reciprocity framework – Optimising the Māori in Māori Economic Development

Chapter 5: Whakatōhea Transformation Framework

This chapter describes a project funded by Ngā Pae o te Maramatanga that focused on iwi development, particularly the transition from trauma to transformation. It was led by Professor Linda Tuhiwai Smith who brought her experience with Indigenous communities and their development pathways to the project. The Transformation Framework was based around a series of steps including reconciliation with society, regenerating culture, intergenerational development, and practising hospitality. They were enabled by building leadership, capacity, capability, community engagement, whānau, and collective decision-making. The project involved a series of case study projects targeting different steps of the framework including:

- Reconciliation with Society – Healing from Trauma (Raupatu),
- Regenerating Culture – Cultural Development Strategy,
- Intergenerational Development – Whenua Assessment, and
- Practising Hospitality – Whakatōhea Celebration.

Figure 8: Whakatōhea transformation framework (Te Arawhiti, 2023)

The project was conducted while Whakatōhea were in the middle of their Treaty of Waitangi negotiations process. This was a contentious and traumatic process for the iwi, not only from living with the effects of the raupatu *(land confiscation)* and colonisation, but also the failed attempt to settle two decades earlier. While members of the iwi were engaged in negotiations with the Crown and facing challenges through the Waitangi Tribunal, efforts were being made to address the practical issues facing whānau and to build trust and resilience. The Whakatōhea Transformation Framework emerged from the project and was used by the Whakatōhea Māori Trust Board to inform development projects particularly in the areas of regenerating culture and intergenerational development. The Whakatōhea

Presettlement Claims Trust (WPCT) used the framework within the treaty negotiations, and it was included as a central part of the relationship agreements between Whakatōhea and Crown agencies[11].

How this project contributed to the development of the Cultural Reciprocity Framework

The primary focus of the project on Indigenous development and Indigenous transformation is reflected across the different dimensions of cultural reciprocity. The self-determination element reinforces cultural authority and cultural alignment, and processes of reconciliation and practising hospitality are grounded in cultural integrity. Similarly, cultural veracity is necessary for re-generating culture. The importance of building different capacities, as reflected in the Whakatōhea Transformation Framework, translates into the need to identify different skills and/or attributes. The attributes that were directly informed by this project include project governance, project purpose, Indigenous roles, Indigenous development, Indigenous capacity building, community engagement, recognition, contexts, and Indigenous logics and language.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- An institution led project with a single focus on Whakatōhea allowed for a higher degree of control over the project.
- Cultural authority was represented through control of the research process for the case study. Limited resources were available for the project.
- Cultural alignment was present across project purpose, the use of an iwi researcher, and the usefulness of the project for investment discussions taking place around aquaculture.
- Cultural integrity was addressed as the iwi researcher was able to use culturally appropriate protocols for engagement with the board and ensure recognition of contributing parties.
- Cultural veracity was an important part of making the transformation framework relevant to Whakatōhea and this was reinforced by recognising provenance through place names, applying iwi values to the context, and using Indigenous logics to inform the tool which was reviewed by the WPCT members and the CEO of the WMTB.

[11] https://www.tearawhiti.govt.nz/assets/Treaty-Settlements/FIND_Treaty_Settlements/Whakatohea/DOS_documents/Whakatohea-Documents-Schedule-27-May-2023.pdf

Project: Whakatōhea Transformation Framework project explored Indigenous processes for moving from a state of trauma to a state of transformation		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	Ngā Pae funded project led by Prof Linda Smith out of Te Kotahi Research Institute. Supported iwi researchers with multiple case studies.
Resource governance	M	The case studies focused on areas where Whakatōhea has some influence or control over the resources in those spaces.
Data governance	M	No specific datasets were generated. Some data relevant to case studies was under the control of WMTB.
Rules & process definition	Y	Whakatōhea were able to determine the focus and process for investigating the various case studies.
Cultural Alignment		
Project purpose	Y	Project was co-developed with Whakatōhea and came at a time when treaty settlement processes were being considered.
Indigenous roles	Y	Whakatōhea researchers supported the project. Iwi researchers conducted the work in the case studies.
Indigenous development	Y	Drew on Prof Smith's experience in other Indigenous community settings and reinforced the importance of research in supporting development activities.
Indigenous capacity building	Y	Project provided space for discussions and building understanding and knowledge in the community
Cultural Integrity		
Community engagement	Y	Direct engagement with the community around each of the case studies.
Indigenous ethics	Y	Whakatōhea protocols guided engagement.
Data access & use	M	Project didn't generate datasets but information remained with Whakatōhea.
Recognition	Y	Whakatōhea was recognised as the primary contributor.
Cultural Veracity		
Provenance	Y	Whakatōhea ensured the right information was accessed from the right people.
Context	Y	The context for the use of the information was decided by Whakatōhea.
Indigenous logics & language	Y	Iwi researchers ensured the report made sense to the Whakatōhea community and created the Whakatōhea Transformation Framework.
Indigenous review	Y	The Whakatōhea Transformation Framework was reviewed by the research team, the iwi partners, and the community.
Impact: **Significant** – Language and insights from the project have been used to guide strategy development for the WMTB and also for the negotiations strategy for the Whakatōhea Settlement. The Whakatōhea Transformation Framework is embedded in the Settlement Relationship Agreements with Crown agencies. https://www.tearawhiti.govt.nz/assets/Treaty-Settlements/FIND_Treaty_Settlements/Whakatōhea/DOS_documents/Whakatōhea-Documents-Schedule-27-May-2023.pdf		

Table 13: Cultural reciprocity framework – Whakatōhea transformation framework

Chapter 6: Aotearoa Local Contexts Pilot Project

This chapter describes Whakatōhea's participation in a Te Puni Kōkiri (TPK) funded project exploring the use of Traditional Knowledge Labels which was illustrated in a film 'E Kore Au e Ngaro' (Burgess et al, 2023). Whakatōhea have been proactively engaging with research organisations to support their activities, particularly in aquaculture and cultural development spaces, often contributing mātauranga Māori into these collaborations. Discussions about cultural intellectual property and Māori data sovereignty circulated around these projects and highlighted the challenge of protecting mātauranga Māori when they were wanting to participate in processes that facilitated sharing both data and knowledge.

Having become a co-director of Local Contexts I was in the position to share the potential usefulness of the Traditional Knowledge (TK) and Biocultural (BC) Labels with the Whakatōhea Māori Trust Board. The Whakatōhea Māori Trust Board has developed a Digital Hub where it was supporting digital literacy and building coding capacity in the community. They were also working with the School of Computer & Mathematical Sciences at the University of Waikato to build a Whakatōhea digital archive, a waiata app, and a hikoi app. The Cultural Development Manager, who was also responsible for the Digital Hub, managed Whakatōhea's participation in the pilot project which also involved Te Roroa, and Ngāti Maru ki Taranaki. Whakatōhea were also able to leverage additional funding from the Ministry of Culture and Heritage to work with Ngā Taonga Sound and Vision and repatriate Whakatōhea cultural heritage recordings back into its digital archive.

The project team developed a number of resources to build understanding about the purpose and use of the labels and hosted a Traditional Knowledge Labels wānanga for community members. At the wānanga the participants learnt about intellectual property, Indigenous data sovereignty, Local Contexts, and the TK/BC Labels. They also co-produced the text for each of the labels and discussed potential applications on digital and physical materials. With some community understanding and support for the use of the labels in place the Digitech team started applying them to a range of contexts including: Digitised archival records, songs, and recordings from Ngā Taonga, Whakatōhea Waiata App, Whakatōhea Digital Archive, Whakatōhea Historical Account, Whakatōhea Moana Plan, and Manaaki Whenua's Systematics Collections Database. Whakatōhea's application of Biocultural Labels in the context of the Moana Project and with Manaaki Whenua became the focus of a Local Contexts Film 'E Kore Au e Ngaro'.

How this project contributed to the development of the Cultural Reciprocity Framework

The Local Contexts initiative is focused on using labels to bring Indigenous cultural authority back into digital records and manifest in more active participation in data governance as it relates to the access and use of traditional knowledge, cultural heritage, and biocultural resources across a wide range of institutional settings. This work highlights the importance of all the dimensions of cultural reciprocity, reinforcing cultural authority, ensuring cultural alignment, making transparent the conditions for cultural integrity, and enabling cultural veracity. Several attributes align with the key areas of provenance, protocols and permissions, that the labels cover in particular, data governance, rules and definitions, project purpose, community engagement, Indigenous ethics, data access and use, recognition, provenance, context, Indigenous logics and language, and Indigenous review.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- The high level of independence was created in part because Whakatōhea were able to leverage direct resourcing aligned to the project which allowed them to assert a greater level of cultural authority over the project.

- Cultural authority was represented in resource governance and rules and process definitions
- Cultural alignment was present across all the domains as the project focused on building capacity within Whakatōhea to address issues of intellectual property (IP) and Indigenous data sovereignty (IDSov).
- Cultural integrity was maintained across all areas as Whakatōhea were able to run the project in a manner consistent with their cultural values and they are acknowledged as key contributors and example of community engagement.
- Cultural veracity is central to the use of labels and directly addresses the different criteria.

This project has had a significant impact supporting initiatives within Whakatōhea and providing an exemplar for other communities around the world. Whakatōhea members have spoken at three of the Local Contexts Summits and are profiled in the Local Contexts Film. Whakatōhea use the labels to assert Māori data sovereignty over data and materials in a variety of places and had them included in the Whakatōhea Treaty Settlement Act.

Figure 9: Whakatōhea pānui for Traditional Knowledge Labels wānanga

Project: Aotearoa Local Contexts Pilot Project working with Whakatōhea, Te Roroa, and Ngāti Maru ki Taranaki to apply TK and BC Labels to collections		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	N	Funding and project was managed out of Te Kotahi Research Institute.
Resource governance	Y	The project worked alongside Manaaki Whenua and identified physical specimens in their collections that came from the Whakatōhea rohe. Subcontract funds were the responsibility of Whakatōhea and they leveraged additional direct resourcing.
Data governance	M	Whakatōhea BC Labels were applied to records on the Systematics Collection Database. As open data it isn't direct governance but the labels express Whakatōhea aspirations for appropriate use.
Rules & process definition	Y	Whakatōhea develop their own process for community engagement around the use of the labels.
Cultural Alignment		
Project purpose	Y	The Whakatōhea digital strategy and DigiTech hub are creating material using mātauranga. Protecting that knowledge is important.
Indigenous roles	Y	Project lead was from Whakatōhea and Cultural Manager was key contact within Whakatōhea case study.
Indigenous development	Y	Project created tools (labels) which can be used in a variety of contexts and settings.
Indigenous capacity building	Y	Training resources were developed for the project and workshops held with key staff and community members around IP, IDSov, and Labels.
Cultural Integrity		
Community engagement	Y	Engagement with WMTB and staff. Discussions with Taumata kaumatua and then workshops with community members.
Indigenous ethics	Y	Whakatōhea values informed workshop processes and the customisation of the Labels.
Data access & use	Y	Whakatōhea control access to their account on the Local Contexts Hub and decide where the Labels get applied.
Recognition	Y	Whakatōhea applications of the labels are profiled on Local Contexts website and shared in numerous gatherings.
Cultural Veracity		
Provenance	Y	The provenance of Whakatōhea labels is recorded and has been acknowledged in film and print.
Context	Y	In the film it is Whakatōhea members that speak to the work that was completed through this project. Labels are being used in multiple places including a Waiata App.
Indigenous logics & language	Y	The labels reflect Indigenous logics and communicate important values in their own words. The labels were translated into Māori and sign language.
Indigenous review	Y	Labels were reviewed by the community members as they were being customised and were then actioned by the Whakatōhea Digitech team.
Impact: **Major** - The Whakatōhea Labels are complementary to the activities of the WMTB and the Digitech Hub. They have been applied to material in the Whakatōhea Digital Library, Whakatōhea Waiata App, the Whakatōhea Moana Plan, the Whakatōhea Historical Account, and are referred to in the Whakatōhea Treaty Settlement legislation. The Whakatōhea use-case is promoted widely around the world in relation to recognising Indigenous interests in biospecimens as part of the Local Contexts Film https://localcontexts.org/films/the-connection-remains/ and through various presentations.		

Table 14: Cultural reciprocity framework – E kore au e ngaro

Section 2: Nationally Focused Projects

Chapter 7: Te Ara Tika Guidelines for Māori Research Ethics

This chapter describes the development of the Te Ara Tika Guidelines for Māori Research Ethics which were released in 2010 (Hudson et al, 2010a; Hudson et al, 2016a). The Te Ara Tika Guidelines were drafted by the writing group established by Pūtaiora, an informal network of Māori members of ethics committees who had been convening meetings to discuss the topic of Māori ethics. I had joined the Pūtaiora discussions after completing a master's thesis on He Matatika Māori: Māori and Ethical Review in Health Research (Hudson, 2004a).

The issue of Māori ethics in research had been percolating for the previous two decades (Hudson et al 2010a) and was closely linked to the 'by Māori for Māori' aspirations of the kaupapa Māori movement. Ethics committees were seen as gatekeepers in the research context, both facilitating and limited different types of research, and as such became a site for exploring how it might contribute to decolonising research practices. This involved discussions about kawa and tikanga, traditional Māori ethics, critiques of western ethical principles, and the interface between the two approaches. The project was supported by the National Ethics Advisory Committee (NEAC), the Health Research Council of New Zealand (HRC), and Ngā Pae o te Maramatanga (NPM), Māori Centre of Research Excellence. NEAC had commissioned a literature review on Māori research ethics which it eventually published in 2012 (NEAC, 2012).

The purpose of the framework was to explain key ethical concepts for Māori; support decision-making around Māori ethical issues; identify ways to address Māori ethical concerns; and clarify the kaitiaki roles of Māori ethics committee members. The development of the Te Ara Tika framework became an exercise in braiding together the aspects of both sets of principles that retained relevance for Māori in the context of research ethics. Tikanga Māori, and its philosophical base of mātauranga Māori, provided the foundation but it also drew on the Treaty of Waitangi, Indigenous values, and Western ethical principles. The four key concepts in the framework (whakapapa, mana, tika, manaakitanga) arose through compelling practical and conceptual logics. They were the basis for practical questions communities could ask researchers about their proposed projects:

- He aha te whakapapa o tēnei kaupapa? What was the genesis of this project?
- Kei ā wai te mana mō tēnei kaupapa? Who has control over the project?
- Me pehea e tika ai tēnei kaupapa? How will it be done correctly?
- Mā wai e manaaki tēnei kaupapa? Who will ensure respect is maintained?

They could also be aligned to a subset of the existing Western ethical principles, ones that were formally mandated through National standards documents. Interestingly alignment occurred around principles like justice, equity, social and cultural responsibility, ones which tend to be assessed at a collective level. Individually mediated principles, such as autonomy and informed consent, were located within the framework rather than being foundational components. Te Ara Tika is an example of braiding Indigenous values with western values at the cultural interface of research ethics.

How this project contributed to the development of the Cultural Reciprocity Framework

Te Ara Tika was a response to concerns that Māori members of ethics committees had about the cultural appropriateness of research practices. It was expected that researchers would have greater respect for Māori values, recognise the importance of Māori knowledge, and demonstrate more reciprocity in terms of benefits to Māori communities. The key concepts highlighted the importance of cultural authority (mana), cultural integrity (manaaki), and cultural alignment (tika). It also anticipated different behaviours for different types of research depending on whether it is mainstream, Māori focused, or kaupapa Māori.

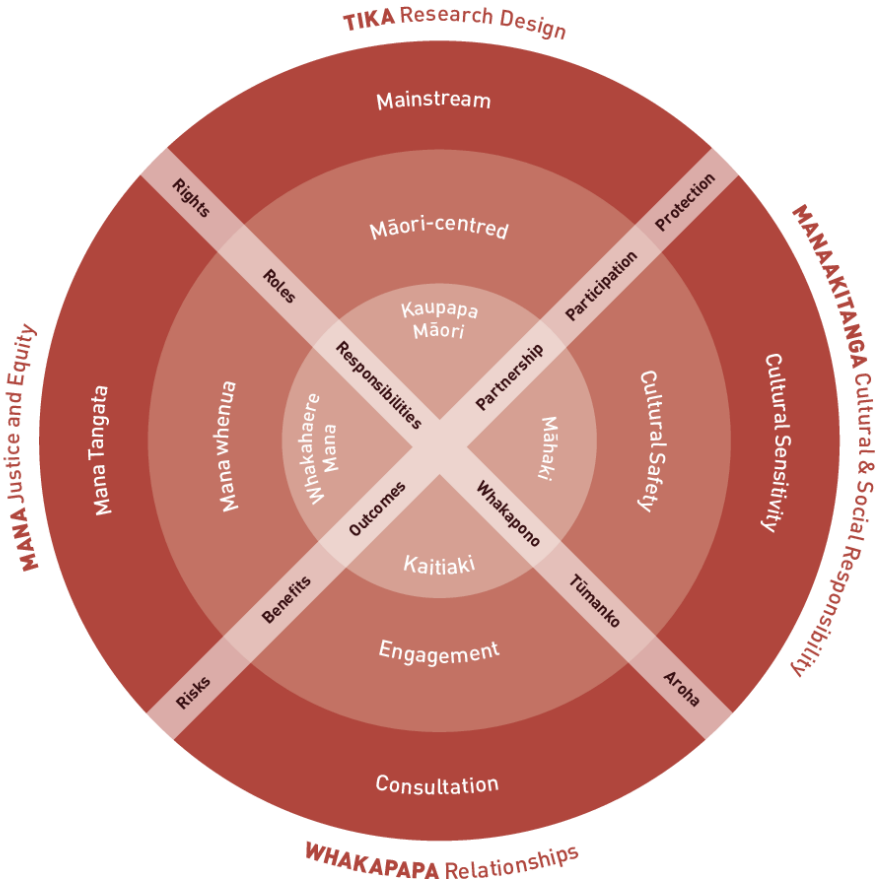

Figure 10: Te Ara Tika framework (Hudson et al 2016b)

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- As an Indigenous led kaupapa Māori project a greater level of control over the project and processes was present, even though limited resources were available for it.
- Cultural authority was represented through control of resources, and control of the research process.
- Cultural alignment was present across project purpose, the wholly Indigenous writing team, and the focus on capacity building.
- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement, ethics, and recognition of contributing parties
- Cultural veracity was a key part of the project, and we incorporated provenance, context, and Indigenous logics into the development of the guidelines. Formal open review by Māori researchers was conducted before being finalised for publication.

The impact of this project is rated major because once published, the Te Ara Tika framework was immediately given relevance by being appended to the Guidelines for researchers on health research involving Māori (Health Research Council of New Zealand, 2010), required reading for people applying for ethics approval from Health and Disability Ethics Committees. The Te Ara Tika Guidelines can be found on numerous institutional websites and were utilised in the development of Te Mata Ira Guidelines for Genomic Research with Māori (Hudson et al, 2016a). The Te Ara Tika principles were adopted alongside bioethics principles as New Zealand's ethical principles in the National Ethical Standards for Health and Disability Research and Quality Improvement published in 2019 (National Ethics Advisory Committee, 2019).

Te Ara Tika Guidelines for Māori Research Ethics: This document outlines a framework for addressing Māori ethical issues within the context of decision-making by ethics committee members. It brings together Māori ethical concepts, Māori ethical issues, and western bioethical principles.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	Indigenous led - Pūtaiora was a name for Māori members of ethics committees that met to discuss Māori ethical issues. They formed the writing group but had support from NEAC, HRC, and NPM.
Resource governance	N	Limited resources available for this project. In-kind contributions from authors.
Data governance	NA	Guidelines are open access. No ongoing data considerations.
Rules & process definition	Y	The writing group had full control over the development process.
Cultural Alignment		
Project purpose	Y	Pūtaiora expressed a need for more guidance on Māori ethics to inform both researchers and research ethics committees.
Indigenous roles	Y	The Pūtaiora writing group was made up of Māori members of ethics committees with a diverse set of ethical and cultural expertise.
Indigenous development	Y	Ethics committees were seen as gatekeepers in the research process which restricted Māori research and enabled the continuation of culturally inappropriate research practices.
Indigenous capacity building	Y	Developed guidelines to specifically assist with capacity building for both Māori communities and ethics committees.
Cultural Integrity		
Community engagement	Y	Writing group engaged with Pūtaiora (Māori network of ethics committee members) and Māori researchers. Process was supported by Māori members of NEAC, HRC, and NPM.
Indigenous ethics	Y	The writing group used cultural protocols as necessary to guide the process which directly focused on Māori ethics.
Data access & use	NA	The writing group did not generate datasets beyond the guidelines. NEAC had published a lit review on Māori ethics that informed the process.
Recognition	Y	The writing group were listed as authors and acknowledgements made to the supporting organisations.
Cultural Veracity		
Provenance	Y	The framework drew on traditional Māori ethical concepts, contemporary Māori rights, and Western ethical principles Indigenous knowledge was sourced from experts in Māori ethics and mātauranga Māori and their wider networks.
Context	Y	The writing group identified the right information within the body of mātauranga Māori to inform the framework
Indigenous logics & language	Y	The framework uses Māori concepts, drawn from questions that communities would ask researchers, to frame both western ethical principles and the Māori ethical issues
Indigenous review	Y	The framework was reviewed by Māori researchers, the broader Pūtaiora network, members of Māori Health Committee of the HRC, NPM, and NEAC before being finalised. It was published as an independent document and an appendix to the Guidelines for Māori Health Research.
Impact: **Major** - The Te Ara Tika Guidelines for Māori Research Ethics were published in 2010. The were utilised in the development of Te Mata Ira Guidelines for Genomic Research with Māori published in 2016. Being added as an appendix was strategically useful because the Guidelines on Māori Health Research was required reading as part of ethics application process. The Te Ara Tika principles were adopted alongside bioethics principles in the National Ethical Standards published in 2019.		

Table 15: Cultural reciprocity framework – Te Ara Tika framework

Chapter 8: Te Mata Ira: Māori views on Genomics and Biobanking

This chapter focuses on a paper 'Te Mata o te Ira: Faces of the Gene' produced as part of the Health Research Council (HRC) funded project Te Mata Ira: Māori views on Genomics and Biobanking. The project itself built on the Te Ara Tika Guidelines which had highlighted the additional sensitivity that Māori communities had around research involving biospecimens and/or genetics. While cultural concerns were being expressed about genetic research and genetic modification it was also evident that different Māori whānau and communities were choosing to engage with genetic researchers and genetic services when it was relevant to their health context. The aim of the project was to explore Māori views on genomics and biobanking and develop guidelines to support culturally appropriate and ethical genomic research with Māori. The project engaged with key stakeholders, iwi members, Māori whānau, and Indigenous experts and created the Te Mata Ira Guidelines for Genomic Research with Māori, and the He Tangata Kei Tua Guidelines for Biobanking with Māori.

A key component that emerged from the project was the importance of understanding the cultural foundation, the key cultural concepts, and logic that connected to the context of genetics, genomics, and biobanking. While it was clear that most Māori participants didn't understand the language of genomics, they could use Māori concepts as a scaffold for understanding genomics research and identify key ethical issues. We explicitly made use of different cultural concepts (kupu - *words*, whakaaro - *ideas*, whakatauki - *proverbs*) which were utilised and layered in different ways. Some of the concepts formed the key cultural logics expressed in the guidelines document. This highlighted the importance of whakapapa *(genealogy),* the taonga *(precious)* nature of DNA and genomic data, which creates a state of tapu *(sacred or regulated),* and when shared in research is a tākoha *(gift of responsibility)*. The gift is not the DNA/data itself but the responsibility to look after the taonga. This creates a need to understand the parameters of that responsibility and we created kawa *(principles)* and tikanga *(protocols)* drawn from traditional examples to guide the actions/decisions of researchers. Kawa are necessary because consent for unspecified future use is 'an informed consent to be uninformed', and this effectively delegates authority to the researcher/biobank. The kawa, kia pumau te mana o te tangata *(level of control),* kia tau te wairua o te tangata *(level of comfort),* kia hiki te mauri o te kaupapa *(level of integrity)* provide a guide for decision making in a way that Māori whānau and communities would respect. Within this paper we describe the cultural foundation and different cultural concepts that informed the cultural logics that support the positions that we have outlined in the guideline documents.

How this project contributed to the development of the Cultural Reciprocity Framework

The Te Mata Ira project focused on Māori ethical issues in relation to genomics and explore needs that primarily related to the dimensions of cultural alignment and cultural integrity. Through the course of the project the use of cultural logics and connections with genomic contexts provided distinct attention on issues related to cultural veracity which became the focus of the Te Mata o te Ira paper. The provenance and context of traditional stories and whakatauki sourced for the project became part of the narrative and contributed to the Indigenous logics and language used in the project. This reflects the cultural foundation upon which the cultural logic was developed linking traditional perspectives with contemporary needs for the genomics context. The quality and acceptability of the outputs was linked to both attributes of cultural veracity and the attributes of cultural integrity.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- As an Indigenous led kaupapa Māori project a greater level of control over resources and processes was present.

- Cultural authority was represented through control of resources and control of the research process.
- Cultural alignment was present across project purpose, the predominance of Indigenous researchers in the team, and the focus on capacity building through research activities and aligned initiatives.
- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement, ethics, and recognition of contributing parties.
- Cultural veracity was a key part of the project as we used an iterative approach sharing information between different communities and stakeholders which reinforced the importance of provenance, context, and Indigenous logics in the process. It also supports Indigenous review creating informal and formal opportunities for feedback and review.

The impact of this project is rated as significant because it is referenced in national documents, informs teaching practice and capacity building initiatives, and has inspired work with other Indigenous communities.

Te Mata Ira – Māori Perspectives on Genomics and Biobanking: This research project explored the interface between Māori and genomics/biobanking identifying Māori perspectives and more ethical practice.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	M	Indigenous researcher led - Te Mata Ira was a HRC funded project led out of the Te Kotahi Research Institute at the University of Waikato.
Resource governance	Y	Māori principal investigator (PI) was responsible for the project funds. The project didn't directly impact on Māori resources but generated discussions about data and tissue being taonga.
Data governance	NA	No available data beyond the guidelines and other journal articles produced by the research team.
Rules & process definition	Y	Māori PI and Māori research team has full control of the operations of the project.
Cultural Alignment		
Project purpose	Y	The aim of the project was to understand Māori views and develop guidelines that would support Māori communities.
Indigenous roles	Y	Majority Māori team with diverse cultural, scientific and ethical expertise led different components of the work.
Indigenous development	M	Genomics was seen as a low priority issue within Māori health circles. Issue is of high level of interest to Māori with genetic conditions. Research team anticipated increasing use in future.
Indigenous capacity building	Y	Engagements built awareness and research team develop SING Aotearoa to support ongoing capacity building. Trainings provided in other forum.
Cultural Integrity		
Community engagement	Y	The team engaged Māori experts, Māori researchers, 5 x iwi, and Māori whānau in the project.
Indigenous ethics	Y	Cultural protocols were used as necessary to support Indigenous values. Project engaged directly with Māori values and ethics.
Data access & use	NA	Papers and guidelines are publicly available. No publishable datasets were generated. Iwi and case study reports provided to contributors.
Recognition	Y	Research team co-authored guidelines and papers. Acknowledgements made to participating communities. Co-authorship with iwi assistants on some outputs.
Cultural Veracity		
Provenance	Y	Indigenous ways of understanding were specifically utilised and examples highlighted the source whether that was specific people or meetings.
Context	Y	The team specifically described the cultural logics that connected Māori concepts to the genomics/biobanking context
Indigenous logics & language	Y	The cultural logic of the framework and underpinning thought was tested in hui with each of the iwi and other Māori participants and researchers to ensure a coherent message. The cultural logic can be understood by Māori, other Indigenous, and scientific audiences.
Indigenous review	Y	The work was reviewed by iwi participants, Māori researchers, and Indigenous colleagues.
Impact: **Significant** - Produced world first Indigenous led guidelines for genomic research, Te Mata Ira Guidelines for Genomic Research with Māori (Hudson et al, 2016b), and He Tangata Kei Tua Guidelines for Biobanking with Māori (Hudson et al, 2016d). These guidelines are highlighted in the National Ethical Standards Health and Disability Research and Quality Improvement (National Ethics Advisory Committee, 2019). Invited presentations on the guidelines have been held in Australia, US, and Canada. SING Aotearoa has operated for 8 years (2016-2024) and the SING Consortia hosted Indigenous Genomics Conferences in 2020 and 2024. WHO Western Pacific Region requested a presentation on the Biobanking guidelines at a workshop on Accelerating Access to Human Genomics for Public Health in April 2024. Supports international discussions around Indigenous rights in genomic data and Digital Sequence Information (DSI).		

Table 16: Cultural reciprocity framework - Te Mata Ira

Chapter 9: He Matapihi ki te Ao Raraunga

This chapter focuses on a publication for a book focusing on Māori engagement with language, culture and technology (Hudson et al, 2017). It brought together information collected through summer student projects (Tiriana Anderson, Te Kuru Dewes) in support of the emerging Māori Data Sovereignty movement. I developed the scope and was the supervisor for both projects drawing the ideas together for this book chapter. The Te Kuru Dewes project explored how key Māori stakeholders understood the taonga nature of different data sets. As Te Mana Raraunga Māori Data Sovereignty Network started advocating that 'data is a taonga' it became necessary to explore what this meant in practice for Māori. A range of activities were conducted included wānanga/workshops at Te Mana Raraunga meetings and a legal opinion from Te Kahui Legal based on Waitangi Tribunal reports on taonga in other contexts (Kahui Legal, 2016). The opinion suggested there would be a spectrum, with some types of data more closely aligned to taonga and some which wouldn't be considered taonga. Interviews with stakeholders supported this opinion and suggested that provenance, opportunity, and utility were key factors in stakeholders deciding whether datasets would be considered taonga, and then subject to greater levels of control.

Tiriana Anderson spoke with tohunga *(experts)* to understand what factors influenced their decision to share mātauranga with other people. Indigenous knowledge systems, like mātauranga, assign responsibilities to particular people as tohunga and/or kaitiaki *(stewards)* of types of knowledge that benefit the community but can't be effectively maintained by all the members of that community. In its best form this model creates interdependence and an ability to value different contributions with the tohunga deciding who can use the knowledge they share in a responsible manner. While many forms of mātauranga have been written down and become generally accessible, tohunga still retain deeper levels of knowledge which they protect, utilise, and share according to traditional protocols. Through interviews with tohunga, we identified ten cultural concepts associated with sharing mātauranga that we could frame in three areas; the nature of the data; the nature of the data use; the nature of the data user. We identified characteristics associated with the cultural concepts that are relevant to data use and created the Te Mana o te Raraunga Model which is described in the chapter.

How this project contributed to the development of the Cultural Reciprocity Framework

This publication explored the relevant of Māori concepts to the challenges of data sharing which can be seen across different dimensions and various attributes. Data governance within cultural authority, Indigenous roles within cultural alignment, Indigenous ethics and recognition within cultural integrity, and context and Indigenous logics and language in cultural veracity were highlighted within the development of the model. The project reiterated the potential value of traditional concepts and ideas within contemporary environments and its applications to data use and data ethics linking Indigenous knowledges with data science to inform research practice.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Projects can involve combinations of work done in different contexts with different people. The elements of Indigenous control were apparent across the various components even if it was the culmination of a series of projects.
- Cultural authority was represented in the process definition which is reflected in the other dimensions. There was no formal governance as it wasn't a resourced project.
- Cultural alignment was present across the project purpose, being all Indigenous researchers, a direct contribution to Indigenous development, and the focus on student capacity building.

- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement, ethics, and recognition of contributing parties through authorship. No data sets were developed that required ongoing data access agreements.
- Cultural veracity was a key part of the project, and we reviewed the key assumptions and characteristics of the model with the tohunga to ensure that the provenance, context, and Indigenous logics of the model were correct.

The impact of this work has been significant as it formed the basis for the development of the Nga Tikanga Paihere Ethical Framework used by StatsNZ to determine access to data on the Integrated Data Infrastructure (IDI). It is informing other national and international projects too.

He Matapihi ki te Mana Raraunga: Conceptualising Big Data through a Māori lens: A chapter that explored the interface between mātauranga Māori and big data by looking at traditional understandings of data and practices of knowledge sharing and their potential application to data. Generated from student research x 2		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	M	Indigenous researcher led - student projects directed by a university researcher that was a member of Te Mana Raraunga (Māori Data Sovereignty Network).
Resource governance	N	Students given a stipend with limited expense budget.
Data governance	NA	Student reports turned into a book chapter by combining information but no other datasets available.
Rules & process definition	Y	Students and PI had control over research processes.
Cultural Alignment		
Project purpose	Y	Project sought to uncover Māori values and ethics relevant to the context of data sovereignty.
Indigenous roles	Y	Māori students engaged with Māori experts under the guidance of Māori supervisors.
Indigenous development	Y	Data access and data governance were prominent issues for the emerging Māori data sovereignty network. Finding Māori solutions from within te ao Māori was a priority.
Indigenous capacity building	Y	Built student capacity. Subsequent outreach activities and talks contributed to capacity building.
Cultural Integrity		
Community engagement	Y	Key Māori stakeholders and Indigenous knowledge experts were the primary source of information for the project.
Indigenous ethics	Y	Cultural protocols were followed to ensure comfort of participants in research activities which focuses on Māori values and ethics.
Data access & use	NA	Book chapter is publicly available. No publishable datasets were generated.
Recognition	Y	The students and the Indigenous knowledge experts were named as co-authors on the chapter that was produced 'He Matapihi ki te Mana Raraunga: Conceptualising Big Data through a Māori lens' (2017).
Cultural Veracity		
Provenance	Y	Indigenous ways of understanding specifically informed the model that was developed.
Context	Y	Indigenous knowledge was collected from a related traditional context then analysed and applied to a big data context.
Indigenous logics & language	Y	The model was checked by the Indigenous knowledge experts to ensure it made sense to them, then tested through presentations with data experts. The model uses Māori words and concepts.
Indigenous review	Y	The model was reviewed by Indigenous knowledge experts
Impact: **Significant** - The Te Mana o te Raraunga Model was published in a book chapter in 2017 (Hudson et al, 2017). It provided the foundation for the development of Ngā Tikanga Paihere, a StatsNZ framework and tool supporting data ethics, used when researchers want to access data from the Integrated Data Infrastructure (Stats NZ, 2020). The model was utilised within teaching programmes and then adapted for use by government agencies. The Te Mana o te Raraunga Model provided a framework for work on Māori views on AI in health. Ngā Tikanga Paihere provided the foundation for a Data Equity Framework developed by the WEF Global Futures Council on Data Equity (World Economic Forum, 2024).		

Table 17: Cultural reciprocity framework – He matapihi ki te mana raraunga

Chapter 10: Ngā Tohu o te Taiao

The Ngā Tohu o te Taiao project was a Foundation for Research Science and Technology (FRST) funded project looking at development of cultural indicators for mahinga kai *(traditional foods*) to support emerging policy in freshwater management. The project emerged from a research sandpit, a co-design workshop with a selected group of researchers with expertise in different aspects of mātauranga and freshwater science. Mixed groups of researchers developed ideas which were assessed in a dragon's den type setting with two projects being selected to move through to a formal proposal and resourcing. The concept of the negotiated space informed activities in this project (Hudson et al, 2010b; Hudson et al, 2012) and while the project emerged from a co-design process it only involved researchers and not iwi or community members. As such subsequent discussion with iwi partners were limited to participation in a project with established objectives.

The paper focuses on the challenges of integrating Indigenous knowledge into freshwater management in the context of a policy reform that aimed to be more cognisant of community values as well as consider Indigenous knowledge and aspirations (Hudson et al, 2015). Through the Ngā Tohu o te Taiao project we understood that dichotomising Indigenous knowledge and science is as much about the politics of recognition as it is about different ways of knowing. The points of connection between scientific knowledge and Indigenous knowledge occur in specific contexts where there is a common challenge or focus. In the policy context the information that informs values and community aspirations is beyond the scientific perspective but within the Indigenous knowledge frame. It is important to align the right type of Indigenous knowledge content with the right context, whether that is philosophical, ethical, scientific, or technical. We identified dimensions of mātauranga Māori relevant to different parts of the freshwater management framework including governance, goals, objectives, actions, limits, and monitoring.

How this project contributed to the development of the Cultural Reciprocity Framework

The Ngā Tohu o te Taiao project was an early example of co-production and even though it involved Māori researchers, iwi researchers, and freshwater scientists several challenges emerged through the project that are directly relevant to the Cultural Reciprocity Framework. Issues of cultural authority and cultural alignment in relation to project governance, resource governance, and project alignment arose between members of the research team in part due to different expectations around community engagement, Indigenous ethics, and the use of Indigenous logics and language. Cultural veracity in general and issues relating to data governance, data access and use, and Indigenous review became evident as outputs were generated by different team members. This highlighted clarity around Indigenous roles as well as process and rules definition.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Projects can be collaborations between Indigenous and non-Indigenous researchers, but this doesn't necessarily translate to power sharing with tribal entities.
- Cultural authority was represented in project governance and resource governance and efforts made to address Indigenous knowledge protections in data governance. A distinction can be made between Indigenous representation and tribal authority within projects.
- Cultural alignment was present to some degree in the project purpose albeit framed by Indigenous research aspirations rather than tribal priorities. The roles of Māori and iwi researchers was clear, but there was some divergence in the development priorities of the parties, despite a focus on capacity building.
- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement, ethics, and recognition of contributing parties through authorship.

Access to Indigenous knowledge was managed but there were no discussions about whether access to scientific data should be managed.

- Cultural veracity was a key part of the project and iwi researchers contributed to ensuring that the provenance, context, and Indigenous logics of the various tools and frameworks were correct.

The impact of this work was moderate because the project informed actions for different parties who utilised it in their contexts. Although there were opportunities for greater impact through the freshwater policy making process, a lack of coordinated knowledge exchange post project limited the value generated by the work.

Ngā Tohu o te Taiao: This project explored the contribution of mātauranga Māori and science to the development of freshwater management policy in Aotearoa.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	Project was co-led by Māori and non-Māori PIs based at the University of Waikato.
Resource governance	Y	Project funds were the responsibility of PI's.
Data governance	M	Protocols were established with iwi to protect mātauranga, but these didn't extend to other scientific data.
Rules & process definition	M	Project team had control over the process of the project. Primarily sat with the PIs with input from iwi partners.
Cultural Alignment		
Project purpose	M	Project responded generally to an emerging issue of freshwater management which was significant to Māori, but focus was determined by researchers rather than iwi which created some challenges.
Indigenous roles	Y	There were clear roles for Māori and iwi researchers in the project.
Indigenous development	M	The project was oriented towards informing emerging freshwater management policy and supporting iwi participation in those processes.
Indigenous capacity building	Y	The project brought together Māori scientists and mātauranga Māori knowledge holders, built their respective capacities, and informed subsequent projects. Student capacity building occurred.
Cultural Integrity		
Community engagement	Y	The project held workshops with targeted Māori scientists and mātauranga Māori knowledge holders. Presentations and discussions were held in other forum.
Indigenous ethics	Y	Cultural protocols informed all research activities.
Data access & use	M	There were discussions about the appropriate use of mātauranga Māori shared during the workshops and this was respected.
Recognition	Y	All participants were acknowledged in the final report. Māori researchers named on all publications.
Cultural Veracity		
Provenance	Y	Mātauranga Māori informed the project and was included in all publications and presentations with specific reference back to iwi involvement.
Context	Y	The purpose of the project was to understand how mātauranga Māori could be applied to freshwater management.
Indigenous logics & language	Y	Engagement with mātauranga Māori knowledge holders and Māori researchers provided opportunities to include Māori logics and understandings in the project.
Indigenous review	Y	Outputs were reviewed by iwi partners alongside Māori team members.
Impact: **Moderate** - The project created some tools and understanding that was utilised by different partners in the research project to inform subsequent research activities and publications (Hudson et al, 2020; Leonard et al, 2022; Sousa et al, 2023; Strand et al, 2024). There was limited promotion of the outputs into policy circles so its impact in those spaces was limited.		

Table 18: Cultural reciprocity framework – Ngā tohu o te taiao

Chapter 11: Turbo-Breeding New Zealand's Plant Industries

This chapter focuses on a Ministry of Business, Innovation, & Employment (MBIE) funded research project led by Plant and Food Research (PFR) called Turbo-breeding New Zealand's Plant Industries. It focused on developing scientific capacity for gene editing in horticultural plants and involved a Māori research aim exploring the co-innovation interface, the intersection between Māori commercial and cultural interests. The project had a future focus in the sense that we anticipated the growing relevance of gene technologies to society for both commercial and non-commercial purposes. We also expected that over time various Māori stakeholders would see value in the use of those technologies to meet the needs of their communities and/or businesses. This work built on the foundational work developed through the Te Mata Ira project and looked at the ethical concerns and potential opportunities for Māori to engage more proactively with gene editing technologies. A range of research activities were undertaken to understand Māori perspectives and the paper represents the evolving nature of Māori views towards gene editing, those in support and those that continue to oppose. It is the most comprehensive collection of Māori perspectives on gene editing to date.

The paper summarises the key findings of the different research activities and demonstrates a nuanced understanding of not only genetic technology and its application, but also the way in which it should be deployed to maximise benefit to Māori (and Indigenous) communities (Clark et al, 2024). Like many other tools and technologies that have entered society, genetic technologies can enhance or diminish Māori values depending on their use. This was reinforced by the quantitative survey that showed distinct differences in the level of support for different applications of gene editing across all groups, whether they were generally supportive or generally opposed. Factors that contribute to greater support relate to the area of application (ie. conservation vs body enhancement), the level of control (Indigenous led), contribution to capacity building, and use alongside non-genetic approaches. In this context it reinforced the importance of cultural authority, cultural values, and aligning the use of technology to the aspirations of the community.

How this project contributed to the development of the Cultural Reciprocity Framework

The Turbo-breeding project built on work to explore Māori perspectives on genomic research and focused on gene editing which has more pointed cultural considerations. The discussions highlighted the importance of control in making decisions, particularly in the context of commercial uses. This reinforced the dimensions of cultural authority and cultural alignment as it related to project and resource governance, as well as project purpose and Indigenous development. Taking time to work through these issues also highlights the importance of community engagement and Indigenous ethics, core attributes of cultural integrity.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Large researcher led projects balance the needs of multiple aims and the motivation and interest of the principal investigator in the Māori component is necessary.
- Cultural authority was not really reflected in this project other than the control that the Māori team has over their research aim. This was enhanced through the entire funding for the research aim being subcontracted directly to a Māori research institute.
- Cultural alignment was present to some degree as Māori researchers developed their research aim and had distinct roles in the project which also enabled a focus on capacity building.
- Cultural integrity was addressed using culturally appropriate protocols for community engagement and ethics.

- Cultural veracity was a key part of the project and while contributions were made by the wider team the Māori researchers ensured that the context, and Indigenous logics shared in the papers were appropriate.

The impact of this work is moderate because it is informing policy activities but is not yet clear what impact the work will have on the outcome of those processes. However, there is national and international interest in this work.

Turbo-Breeding for NZ's Plant Industries: A project developing gene editing techniques for horticulture which had an aim focused on the co-innovation interface, an exploration of the interface between Māori cultural and commercial interests.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	N	Project was led by Plant and Food Research with the co-innovation interface research aim subcontracted to Te Kotahi Research Institute.
Resource governance	M	Te Kotahi Research Institute had control over subcontracted research funds but no responsibilities for resources external to the project.
Data governance	N	Default institutional data governance processes applied.
Rules & process definition	M	Māori researchers had control over the activities of the co-innovation interface research aim.
Cultural Alignment		
Project purpose	M	Primarily a science led project which had a social science focused Vision Mātauranga (VM) component led by Māori researchers.
Indigenous roles	Y	Māori researchers had clear responsibilities for their research aim.
Indigenous development	M	While gene editing is not a priority for Māori growers or Māori communities it is an increasingly useful tool for both conserving biodiversity (cultural value) and enhancing food production (commercial value). Māori engage in debates about both activities and can benefit from both.
Indigenous capacity building	Y	The project actively supported SING Aotearoa and created additional spaces for Māori to discuss issues of genomics and gene editing.
Cultural Integrity		
Community engagement	Y	The project canvased general views through a national survey and sought views of key Māori individuals and held workshops for interested Māori. Also conducted wānanga (workshops) with Indigenous knowledge holders.
Indigenous ethics	Y	Cultural protocols were used in all research activities as appropriate. There was a focus on understanding Māori values in relation to gene editing.
Data access & use	N	No responsibility for data generated through science aims and data from national survey is stewarded by survey leads.
Recognition	M	Māori researchers recognised as authors on co-innovation interface research aim publications. No specific acknowledgement of Māori community contributions.
Cultural Veracity		
Provenance	M	Māori views and ways of understanding shaped the activities of the social science team and were reflected in both qualitative and quantitative outputs
Context	Y	Māori values, perspectives, and knowledge were contextualised for the context of gene editing
Indigenous logics & language	Y	Cultural wānanga were used to assist the researchers in making sense of the cultural perspectives. Indigenous logics informed outputs
Indigenous review	Y	Papers produced by the co-innovation interface team were reviewed by Māori researchers, have been used in consultation exercises with Royal Society of New Zealand (RSNZ), and have been presented at national and international conferences
Impact: **Moderate** - The Māori component of the project represents the most comprehensive collection of Māori perspectives on gene editing conducted to date. It has been shared in national forum and at the 3rd Human Genome Editing Summit hosted by Royal Society in London. The work is now informing the work of Aotearoa Circle's Biotechnology stream focus on modern genetic technologies, and the policy development work of the Gene Technology Technical Advisory Group.		

Table 19: Cultural reciprocity framework – Turbo-breeding for NZ's plant industries

Chapter 12: The Moana Project

This chapter focuses on a paper produced through the MBIE funded Moana Project which aimed to improve understanding of coastal ocean circulation, connectivity, and marine heatwaves to provide information in support of New Zealand's seafood industry (Souza et al, 2023). The project was a large multi-institutional research collaborations involving research organisations in New Zealand and overseas including a partnership with Whakatōhea. While primarily a science and data modelling-oriented project it included a Vision Mātauranga research aim called He Papa Moana which focused on cross cultural ocean knowledge. It brought together a team of experienced Māori researchers to improve capacity to use mātauranga and science to inform environmental planning, monitoring, and decision-making for the moana (ocean). He Papa Moana has four strands.

- Māori as Oceanographers explored the understandings of non-instrument navigators around ocean voyaging and climate change (McDonald et al, 2025). This component was led by Dr Haki Tuaupiki and Rangihurihia McDonald completed her PhD on this topic.
- Whakatōhea Rohe Moana explored Whakatōhea's interests in the marine space and was led by Dr Kimberley Maxwell alongside Danny Paruru. They developed the Whakatōhea Moana Plan (Maxwell et al, 2023) and worked alongside Dr Kepa Morgan to develop a Mauri Model for the Whakatōhea Mussel Farm.
- Informing Iwi Interests and Priorities was led by Dr Ocean Mercier who explored a range of marine management contexts alongside master's and PhD students at Victoria University.
- Iwi Fisheries Project with Tony Craig and Katherine Short from Terra Moana who looked at the relative value of fishing and aquaculture in the Bay of Plenty.

Whakatōhea's involvement came about through a personal relationship between Dr Kimberley Maxwell, a recent PhD graduate from Whakatōhea and Prof Moninya Roughan, the Principal Investigator, which initiated discussions about Whakatōhea's interests in the marine space and the potential value of the scientific aims for making decisions about aquaculture investments. This led to my involvement in the development of the research proposal and eventual listing as the research leader for He Papa Moana.

How this project contributed to the development of the Cultural Reciprocity Framework

The Moana project was a large interdisciplinary project that had elements of co-production built into its design. Cross-cultural knowledge exchange was an explicit aim, and this required cultural reciprocity, even if that wasn't the language used within the project. The project made efforts to work across all the dimensions of cultural authority, cultural alignment, cultural integrity, and cultural veracity, some more effectively than others. This project highlighted the need to bring together the different activities into a more coherent framework and be explicit about the actions. The identified dimensions and attributes provide the foundation for thinking about the quality of engagement and the quality of outputs within projects that aim for deep knowledge co-production.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- While a large researcher led project, they made efforts to ensure Māori participation at all levels of governance and decision-making and understood the importance of relationship building and maintenance with Whakatōhea.
- Cultural authority was reflected through Māori participation in all levels of governance and management although greater control existed around the He Papa Moana research aim. The funding went directly to the Māori research team including Whakatōhea based on completed

outputs. Māori contributed to discussions about data governance and the rules for running the project.

- Cultural alignment was present as the Māori research team had been directly involved with the development of the project and were clear about the purpose, their roles and opportunities for development.
- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement and ethics. The relationship with Whakatōhea was prioritised and this supported capacity building for wider research team. Recognition of Whakatōhea's contributions to the project were also highlighted in multiple places.
- Cultural veracity was a key part of the project with Māori researchers and Whakatōhea ensuring that the context and Indigenous logics shared in the papers/outputs were appropriate through both review and ensuring provenance of mātauranga was acknowledged.

The impact of this work is moderate in part because the project has only recently been completed and we have yet to see how it might inform community and policy activities (Leonard et al, 2022). However, there is national and international interest in this work, and it was included in a Report for the High Level Panel for A Sustainable Ocean Economy focused on co-producing sustainable ocean plans with indigenous and traditional knowledge holders (Strand et al, 2024).

The Moana Project: Large interdisciplinary research project focused on modelling marine heatwaves with a research aim on cross cultural knowledge exchange which worked directly with an iwi (Whakatōhea), waka (traditional seafaring vessel) voyagers, and Māori students.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	Researcher governed – Indigenous and iwi participation in governance and advisory bodies.
Resource governance	Y	Specific subcontracts with Whakatōhea and Te Kotahi Research Institute which allocated resources to Māori led activities.
Data governance	Y	General protocols developed for sharing data and information from the project. Sharing Indigenous knowledge subject to permissions from iwi and Māori researchers. Use of TK Labels on Whakatōhea outputs.
Rules & process definition	M	Indigenous input into discussions about research processes for the whole project. Māori control over Māori focused research aim
Cultural Alignment		
Project purpose	M	Primary focus on modelling marine heatwaves was researcher led but aligned with Indigenous interests.
Indigenous roles	Y	Strong Māori research team including iwi researchers (Whakatōhea). Supported Māori students and engaged with communities.
Indigenous development	Y	Whakatōhea interest in effect of marine heatwaves on offshore mussel farming operations. Indigenous interests in waka voyaging and related iwi interests in marine space. Focus on development for Māori students.
Indigenous capacity building	Y	Hui and wānanga adopted in VM aim. Some opportunities created to support knowledge exchange between research aims and stakeholders.
Cultural Integrity		
Community engagement	Y	IK content utilised strongly within VM research aim. Some efforts made to share with other parts of the program.
Indigenous ethics	Y	Overall research team made efforts to build relationships with Whakatōhea and respect cultural protocols. Indigenous values drove VM research aim with some adoption in other parts of the research program. Utilised cultural protocols during engagements with communities and Māori participants. Respect for cultural protocols in general forum too.
Data access & use	M	Gained ethics approvals from institutions. Sought permissions from iwi for sampling activities. Gained consent from participants for interviews. Ocean monitoring data sets published on NZ Ocean Data Network (NZODN) as open access datasets.
Recognition	Y	Whakatōhea recognised as partner on website, acknowledged in research outputs, TK Labels used on specific documents (Whakatōhea Marine Plan). Whakatōhea named a new scientific sensor and are acknowledged.
Cultural Veracity		
Provenance	Y	Indigenous knowledge sought from relevant experts in VM research aim. Tribal experts, waka voyaging experts, community knowledge holders.
Context	M	IK used for Indigenous focused VM research activities. Some efforts made to align with other science focused research activities.
Indigenous logics & language	Y	Indigenous logics and language were present in all VM specific activities and outputs had strong alignment to Māori knowledge and values. Not often present in outputs for science focused research aims.
Indigenous review	Y	Whakatōhea Moana Plan was reviewed by community members and WMTB. Other VM papers were reviewed by Māori team members. Some science papers were reviewed by Māori team members and Whakatōhea.
Impact: **Moderate** - The Whakatōhea Moana Plan is the first iwi marine and coastal plan in the country. It has prompted interest from agencies and other iwi. Whakatōhea Moana Plan is an example in Paper on 'Co-producing Sustainable Ocean Plans with Indigenous and Traditional Knowledge Holders' (Strand et al, 2024).		

Table 20: Cultural reciprocity framework – The Moana project

Section 3: Internationally Focused Projects

Chapter 13: CARE Principles for Indigenous Data Governance

This chapter focuses on a paper describing the CARE Principles for Indigenous Data Governance which were developed as part of the Indigenous data sovereignty movement (Carroll et al, 2020). The principles emerged from a meeting held by the Research Data Alliance's International Indigenous Data Sovereignty Working Group meeting at International Data Week in Botswana in 2017. The CARE Principles were created to respond to the use of the FAIR Principles for Scientific Data Management (Wilkinson et al, 2016) and the Open Data Charter which were being used to support the open data movement. Given the concerns of Indigenous data sovereignty networks about the potential harms of open data to their communities it was important to provide a different narrative and way to discuss ethical data use from an Indigenous values base. The working group was made up of the authors of the paper who were primarily Indigenous researchers or working with Indigenous communities.

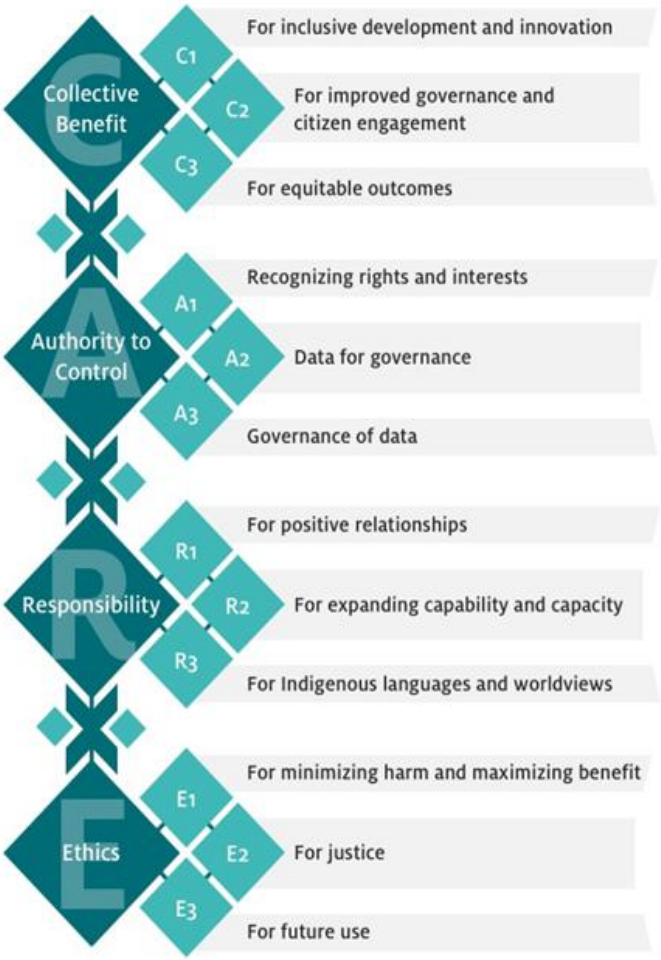

Figure 11: CARE principles for Indigenous data governance (Carroll et al, 2020)

The principles emerged after comparing the various Indigenous data sovereignty related principles and those associated with the open data movement. Across all the various frameworks there were data-oriented principles, people-oriented principles, and purpose-oriented principles. Open data frameworks had a bias towards data-oriented principles whereas Indigenous frameworks had a preference for people and purpose-oriented principles, and this became the rationale for selecting the principles of Collective Benefit, Authority to Control, Responsibility, and Ethics. The acronym CARE became an important part of the narrative and allowed us to position them as complementary to the data-oriented FAIR principles using the tagline 'Be FAIR and CARE'.

The robustness of the Indigenous foundation for the CARE principles and the alignment with the widely promoted FAIR principles has enabled broad uptake of the CARE principles across global networks.

They have been included in the following documents:

- UNESCO Recommendation on Open Science
- World Data Systems Data Sharing Principles
- Global Biodata Coalition Working Group on Open Data Strategies
- IPBES Data and Knowledge Management Policy
- Earth Biogenome Project Data Sharing and Management Best Practices

- Research Data Alliance COVID-19 Indigenous Data Guidelines
- AIATSIS Code of Ethics
- Arctic Research Plan 2022-2026
- Aotearoa New Zealand Antarctic and Southern Ocean Research Directions and Priorities
- Asian Framework on Indigenous Knowledge and Data Sovereignty
- Decision 15/9 Conference of Parties Convention on Biological Diversity (COP CBD).

How this project contributed to the development of the Cultural Reciprocity Framework

Issues of Indigenous data sovereignty and Indigenous data governance have become more prominent as the digitisation of traditional knowledge and cultural heritage exacerbates community concerns about misappropriation of knowledge. The CARE principles provide a framework for thinking about overarching Indigenous needs in relation to collective benefit, authority, responsibility, and ethics. These foci align with the dimensions of cultural authority, cultural integrity, and cultural veracity and specifically informed the attributes of data governance, data access and use, and provenance. It also highlights the need for cultural alignment and Indigenous development.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Indigenous frameworks need to have the endorsement of Indigenous entities to be trusted by both Indigenous communities as well as non-Indigenous networks.
- Cultural authority is only reflected in this project through the influence of Global Indigenous Data Alliance (GIDA) as the primary sponsor of the CARE principles and the positioning as CARE principles for Indigenous data governance.
- Cultural alignment is present through the alignment with Indigenous aspirations for Indigenous data governance, the role of Indigenous researchers, and opportunities for capacity building.
- Cultural integrity was addressed through use of culturally appropriate protocols for community engagement, integration of Indigenous ethics, and acknowledgement of Indigenous contributions.
- Cultural veracity was a key part of the project as it provides a meta-narrative based on Indigenous values and Indigenous logics while promoting local protocols. The CARE principles went through an extensive review process with Indigenous academics and communities before being adopted by GIDA.

This work is having a major impact as evidenced by the number of national and global policy documents which reference it. Implementation efforts, including publications, are underway in a variety of settings and it widely promoted across e-research and data ecosystems (Carroll et al, 2021; Carroll et al, 2022a; Carroll et al, 2022b; Garba et al, 2023; Jennings et al, 2023; O'Brien et al, 2024).

CARE Principles for Indigenous Data Governance: Set of data principles developed by the Research Data Alliance (RDA) International Indigenous Data Sovereignty Working Group and endorsed by GIDA.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	GIDA continues to promote the CARE principles and is widely known as the Indigenous entity with responsibility for them.
Resource governance	N	Resources to support developments with CARE principles arise from different research projects under responsibility of various leads.
Data governance	N	Principles speak to data governance but has no specific responsibility for datasets.
Rules & process definition	M	The development of CARE criteria is beginning the process of rules definition. Similarly, work with publishers and repositories is underway with participation from GIDA members.
Cultural Alignment		
Project purpose	Y	Indigenous researchers identified the need for principles that speak to Indigenous community concerns about widespread adoption of open data principles.
Indigenous roles	Y	Indigenous people led development and consultation around the principles.
Indigenous development	Y	Principles have become a key tool for engaging institutions in discussions about data governance across a wide variety of domains.
Indigenous capacity building	Y	GIDA, ENRICH, Collaboratory have supported training activities in both communities and with institutions.
Cultural Integrity		
Community engagement	Y	Conceptualised by a majority Indigenous working group and engaged via IDSov networks and with Indigenous researchers.
Indigenous ethics	Y	Assessed Indigenous ethical frameworks as part of its development and have used cultural protocols as appropriate during engagement activities.
Data access & use	NA	Speaks to data governance but doesn't have responsibility for datasets.
Recognition	Y	Acknowledgement of contributors on papers and GIDA retains primary Indigenous oversight of the CARE principles.
Cultural Veracity		
Provenance	Y	Developed from knowledge of Indigenous values and ethics as a meta-narrative. Recognise the ongoing independent value of that source material.
Context	Y	Indigenous narratives applied to the context of Indigenous data governance. While it has broad application, they also promote the use of local frameworks.
Indigenous logics & language	Y	Principles were discussed with IDSov networks to ensure they make sense to different Indigenous communities. Principles have been translated into other languages including Māori.
Indigenous review	Y	CARE Principles were reviewed by Indigenous researchers and then endorsed by the GIDA.
Impact: **Major** - CARE principles are recognised in a number of national and global policy frameworks including UNESCO Recommendation on Open Science, and COP16 discussions on DSI. There are multiple initiatives in place to operationalise the CARE principles, and it has also prompted work on the development of Indigenous data standards. Increasing number of publications focusing on implementation of CARE principles (Carroll et al, 2021; Carroll et al, 2022a; Carroll et al, 2022b; Garba et al, 2023; Jennings et al, 2023; O'Brien et al, 2024).		

Table 21: Cultural reciprocity framework – CARE principles for Indigenous data governance

Chapter 14: Rights, Interests, & Expectations: Indigenous perspectives on unrestricted access to genomic data

This paper focuses on how Indigenous rights, interests, and expectations inform their positions on unrestricted access to genomic data. It represents an intersection between the work I had completed around Māori views on genomic research and Māori data sovereignty in the broader global context where issues of Indigenous rights to genomic data were not considered a part of the discourse. The publication was a large collaborative exercise involving a range of international colleagues working in Indigenous genomics. It built on a number of publications that had been speaking to ethical issues for Indigenous communities in the context of genomic research and responded directly to an article in Science calling for unrestricted access to public genomic data (Amann et al, 2019). The systematic calls for open data were becoming embedded in the science ecosystem through government policy, funding criteria, ethical expectations, and publication processes. Even when researchers wanted to act responsibly towards Indigenous communities and support Indigenous governance of genomic data it was difficult to put into practice. It was important to provide an 'Indigenous' position on the subject because there were also increasing calls to address diversity and inclusion within genomics by bringing more Indigenous subjects into studies.

The challenge of competing interests and priorities plays out across multiple levels. Indigenous peoples are building their capacities around science, technology, engineering, and mathematics (STEM) subjects and are proactively engaging science and innovation to support their growth and development. Through this process, some Indigenous researchers and communities exhibit support for open science and improving accessibility to Indigenous data. At the same time the issue of Indigenous data sovereignty has reiterated concerns about protection of Indigenous knowledge and rights of Indigenous peoples to benefit from Indigenous data. The aim is to enable Indigenous communities to actively participate and benefit from research and development by leveraging the use of data within this domain. While similar tensions exist for researchers caught between the expectations of Indigenous communities and government funders, or competing government priorities, the stakes are higher for Indigenous communities as they lose out on the potential dividends that arise from innovation. To balance the calls for greater diversity and inclusion of Indigenous communities, as an input to genomic research, and support more opportunities for Indigenous involvement in the outputs of genomic research we identified three principles (building trust, enhancing accountability, and improving equity) and a range of actions for researchers.

How this project contributed to the development of the Cultural Reciprocity Framework

Genomic data or digital sequence information (DSI) generated from a taonga species, the biological resource, has a value both interdependent with and independent from the taonga itself. Indigenous communities have a strong relationship with the taonga as well as the data generated from it. In responding to calls for open access to genomic data the paper emphasised the need for trust, accountability, and equity, all of which are relational principles suited to considerations of cultural reciprocity. The logics of trust and accountability must be both built into the framework as well as emerge from the use of the framework. These principles strengthen the need for cultural authority, cultural alignment, and cultural integrity as part of the process of research collaboration. It advocates for attributes like data governance, Indigenous ethics, data access and use, and Indigenous review.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Indigenous position papers are necessary to reflect which issues should be prioritised to build trust, enhance accountability, and improve equity.
- Cultural authority was represented through the authorship, control of the writing process, and deciding on key messages.
- Cultural alignment occurred as the purpose was defined by Indigenous authors to meet Indigenous development needs. Indigenous authors led and were supported by allies.
- Cultural integrity was addressed directly as Indigenous ethics was a core part of the subject matter and all contributors were recognised as authors.
- Cultural veracity was a key part of the project and Indigenous publications were prioritised, Indigenous authors framed the context, Indigenous concepts informed the paper, and it was reviewed by Indigenous authors.

This work has had a moderate impact through a significant number of citations as well as invitations to keynote genomic and data related conferences.

Project: Indigenous Genomics – This area of work arose from several collaborative activities including SING Aotearoa and the SING Consortia, as well as joint publications speaking to the ethical issues for Indigenous communities engaging with genomics research.		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	M	There was no specific project per se, but Indigenous researchers led the range of capacity building initiatives and joint publications.
Resource governance	NA	There was no external resourcing provided specifically for this activity.
Data governance	NA	No data sets were generated that required data governance discussions.
Rules & process definition	Y	The authors decided on the process and rules for the joint writing exercise.
Cultural Alignment		
Project purpose	Y	The authors were conscious of balancing the interests of the research community and Indigenous communities. As most of the authors were Indigenous researchers they often deal with this directly.
Indigenous roles	Y	Indigenous leadership was important as was supporting non-Indigenous allies as authors.
Indigenous development	M	The intention was for the paper to contribute to changes in practice and approach to enabling access to Indigenous genomic data.
Indigenous capacity building	NA	No specific capacity building activities were engaged in although we included some early career researchers as authors.
Cultural Integrity		
Community engagement	NA	No direct community engagement was necessary for this paper.
Indigenous ethics	Y	The topic focused on Indigenous ethics in relation to the use of genomic data.
Data access & use	NA	No data was generated through the writing of the paper.
Recognition	Y	All contributors were recognised as authors.
Cultural Veracity		
Provenance	Y	Publications were cited and Indigenous led publications were prioritised.
Context	Y	Indigenous authors framed the paper and its content.
Indigenous logics & language	Y	Indigenous concepts and understandings informed the paper.
Indigenous review	Y	Indigenous authors reviewed the paper and made improvements.
Impact: Moderate – This paper was published in Nature Review Genetics and has been cited a significant number of times. It has had some limited influence in supporting the development of more diverse and inclusive approaches to governing genomic data. As an author I have been invited to keynote several genomic and data related conferences as well as participate in various global forum on genomic data.		

Table 22: Cultural reciprocity framework - Indigenous genomics

Chapter 15: Indigenous Peoples' Rights in Data: a contribution toward Indigenous research sovereignty

This paper focuses on the articulation of Indigenous People's rights in data. Since the publication of the seminal book Indigenous Data Sovereignty: Towards an Agenda (Kukutai & Taylor, 2016) the concept has been widely discussed and incorporated into academic and policy environments, particularly in Aotearoa New Zealand, Australia, United States, and Canada. Indigenous data sovereignty promoted Indigenous control of Indigenous data asserting the existence of foundational rights and interests in data, information, and knowledge generated from Indigenous peoples and Indigenous territories. The broad definition of Indigenous data was useful in terms of demonstrating the range of environments and where Indigenous communities would like to reclaim control over data and become involved in data governance. However, the specific nature of the bundle of rights and interests in data that was being sought had not been clarified and this paper addressed that need.

The paper was led by members of the Collaboratory for Indigenous Data Governance in partnership with the Te Kotahi Research Institute. Members of the writing team had collaborated previously on a number of publications since the release of the paper on the CARE Principles for Indigenous Data Governance. The team identified and discussed the different rights that had been articulated in documents that promote Indigenous rights (e.g. United Nations Declaration on the Rights of Indigenous Peoples), Indigenous cultural intellectual property (e.g. Mātaatua Declaration), Indigenous research ethics (e.g Te Ara Tika), and Indigenous data sovereignty (e.g. Te Mana Raraunga Māori data sovereignty principles). The paper identifies 12 rights in relation to data that are grouped under data for governance and governance of data, key themes discussed in the Indigenous data sovereignty literature.

The paper also discussed how the rights might be understood by communities and researchers and the need to identify which rights take precedence in any given context as different rights might need to be balanced with each other. The paper also recognised it may take time to operationalise the rights and promoted direct engagement with Indigenous communities to determine what appropriate actions might look like, although the importance of acknowledgment, attribution, authorship, access, and authority was highlighted.

Figure 12: Actions that support Indigenous recognition (Hudson et al, 2023)

How this project contributed to the development of the Cultural Reciprocity Framework

Indigenous rights should be respected as part of research collaborations and need to be understood in relational terms. The articulation of Indigenous Peoples rights in data provides more nuance to the ways in which research collaborations or deep knowledge co-production can be done in a cultural

respectful and reciprocal manner. Cultural authority is expected and supported through actions that enable cultural integrity and cultural veracity. This paper reinforces the underpinning dimensions and attributes that form the Cultural Reciprocity Framework.

Assessing the project using the Cultural Reciprocity Framework highlighted the following factors:

- Indigenous academic networks can leverage their skills and expertise to address key challenges for Indigenous communities
- Cultural authority was reflected in this project through the leadership of Indigenous research groups who were able to define process and protocols for developing the paper.
- Cultural alignment is present through the alignment with Indigenous aspirations for Indigenous data sovereignty, the leadership role of Indigenous researchers, and opportunities for capacity building.
- Cultural integrity was addressed through use of a clear focus on the integration of Indigenous rights and Indigenous ethics, and acknowledgement of Indigenous contributions.
- Cultural veracity was addressed in the project by ensuring the context and Indigenous logics were consistent with Indigenous discourse and the underpinning traditional knowledge. The paper was reviewed by Indigenous academics.

This work is having a moderate impact to date in part due to the short amount of time since it was published. However Indigenous Peoples rights in data and the actions that support Indigenous recognition have been shared in various international conferences and meetings.

Project: Indigenous Peoples' Rights in Data: a contribution toward Indigenous research sovereignty was a paper describing the elements of a bundle of rights and interests associated with use of data		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance	Y	Project was led by the Collaboratory for Indigenous Data Governance and involved Te Kotahi Research Institute.
Resource governance	N	It was a collaborative writing exercise with no formal resource contributions.
Data governance	N	The project didn't generate datasets.
Rules & process definition	Y	Indigenous researchers decided on the rules and process for development of the paper.
Cultural Alignment		
Project purpose	Y	Indigenous researchers determine the nature and direction for the paper.
Indigenous roles	Y	Indigenous roles were clearly defined and supported by Indigenous leadership.
Indigenous development	Y	Paper continues the articulating of Indigenous peoples' rights in data supporting aspirations for Indigenous data sovereignty.
Indigenous capacity building	Y	Process created opportunities for Indigenous early career researchers to participate and add a publication to their CV.
Cultural Integrity		
Community engagement	N	This was a collaborative writing exercise that didn't require community engagement.
Indigenous ethics	Y	The process involved Indigenous and non-Indigenous authors collaborating and considering Indigenous rights and its intersection with Indigenous ethics.
Data access & use	N	The project did not generate datasets.
Recognition	Y	All writers contributions were recognised.
Cultural Veracity		
Provenance	M	The project drew on Indigenous values, experiences, and understandings but no specific traditional knowledge was utilised for this paper.
Context	Y	The Indigenous values and ethics were located within the Indigenous data sovereignty discourse which a number of the authors had been actively involved with developing.
Indigenous logics & language	M	The language and logics were consistent with academically based Indigenous discourse which draws on traditional understandings however it is a step removed.
Indigenous review	Y	Drafts were shared with GIDA network for feedback and the paper was reviewed by Indigenous colleagues.
Impact: Moderate – The paper contributes to a developing discourse around Indigenous data sovereignty and provided a unique contribution by describing the range of data rights and interests that Indigenous peoples might assert. This is of value to both communities and institutions wanting to respond to the Indigenous data sovereignty aspirations of Indigenous communities.		

Table 23: Cultural reciprocity framework – Indigenous people's rights in data

Chapter 16: Reflections

For thousands of years, the cultural continuity of Indigenous communities has been maintained through the activation of Indigenous value systems. This includes value systems of reciprocity, which enable Indigenous Peoples to harness reciprocal methods for relating to life ways on Earth (Jacobs et al, 2022)

Reflections on the Present

Hoki whakamuri kia haere whakamua[12]

As we contemplate the next thousand years new systems of reciprocity are necessary to sustain diverse ecosystems and maintain inclusive socio-cultural networks in multiple nested forms. Research is agnostic to these outcomes and is a tool that provides information and justification for stakeholders with interests in continuing systems of extraction or communities reimagining networks of reciprocity. It is people and the entities they create (e.g. communities, institutions, businesses) that utilise the tools of research to generate understanding, reinforce rights, manage resources, and create new futures. The long tail of colonialism continues to impact on inequalities in society and is entrenched in concentrated centres of power affecting the distribution of resources and access to opportunities. Indigenous communities feel the effects of colonisation more than most and this provides the impetus for a variety of justice, equity, diversity, and inclusion initiatives. Inequities developed over multiple generations therefore reconciliation, redistribution, revitalisation, and resurgence efforts will be intergenerational projects too. The growing importance of data, information, and research to decision-making reinforces the need for greater equity and inclusivity across the fields of research, science, and technology. The increase in mixed methods and participatory processes within research and motivation contribute to Indigenous development and create new spaces for inclusion of Indigenous peoples and Indigenous knowledge. While this is not a new phenomenon the nature of these activities is changing in response to new technologies, new ethical standards, and a new assertiveness within Indigenous communities. The lessons of centuries of paternalistic and extractive approaches to research have been learnt and many Indigenous communities are developing capacity to advance their own research aspirations and development initiatives, promoting ethical practices aligned to their cultural protocols and expectations of good research behaviour. Indigenous voices and concerns are amplified by Indigenous networks and influence global bodies as they pursue the dual strategy of self-determination and integration.

Within the Aotearoa New Zealand context the importance of Indigenous knowledge/mātauranga Māori as a contributor to decision-making has emerged as a consequence of the increasing political influence of Māori within society. However, the influence has been hard fought and continues to be contested as various parties challenge the authority of Māori involvement in governance and the legitimacy and validity of mātauranga Māori (Mead et al, 2022). While science occupies a privileged position as the primary contributor and arbiter of information in support of evidence-based policy, the increasing recognition of other legitimate perspectives and values when considering complex issues has prompted the emergence of new frameworks for understanding the science-policy interface. As Saunders et al (2023:219) state "*Research in the interfaces between Western science and other bodies of knowledge can amplify the wellbeing impact of researchers, but requires respect for the mana and integrity of each knowledge stream*". The need for more dialogue and transparency between scientists, community, policy makers and society provide a space for considering the interaction between

[12] Walk backwards into the future with your eyes fixed on the past

different knowledges, values and perspectives and how they contribute to greater diversity, inclusivity, and equity within research and decision-making processes. Indigenous knowledge provides unique perspectives and insights to this setting however its integration into a broader amalgam of ideas and values provides challenges for maintaining the integrity of its origins and authenticity of its message. The key challenge for Indigenous knowledge in the socio-political context of the 21st Century is a shift from the 'assertion of relevance' to the 'demonstration of relevance'.

The increasing importance of research collaboration and knowledge co-production with Indigenous communities is reflected in the growing number of publications, and development of Indigenous knowledge focused research platforms. Ngā Pae o te Maramatanga, a Māori Centre of Research Excellence (CORE) in Aotearoa New Zealand has been in existence for over 20 years supporting transformative research for Māori communities. Rauika Māngai, Māori research leads across the National Science Challenges, focused attention on the nature of scientific and research collaborations with Māori communities (Rauika Māngai, 2020; Kukutai et al, 2021; Potter & Rauika Māngai, 2022; Simmonds & Rauika Māngai, 2024). Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia has established an area focusing on Indigenous science and engagement which acknowledges the contributions Aboriginal and Torres Strait Islander people have made to culture and the economy and work with Indigenous communities to create Indigenous-driven science solutions that support sustainable futures for Indigenous peoples, cultures and Country. The National Science Foundation (NSF) in the United States of America (USA) has recently funded a Science and Technology Center (STC) based at the University of Massachusetts. The Center for Braiding Indigenous Knowledge and Science (CBIKS) is the first social science and Indigenous focused STC in its history. The purpose of CBIKS is to enhance the capacity for engaging with Indigenous communities and the quality of braiding Indigenous knowledge and science. The thematic working groups cover topics such as relationality, data sovereignty, fieldwork practices and braiding traditional knowledge/data, storywork and knowledge mobilisation, formal and informal science education, training scientists, as well as engagement with policy and government agencies.

The importance of recognising traditional/Indigenous knowledge can also be found in other places. The UNESCO Open Science Outlook (2023:32) includes a section on open dialogue with other knowledge systems which emphasises the need for dialogue and notes "*the degree of openness of knowledge produced from research is dependent on the kinds of research being performed, who drives the research agenda and, importantly, for whom the research is being performed*". It also recognises the importance of the CARE principles in engagement with and use of data from Indigenous communities. Similarly, a report on co-producing sustainable ocean plans with Indigenous and traditional knowledge holders highlights the role of transdisciplinary approaches that are inclusive, place-based, ecosystem-based, and knowledge-based through meaningful co-production (Strand et al, 2024). Co-production processes require sufficient time, mutual respect, and trust, as various actors may have fundamentally different values. Recognising Indigenous peoples' rights, respecting knowledge plurality, and establishing equitable partnerships from inception to implementation is essential for achieving equity, restorative justice, and decolonisation in this context. Centering relationships to place can build empathy and connections which can lead to more accurate results and improved public trust in the scientific process (Beaty et al, 2024). Place-based relationships within research systems can be enhanced by deepening reflection and communication about relationships with places and peoples; strengthening collaboration among research teams and partners; and transforming systems of knowledge creation to foster place-based roots. While there is recognition that co-production with Indigenous knowledge is an important activity it can be a challenging process. The National Academies of Sciences, Engineering, and Medicine (NASEM) created a committee to guide a consensus study on co-production, the process by which scientists, Indigenous community

members, and other scientific stakeholders jointly create and share knowledge in a way that values diverse perspectives. Indigenous committee members advocated for a new process, putting co-production into practice, to allow more input from Indigenous people which they argued would improve the report's quality and address inequities in how western scientists and traditional knowledge practitioners interact. However, after failing to agree on a consensus approach, NASEM suspended the study[13].

Reflections on the Framework

The aim of this thesis was to summarise learnings from 10 years of collaborative research at the interface of Indigenous knowledge and science and identify key factors that support effective knowledge co-production. Cultural reciprocity describes a mutual commitment to the process of deep knowledge co-production when braiding Indigenous knowledge and science at the cultural interface. It is envisaged that deeper knowledge co-production creates more meaningful engagement and exchange within research through focused attention on the dimensions of cultural authority, cultural alignment, cultural integrity, and cultural veracity. The selection of key terms will always be subject to critique as they have different meanings in different contexts and disciplines. The language of 'braiding' and 'co-production' has been challenged in some Indigenous circles as an unnecessary feature of research or policy making as Indigenous knowledge and Indigenous communities hold the answers to their own challenges and don't need other 'sciences' to save them. This speaks to one end of a spectrum of engagement with knowledge characterised by kaupapa Māori as 'by Māori for Māori' or 'by Indigenous for Indigenous', and at the other end of the spectrum, the use of science or western disciplines by Indigenous communities. Between them lies a diverse range of options constituting different variations of co-production, or braiding, and my positive orientation towards these possibilities is predicated on Indigenous communities themselves having a level of control necessary to decide which option best suits their context. Similarly, the use of the term 'respect' to describe the purpose of each of the dimensions of cultural reciprocity (e.g. respect for Indigenous leadership) could be seen as representing the least ambitious outcome given the lack of respect shown to Indigenous knowledge and Indigenous communities in the past. However, in an Indigenous context, respect is a core ethical principle, and it is important to reiterate these philosophical underpinnings while describing what more effective expressions of this looks like in practice to Indigenous communities.

The Cultural Reciprocity Framework provides a mechanism to reflect on the actions planned or undertaken in research to demonstrate a commitment to deep knowledge co-production in a cultural appropriate manner. The dimensions of cultural authority and cultural alignment bring specific attention to the power dynamics in the collaboration. The framework made visible some significant differences between Indigenous led and science led projects in terms of decision-making and control of resources. It also highlighted differences between academic and applied projects particularly in relation to resource governance, Indigenous development, and capacity building. The dimensions of cultural integrity and cultural veracity focus attention on the epistemological lens that gets prioritised in the knowledge co-production process. The framework highlighted the degree to which Indigenous values and ethics are embedded in the research activities. It also focused attention on protocols around data access and use as well as the process of interpreting Indigenous knowledge and utilisation of that knowledge in research outputs. The framework has been informed by the experiences of others, directly through literature and informally through relationships, and my own active

[13] https://www.science.org/content/article/study-braiding-Indigenous-and-western-knowledge-collapses-amid-acrimony

participation in collaborative projects reflected through the studies used in this thesis. My familiarity with the nature of the research activities and the outcomes of the study allowed me to draw conclusions about the quality of the engagement, the quality of the outputs, and the impact of each project. As the interface between Indigenous knowledge and sciences occurs at multiple scales, I chose projects that focused on iwi, Māori, and Indigenous outcomes.

Unsurprisingly there was an interconnectedness and interplay between attributes in different dimensions. For example, having key Indigenous roles (cultural alignment) had a positive relationship with Indigenous language and logics (cultural veracity). Similarly, resource governance (cultural authority) had a positive association with Indigenous development (cultural alignment), and project governance (cultural authority) was linked to capacity building (cultural alignment). These relationships could be explored in greater detail. The use of the framework highlighted the underpinning importance of values to engagement and decision-making across the entire project. Cultural integrity focused attention on values for processes of engagement, Cultural Alignment illustrated the values for understanding perspectives, Cultural Authority reinforced the values for informing action, and Cultural Veracity illustrated the values for respecting different knowledges. The acknowledgment of and respect for the values that inform decision-making is necessary to make transformational shifts in relational power-sharing and moving research practice towards deeper forms of knowledge co-production.

While the dimensions and attributes create a type of checklist for more equitable research collaborations it was clear that to create culturally robust outputs and research impact it wasn't necessary to meet all the attributes in every instance. Depending on the context of the project it was still possible to have good outcomes even if projects were science-led and levels of cultural authority and cultural alignment were less than optimal. However, it did appear that in those situations the Indigenous members of the team had a high level of autonomy in relation to their component of the project and this was well aligned to Indigenous development outcomes. It was clear that the dimensions of cultural reciprocity could inform the veracity of research outputs including scientific statements and broader ontological or causal claims about the nature of the system being studied by representing a form of endorsement for the project. In lay language this translates to the 'right decision for the right reason in the right way with the right information':

- Authority represented by tribal governments or communities reflecting a 'political' endorsement (right decision)
- Alignment with Indigenous worldviews and aspirations reflects an 'ontological' endorsement (right reason)
- Integrity of interactions reflects an 'axiological' endorsement (right way)
- Veracity of knowledge and expertise reflects an 'epistemological' endorsement' (right information).

The importance of each dimension to the overall impact of the project was difficult to determine. While it was not necessary for every attribute to be actioned in the project it was clear that all the dimensions needed to be addressed. Cultural authority, either within the project or post-project, appeared to have the greatest effect on the impact of the work. Projects that have had a major impact (Local Contexts, Te Ara Tika, CARE principles) were endorsed by Indigenous bodies and then adopted into mainstream policy documents and regulatory environments, effectively a dual authorisation. Projects that had significant outcomes (Whakatōhea Transformation Framework, Te Mata Ira, Te Mana o te Raraunga) had one or the other. The Whakatōhea Transformation Framework was an important part of their treaty settlement and has been hard-wired into their future relationships with the Crown

at a local level. The Te Mata Ira and Te Mana o te Raraunga projects did not seek a direct endorsement from a Māori authority but were promoted and integrated into policy and decision-making processes.

The nature of the Cultural Reciprocity Framework is that the assessment will reflect the interests and perspectives of the assessor. It is necessary for the person using the framework to be familiar with the project, but this can also introduce bias. The Cultural Reciprocity Framework can be used to assess the commitment to the collaboration and build deeper forms of knowledge co-production, either as part of the development of a project or as mid-project review. It will be useful to reflect on some of the attributes as the project ends (e.g. resource governance, capacity building, data access and use, Indigenous logics & language) as the responsibility for generating outcomes often extends beyond the project, and impact is often measured through downstream activities. Post-project reviews also provide an opportunity to identify areas where dimensions of reciprocity could have been enhanced with a view to improving processes and behaviours in subsequent projects. Impact statements will evolve over time depending on the project's uptake and utility contributes to additional downstream activities and re-assessments of impact can be done at later stages. Eventually the impact of increasing cultural reciprocity could be assessed through an increase in trust and credibility thereby increasing uptake and utility which enhances equity within society, and enhance the vitality of Indigenous knowledge, outcomes which reinforce reciprocal relationships and contribute to a virtuous cycle of deep knowledge co-production.

Figure 13: Logic model informing the Cultural Reciprocity Framework

The Cultural Reciprocity Framework provides a checklist of attributes that research collaborators can address in the context of their project. There is no single right way to do collaborations and make relationships work. While there are some consistent elements and features, around respect for Indigenous people and Indigenous values, leadership matters and factors that enhance Indigenous control within the project are important to the overall success of the project. This relates in part to the cultural robustness of the outputs but more importantly implementation and uptake in the post project phase. Communities are advocates for change and are more likely to use information that they feel invested in through the research collaboration or the implementation phase. The He Pikinga Waiora Framework focuses on implementation science for Indigenous communities promotes the core components of community engagement, cultural centerness, systems thinking and integrated knowledge translation when implementing externally validated programmes within their communities (Oetzel et al, 2017; Harding, 2021).

The limitations of the Cultural Reciprocity Framework are that it is a representation of an ideal situation signalling what activities need to be done but not specifying how to do them. In this sense it has identified the responsibilities, as discussed in literature and recognised within the projects included in

this thesis but doesn't outline how to be responsive to the unique needs of each community. Relationships, built through engagement and collaboration, have a personal element which affects intangibles like intent, motivation, and duty. The attributes within the framework are really proxies for actions which communities use to measure personal qualities, which are themselves challenging to assess.

I was actively involved in each of the projects included in this thesis either as a principal investigator or key researcher. I was able to directly influence how engagement occurred, the research direction, and what outputs were generated. For most of the projects, I had a leadership role which meant aspects of the dimensions of cultural authority and cultural alignment were actively addressed. However, it shouldn't be assumed that having an Indigenous principal investigator automatically results in cultural reciprocity. I could position myself on either side of the cultural interface but was often an intermediary coordinating and communication between different parties to facilitate the co-production process (Ruckstuhl et al, 2019a; Science for Technological Innovation, 2020). Co-production is a group process but often needs someone to facilitate and guide as well as take responsibility for moving activities forward. Sometimes this is the role of the principal investigator but often it is another person within the wider group that takes on this responsibility. I frequently found myself doing both activities within the projects included in this thesis.

Indeed, it was difficult to disentangle my own role as a researcher and contributor to the outcomes of the projects and how that was influenced by my own intent, motivations, and sense of duty towards my iwi and different Māori/Indigenous initiatives. The most impactful outcomes, albeit informed by the research project, were generated by investing time in mostly unfunded implementation activities. My role as a member of Whakatōhea Māori Trust Board made me an insider researcher for the iwi focused projects and I also maintained other committee roles and responsibilities in areas of ethics, genomics, and Indigenous data sovereignty that supported implementation efforts within those domains. I would argue that research practitioners have a more natural approach to knowledge translation, capacity building, and knowledge mobilisation because they not only see where the need is but become actively involved in implementing research outputs. Taking responsibility for change activities is a key component of delivering impact.

The Cultural Reciprocity Framework outlines factors that influence braiding or co-production. The depth of the process depends on how well the various factors are dealt with and this was frequently associated with the underpinning and inter-related elements of power and epistemology. Power as it relates to levels of control and decision-making within a braiding exercise is important. Even in a consensus style setting there are people with more influence over the process so respecting Indigenous leadership and voices is vital. Respect for cultural authority is also associated with respect for Indigenous values and knowledges. It is impossible to effectively braid knowledges without understanding the context, understanding the content, understanding the differences and understanding the similarities. This becomes a foundation for understanding the nuances that enable braiding to be done in a culturally appropriate and robust manner.

Reflections on the future

Mai i te whaiao ki te ao marama[14]

The future is built on the past and actioned in the present. Change is an ever-present feature of modern society, and Indigenous communities, while prioritising cultural continuity, are subject to the same pressures. Whether it be treaty settlements creating new iwi governance structures, digital technologies creating new opportunities to reconnect with taonga, or climate change affecting aquaculture investments, communities are forced to respond to change using all the knowledge and tools at their disposal. After decades of subjugation, marginalisation, and underinvestment, an Indigenous resurgence is underway to recover, revitalise, and sustain Indigenous languages and Indigenous knowledges. The "seven R's" of respect, relevancy, reciprocity, responsibility, rights, reconciliation through redistribution, and relationships reflect value systems aligned to both Indigenous philosophy and Indigenous resurgence (Jacobs et al, 2022). Knowledge revitalisation efforts continue through both research and practice and find spaces to intersect with other knowledges in fluid and dynamic ways that increase Indigenous relevancy across both Indigenous and non-Indigenous settings. A Māori elder and colleague, Moe Milne, once said "I see the world with Māori eyes, everything I see must be understood from a Māori point of view".

Indigenous values and Indigenous knowledge maintain our understandings of the natural and social worlds within which our communities evolved. To see the world with "Indigenous eyes" is to know and appreciate the cultural logics which informed the way they made sense of new contexts and approached new challenges. This is particularly important for the tribal/Māori/Indigenous diaspora living in a multicultural world with constant interaction and change. The ability of Indigenous knowledge systems to make sense of and inform contemporary lifestyles sits at the heart of how Indigenous communities will remain relevant to their members in the future. Cultural revitalisation efforts must continue to strengthen the foundation for Indigenous lifestyles and provide a knowledge base for interactions at the cultural interface where Indigenous peoples engage in all manner of contexts. This will result in increasingly diverse manifestations of Indigenous knowledge and Indigenous lifestyles across society in both traditional communities and contemporary environments.

New manifestations of Indigenous knowledge, most frequently emerging from various forms of braiding or co-production, will be seen differently by different eyes. To some it will represent an advance demonstrating the utility of Indigenous knowledge, to others it will be an act of dilution, threatening the authenticity and integrity of the knowledge itself. Recent moves to utilise Indigenous knowledge within science and innovation will continue at pace driven by continuing JEDI (justice, equity, diversity, inclusion) initiatives, increasing Indigenous capacity in STEM (science, technology, engineering, maths), as well as opportunities for the commercial development of new products and services arising from this space. The application of Indigenous values and knowledges to scientific models and management practices will continue to provide alternative possibilities and futures albeit localised within Indigenous contexts or at the margins of societal processes. Co-production supports the dual strategy of self-determination and integration. Indigenous communities fuse Indigenous knowledge with global knowledge to inform local approaches to self-determination. Similarly, research communities fuse Indigenous knowledge with global knowledge to inform global challenges. Both approaches are logical steps in maintaining the vitality and relevancy of Indigenous knowledge to Indigenous Peoples as well as society. Efforts to expand uptake and embed Indigenous approaches more broadly will require a shift from activities to win the hearts and minds of the populous towards the building of infrastructures that normalise these approaches across physical and digital

[14] From the dawn-light to the world of light

environments. The CARE principles are one example and while they have been adopted at a policy level, they will remain an example of virtue signalling until they directly impact on the way groups make decisions about data collection, storage, and use. The development of an action-oriented framework for advancing data equity is another example of a global framework drawing on Indigenous knowledge (World Economic Forum, 2024). The World Economic Forum Global Futures Council for Data Equity, of which I am a member, decided to utilise a Māori model (Te Mana o te Raraunga) as the underpinning logic of the framework. While the report specifically acknowledges this, and references the CARE Principles for Indigenous Data Governance, the nature of a global instrument required the use of English language, and the Māori terms present in Te Mana o te Raraunga were replaced. Some would argue that this (mis)appropriates Indigenous knowledge, but I felt this was more of a process of braiding together concepts and ideas to co-produce a framework to inform a global audience.

Indigenous communities will have to decide how they want to see Indigenous knowledges expressed in Indigenous contexts and non-Indigenous contexts as it is inevitable that these will be different in orientation if not intent. This reflects both how non-Indigenous peoples respect Indigenous values and knowledges, and how Indigenous communities feel when they adopt or use Indigenous values and knowledges. Historical examples of disrespect, theft, and appropriation represent inappropriate uses of Indigenous knowledge by non-Indigenous peoples but what do appropriate uses look like? Fair and equitable benefit-sharing is the language used in the Nagoya Protocol to represent the need for reciprocity in the use of genetic resources and traditional knowledge from Indigenous communities (Secretariat of the Convention on Biodiversity, 2011). The extension of this to digital sequence information within the Convention on Biodiversity (CBD) reflects both the increasing advocacy for Indigenous rights and the increasing value of digital information (Secretariat of the Convention of Biodiversity, 2023). However, benefit-sharing is still largely predicated on non-Indigenous use of Indigenous knowledge with Indigenous peoples becoming beneficiaries to the entities using their resources.

Actively addressing underlying power dynamics is central to effective operationalising of Indigenous value systems and developing more reciprocal relationships within society. Across these spaces the shift from benefit-sharing to power sharing will promote more equity-based co-management/co-governance frameworks where Indigenous communities are treated with respect and have the authority to enact their traditional practices and sustainable relationships with ecosystems; and/or pathways to actualise the #LANDBACK movement (Jacobs et al, 2022). The importance of getting land back as a mechanism to uphold tribal sovereignty and maintain Indigenous reciprocity and responsibility-based relations with ecosystems, is a template for other important resources including water and data. The #DATABACK movement is a logical extension of the Indigenous data sovereignty movements calls for Indigenous control of Indigenous data in the context of the burgeoning digital ecosystems and economies.

Indigenous futures must also deal with emerging technologies, like biotechnologies and artificial intelligence (AI), that are reshaping relationships and creating new ways to engage in the world. While Indigenous contributions to these spaces will continue to provide critiques of these technologies, in terms of their effects on Indigenous practices and values (mostly negative), and perpetuation of inequities in terms of access and opportunity to benefit, there will also be continuing forms of Indigenous co-option and collaboration with technology producers. The intersection of AI and Indigenous knowledge is being explored through various Indigenous (Shedlock & Hudson, 2022; Lewis, 2023; Lewis et al, 2024; Brown et al, 2024) and non-Indigenous led initiatives (Munn, 2023) following a similar pathway to Indigenous engagement with other sciences and technologies. This will create tensions as Indigenous communities debate the effect of these changes on the relevancy, integrity, and

authenticity of these new Indigenous and/or hybrid knowledges to their lifestyles and livelihoods. Indigenous communities have navigated these discussions in the past and have the ethical principles and tools to negotiate them in the future if they retain the authority and autonomy to make their own decisions. The most significant difference in the future will be the rate of change and whether communities can build the necessary capacities in Indigenous knowledge and science to proactively engage in these debates in a timely manner. Deep knowledge co-production isn't just an exercise that happens between knowledge systems but can also occur within knowledge systems as communities negotiate different aspirations and experiences. The principles of respect, relationality, and reciprocity have informed Indigenous relationships for generations and remain useful and relevant for navigating new forms of collaboration and partnership into the future. In the interests of creating a fair and equitable society a renewed commitment to reciprocity in the context of braiding Indigenous knowledge and science will improve relationships across a range of cultural interfaces and enhance the innovation potential of Indigenous knowledge.

Koi te mata punenga, maiangi te mata puihoiho

Reach for knowledge, strive for excellence

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Appendix 1: Cultural Reciprocity Framework for Deep Knowledge Co-Production

Authority Attributes	**Description - Respects Indigenous Authority**
Project governance	Indigenous groups are actively involved in setting the agenda and directing the project through governance and decision-making roles. Indigenous led, Indigenous directed, researcher directed, or researcher led.
Resource governance	Indigenous groups are supported into positions that enable Indigenous control of Indigenous resources.
Data governance	Indigenous groups are actively involved in decisions about use of Indigenous knowledge and Indigenous data, have formal roles in data governance, reflect CARE principles for Indigenous data governance.
Rules & process definition	Indigenous groups have the authority to define the parameters of the project including rules of engagement and operational processes.
Alignment Attributes	**Description – Respects Indigenous Aspirations**
Project purpose	Project is led by Indigenous aspirations with clearly stated aims.
Indigenous roles	Project is clear about the roles of Indigenous members in governance and operations.
Indigenous development	Project is clear about how it contributes to Indigenous outcomes and development needs.
Indigenous capacity building	Project builds capacity of Indigenous participants and/or Indigenous institutions.

Integrity Attributes	**Description – Respects Indigenous Values**
Community engagement	Ensures appropriate participation Indigenous community members and Indigenous knowledge holders in research activities.
Indigenous ethics	Respects cultural protocols that enable culturally appropriate research practices and use of Indigenous methods.
Data access & use	Develops protocols that respect individual and collective privacy and ensure Indigenous knowledge and data are managed with appropriate care including who has the right to access and use Indigenous knowledge and how issues of Indigenous data sovereignty and intellectual property will be addressed.
Recognition	Respects protocols that support appropriate acknowledgement, attribution, and authorship of Indigenous participants.
Veracity Attributes	**Description – Respects Indigenous Knowledge**
Provenance	Indigenous knowledge is gathered from the correct sources and the project is transparent about this and provides appropriate acknowledgement on outputs and in public settings.
Context	Indigenous knowledge is used in the right context for the right reason and is identified, analysed, and interpreted in an appropriate manner.
Indigenous logics & language	Project outputs make appropriate use of cultural logics, cultural cues, and Indigenous language when reporting findings and engaging in knowledge exchange activities.
Indigenous review	Project outputs have been sense-checked by Indigenous communities and the messages and language are appropriate.
Impact	*Negligible - Limited - Moderate - Significant – Major*

Appendix 2: Cultural Reciprocity Framework Reporting Template

Project:		
Dimensions & Attributes	**Rating Y/N/M/NA**	**Description**
Cultural Authority		
Project governance		
Resource governance		
Data governance		
Rules & process definition		
Cultural Alignment		
Project purpose		
Indigenous roles		
Indigenous development		
Indigenous capacity building		
Cultural Integrity		
Community engagement		
Indigenous ethics		
Data access & use		
Recognition		
Cultural Veracity		
Provenance		
Context		
Indigenous logics & language		
Indigenous review		
Impact: *Negligible - Limited - Moderate - Significant – Major*		