Cultural Magnitude

Interactive visual mapping - a hybrid network for indigenous data

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OPPOSITE PAGE:
Figure 0.1 Compass Rose

Whakataukī

Māori Proverb

Whakawhiti ana te pō hei ātārangi kē, inā noa he paku hinātore. Korekore te rama e ngaeki.

*Even as a great darkness, one small light will change it into a great shadow.
Even as a great shadow, it will always recede to that small light.*

ABSTRACT

This research has been undertaken in response to the limitations of standard mapping techniques, in particular, those that use ESRI-based technology and delivery. The work argues that our ability to understand the complex nature of indigenous ontologies and spatial models are affected by the available tools and their ontological frameworks. It sets out to visualise, in a tool, traditionally non-physical, but inherently spatial, data and information. The map, in a traditional sense, now becomes a fluid, open, self-referential virtual topography or ‘space’, challenging the rational top-down fixity of western cartographic representation. As an architectural thesis, it seeks to create holistically structured space as a virtual edifice and is concerned with that which is not represented and concludes that the most important aspect of creating a mapping framework for an indigenous ontology is to understand the inseparable relationship between people, knowledge and land.

The research describes a tool designed and built by the author that contributes to cultural and spiritual health (whai ora) and wellbeing of Māori. Through its ontological framework, it aims to provide an alternate map that enables users to navigate and share cultural knowledge. The central concept is to ‘re-connect’, in particular, urban and disenfranchised Māori, through the creation of a virtual space that can be customised and inhabited in various ways by its users. It questions and challenges what is included and what is excluded, what can be represented, asking where might culture have a ‘place’? How might people and their environments effect change in themselves? In others?

Cultural Magnitude is the exploration of the development of a tool that acts as a digital representation and storage place of *whakapapa* and *taonga*, and as a cultural resource for Māori to understand their spiritual bounds to physical locations - a tangible foundation for a digital marae.

“Actually identities are about questions of using the resources of history, language and culture in the process of becoming rather than being; not ‘who we are’ or ‘where we come from’, so much as what we might become, how we might represent ourselves...they oblige us to read...not the so-called return to roots but a coming-to-terms-with our roots” (Fung 107).

Preamble:

Before the question

So much work has been done and is being done to revitalise Māori culture in New Zealand. The fires are being kindled, and scattered parts of our culture are being gathered and put back together.

But our culture needs you.

This work is for Māori and Māori descendants who have too often been asked, “How Māori are you?” It is for those who do not feel “Māori enough” to connect to our culture. It is for those who have been made to feel like the Māori part of them is less. This work aims to reaffirm to you that not only do you belong but you are an essential part of our culture.

This work is for our cultural leaders and *kaumātua*. Your wisdom and resilience have ensured our survival. Now is our chance to thrive once more, with our own self-determined futures. This work, whether it is the right or wrong path, is an investigation into what digital tools can offer in navigating these futures. It is for those who share their cultural knowledge, with patience, *āroha* and respect for *tikanga* Māori, investing into our future generations.

This work is for non-Māori. The nature of Māori knowledge tends to make it either known or not known to the outsider. This work attempts to bring a third option: to know *and* not know through visualisation and interaction. Much of Māori knowledge, especially in relationship to the land, is invisible to non-Māori because it is protected knowledge. In the spirit of the Treaty of Waitangi, this work hopes to shine a light on the existence of that knowledge, while also protecting it.

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1.0 INTRODUCTION

Research Proposal, Scope & Research Question

There exist large health and socio-economic inequities amongst the indigenous nations of New Zealand, North America, Canada and Australia as a direct result of land dispossession from European Colonisation (Voyle and Simmons 1037). Within Aotearoa, the urbanisation of Māori from rural to urban contexts has de-centered the marae as the traditional nexus of Māori culture and customs. An opportunity exists to use digital technologies to develop bridges (new maps) to address these issues that now span both distance and time, by creating digital connections between people, knowledge and land.

In a Post-Waitangi Tribunal Settlement era, many current architecture projects are working in and with Māori communities, focusing on work that can benefit individual communities, for example, urban developments and papa kāinga (cultural community housing) as a means of reconnecting and geographically ‘resettling’ displaced Māori populations. While this is important and ongoing it addresses only a part of a more holistic equation. This thesis zooms out to a wider focus and asks how digital tools could help to aid in understanding the bigger picture of what is happening amongst the Māori population. The insight gained by this change in perspective might aid in the development of better responses to these issues of urbanisation and colonisation. The research questions how the individual can connect to the wider community and how community leaders might be able to access data that is vital to navigating the future of their communities.

This thesis proposes that a 3D mapping framework could be a cultural information model and visualisation tool that provides a way to visualise Māori ontologies and spatially analyse and manage Māori communities, cultural resources and social connections. The research seeks to create a digital umbrella framework for Māori data that could disseminate information visually that previously hasn’t been available, either to Māori or the general public.

Scope and limitations

The scope of this thesis is not limited to a single site but moves through scales from the individual person to a global scale. The scope is necessarily big - to capture the holistic nature of Māori wellbeing. Therefore mapping, drawing, and making relationships between these scales are the focus of the thesis. The work produced in this thesis has an emphasis on using digital tools and the work presented is in the format of interactive web maps, diagrams, sketches and virtual 3D environments.

No consultation with Māori communities or user testing of the tool was undertaken. Although initial consultations took place to see if a participatory group could be engaged, after discussions around who the data would belong to after the thesis ended, it was deemed that the cultural knowledge involved could not be completely protected at this time by academic ethical policies and the level of engagement sought was outside of the scope of the thesis year.

The research questions:

“How might a cultural information modelling and visualisation (CIMV) tool aid deeper understanding of holistic tribal environments?”

&

“How can we inhabit and interact with the scale of indigenous knowledge through this tool?”

Aims:

The main aim of the thesis is to connect Māori to their whenua and each other, in an effort to mitigate the on-going effects of colonisation which include the health inequalities of Māori and the possibility of traditional iwi marae disappearing in our lifetimes. As that is a difficult aim to evaluate as a design outcome and it would be deterministic to define how it should happen, these aims have been listed as possible steps towards achieving that aim through design:

- Connect Māori to their ancestral lands
- Connect Māori individuals to communities
- Connect Māori communities to each other
- To make visible these relationships and communities

Objectives:

Create a space where dialogue can occur between individual Māori, non-Māori, New Zealanders and wider communities using digital tools.

Methodology

The research in this thesis used a process of research through design. To understand spatial issues stemming from the colonisation and urbanisation of Māori, mapping as a method was used. First existing ESRI-based GIS mapping methodologies were explored - then following a discussion of their limitations and opportunities, an interactive web GL environment was created.

The first phase of the design work employed positivist methods of mapping. A positivist ontology assumes that there is one reality and the epistemology of positivism is an objective approach where the researcher is separate from the research they are manipulating (Groat and Wang 32).

The second phase of design work questioned the appropriateness of the first methodology and employed spatial agency as a new methodology, which aligned more with an emancipatory epistemology of research and with a Māori ontology. An Emancipatory research framework operates from an ontology that acknowledges that there are multiple realities and the epistemology of emancipatory research is that there must be an interactive and collaborative link between the researcher and participants (Groat and Wang 32).

Sitting under or next to this framework of emancipatory research is the localised approach of Kaupapa Māori research. Linda Tuhiwai Smith, a professor of indigenous education at the University of Waikato, has written about Kaupapa Māori as a way to decolonise research methodologies. She describes it as research that is done by, through and for Māori and should try to make a positive difference for the researched with a view to short-term and long-term benefits (193). She argues that Kaupapa Māori is not meant to be a research paradigm in comparison with western science (190) but that it:

“weaves in and out of Māori cultural beliefs and values, Western ways of knowing, Māori histories and experiences under colonialism, Western forms of education, Māori aspirations and socio-economic needs, and Western economics and global politics” (Smith 191).

For Kaupapa Māori research to proceed Smith argues that “researchers have to share their ‘control’ of research and seek to maximise the participation and the interest of Māori” (191). Kaupapa Māori is a philosophy that incorporates Māori values and knowledge and operates through an agenda that reflects this. As a research approach, it takes for granted the legitimacy and validity of Māori knowledge and worldviews. This offered a path for decolonising the mapping process and the design process.

Evaluating the work

The work in each phase of design was evaluated based on its research approach and the epistemologies and ontologies associated with them. The quality standards of positivist research are “Internal validity, External Validity, Reliability and Objectivity” (Groat and Wang 36- 37). The first phase of research was evaluated based on these standards.

The Quality standards for Emancipatory Research are “the historical situatedness of the inquiry, the extent to which the inquiry acts erodes ignorance and misunderstanding and the transformative potential of the inquiry (Groat and Wang 40)”. The second phase of design was evaluated on these standards.

Thesis Structure

2.0 RESEARCH CONTEXTS

Research Contexts

Colonisation and Urbanisation

The advent of Europeans arriving in New Zealand forever changed the way of Māori life. Colonisation needs to be understood not as something that happened as a singularity at one point in time nor is it confined to a historical event but it is a process with a continuous effect, reverberating through time. This process ends when the indigenous culture are reformed/ assimilated or in many cases extinguished.. As we try to address colonisation today, we need to look at the context of history to understand how these issues arose and what they might mean in the future.

Several medical studies on the health disparities facing indigenous people that have been colonised came to the same conclusions which are summarised in this quote:

*“Indigenous people who have been dispossessed of their lands and resources bear a disproportionate burden of health problems”
(Voyle and Simmons 1037).*

In Māori culture, oral knowledge was traditionally only passed down at particular physical locations (marae) that have cultural protocols in place to protect the knowledge. This process of passing down sacred cultural knowledge from ancestors orally has been disrupted, first by land dispossession and then by urban shift in the 1950s. With most Māori now living in Urban centres, new generations of young Māori are growing up far away from their ancestral marae, often only returning for funerals or not at all. A rising number of Māori do not know their iwi affiliations and only 21% of Māori responded as being fluent in the Māori language in the 2013 census.

TOP Figure 2.1: A sketch of the oral traditions and the marae as a mnemonic device.

MID-PAGE Figure 2.2: A sketch of urbanisation and the loss of younger generations.

BOTTOM Figure 2.3 A sketch showing the passing down of knowledge from kuia (grandparent) to mokopuna (grandchild) and the missing links in the chain due to colonisation and urbanisation.

Ngā huarahi ki te marae: Māori connecting to their ancestral marae

Figure 2.4: Ngā huarahi ki te marae: Māori connecting to their ancestral marae. **Statistics New Zealand.**

Treaty of Waitangi | *Te Tiriti O Waitangi*

The Treaty of Waitangi, first signed in 1840, is a contentious document that will not be expounded upon in this research but it is important to note that the spirit of the treaty was one of a partnership between two peoples and that Māori were guaranteed equal rights to British citizens of the Crown under the treaty. Grievances about non-fulfilment of many of the agreements in the Treaty with this understanding have been brought before the Waitangi Tribunal, but the holistic well-being of Māori is still a subject that requires scrutiny.

“Implicit within the Treaty were the concepts of equity, partnership, and economic and cultural security, all of which contributed importantly to Hauora (spirit of life/health). Poor standards of Māori health may, therefore, be regarded in part as non-fulfilment of these Treaty concepts and obligations” (Pomare and Boer 21).

With this understanding of well-being in relationship to the Treaty in mind, it becomes apparent that this is an issue to concern all New Zealanders that have an interest in maintaining the partnership of the peoples of the Treaty. This research attempts to find new ways of addressing these inequities by examining them with expertise in spatial problem-solving and by using a digital lens, and by considering the historical and social contexts within which these issues have arisen.

Post-Treaty of Waitangi Tribunal Settlements Era

In 1975 the Waitangi Tribunal was established to settle grievances of Māori against the crown. This has resulted in some iwi receiving large settlements of money and natural resources. As iwi look to the future for wise ways to invest these settlements and safeguard them for the future generation, there is a need for more information about the people in their communities and about their cultural resources. Most iwi have registries and protected databases about the people that whakapapa to them. However, since urbanisation, many Māori have lost or forgotten their iwi connections, and so they sit outside of the range of the support that might be offered to them otherwise from their own iwi.

As iwi ask how to support their whanau at home and how to support their whanau in cities, more data needs to be available as a decision-making aid.

Holistic Tribal Environments

Hauora Māori is the holistic view central to Māori that includes issues of land, language, extended family and culture which contrasts strongly with the Western model that focuses only on the physical aspects of health and the individual (Voyle and Simmons 1037). This concept of health was captured in a modern healthcare model designed by Sir Mason Jason Durie, and is known as Te Whare Tapa Whā, which has four parts:

- Taha Hinengaro – Mental Health
- Taha Wairua – Spiritual Health
- Taha Whanau – Extended Family health
- Taha Tinana – Physical health

These four elements are inextricably linked to whanau relationships which mean that when an individual is not well, a whanau is not well and vice versa, which is a collective state of well-being that aligns with iwi thinking around the holistic and indivisible (Lawson Te-aho 40).

An element of this model is often left out of or not emphasised in newer iterations of te whare tapa wha, and that element is whenua – land. Loss of land and the associated loss of pride, identity, tribal structure, culture and spirituality, has caused direct and indirect suffering of health amongst Māori (Ellison-Loschmann and Pearce 612; Voyle and Simmons 1037). The urbanisation of Māori, which has led to over 80% of Māori living in city centres, is the “root of the unequal health experience of the Māori people” (Pomare and Boer 31). A generational gap has sprung up amongst urban Māori who have not been raised with knowledge of their Māori culture or language. Simultaneously, the elders with the knowledge that still live at their tribal marae are beginning to pass away. For example, the elders at Ngai Tawake marae have become concerned that marae could face extinction if young people do not return and that say that, although they have been offered money, what they really need is people (Roy 2).

Thirty years ago, the only place for urban Māori to find out about their culture and language was in gangs (Webber 50). Since then, through Māori entrepreneurship, Urban Māori Authorities have emerged as “one-stop-shops” for health, social, justice and educational services and are seen as “the most visible response to urbanisation” (Keiha and Moon 7). Urban Māori Authorities are pan-tribal and cater for urban Māori who either do not know or do not identify with their tribal roots. They are seen as challenging existing tribal authorities and structures (Keiha and Moon 7) because they primarily operate through contracts with central government and local bodies whereas Māori tribal organisations advocate for tribal self-management (Meredith 5).

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Figure 2.5: Hauora Māori
– Te Whare Tapa Wha.

HAUORA Māori

Te Whare Tapa Whā

Māori

NON-Māori

DEPRIVATION

Figure 2.6: Deprivation
Graph. Data from **Minis-
try of Health**, 2013.

SUICIDE

Figure 2.7 Suicide Graph.
Data from **Ministry of
Health**, 2013.

UNEMPLOYMENT

Figure 2.8 Unemployment Graph. Data from **Ministry of Health**, 2013.

LIFE EXPECTANCY

Figure 2.9 Life expectancy Graph. **New Zealand Statistics**.

SPEAK TE REO MAORI FLUENTLY

OF NEW ZEALAND'S PRISONERS
ARE MAORI

OF PEOPLE OF MAORI DESCENT
DO NOT KNOW THEIR IWI

LIVE IN DECILE 8-10 AREAS

A Domino Effect...

There is a tendency to focus on the current socio-economic and health problems in the Māori population without the context of history. The government pours money into initiatives to address these issues, but until they are understood as symptoms of spatial problems, efforts to make changes could be considered similar to putting Band-Aids on holes appearing in a water dam – eventually the dam will burst, and the consequences could be irreversible.

OPPOSITE PAGE:
Figure 2.10: New Zealand Statistics, **Ministry of Health**.

TIMELINE

3.0 LITERATURE REVIEW

Literature Review

The research in the thesis drew from expert knowledge across disciplines of landscape architecture, colonial history, political science, philosophy, sociology and architecture to find a contextual understanding of the spatial implications of urbanisation and colonisation. Key to the research was the need to connect people across large spaces and to understand their social and historical contexts. Mapping provides the ability to understand spatial implications of information across scales of space and time. In a new architecture project, maps are often the first step taken in understanding a site because of their abilities to take large sets of data and reduce them to understandable images. This section of the thesis examines current mapping methods, historic mapping methods, Māori knowledge and architectural theory.

Since the inception of the Environmental Systems Research Institute (ESRI) in the late 1960s it has become the market leader in geographic information systems (GIS) and geodatabase management software applications worldwide (Alban). With GIS evolving initially from the principle of graphically represented informational overlay in the work of Landscape Architect Ian McHarg, the technique allowed concurrent sets of ‘data’ maps to communicate co-relation across the various prioritised layers. This allowed for tentative insight into the coordination of infrastructure development criteria and decision-making with existing ecological and mapped landscaped features. The method could also extend to the mapping of social statistics and demographic geospatial data as a means to gauge societal composition and trends. While the subsequent digitisation of this method over time has seen a shift from vector line based content to eventually incorporate both raster and vector the visualisation aspect or user experience in the mainstream has remained relatively static in the communication of quantitative vs. qualitative understandings of magnitude and cause and effect.

The positivist epistemology and western ontology of GIS mapping methods

create a framework that does not fully acknowledge the complex relationships of indigenous ontologies as visual data and by extension, promotes a western hegemony that subverts indigenous cultures. If indigenous knowledge were an alphabet, then the western scientific method of mapping only recognises the vowels of that alphabet as important data to be mapped. This limited way of comprehending and visualising the nature of indigenous knowledge inherently restricts the map from being a complete and accurate representation of indigenous cultures. The disassociation of the map maker and the map user in western science was not, historically, a Māori way of navigating the world nor does it allow for the Māori protocols of the stewardship of knowledge. Professor Giselle Byrnes, a historian, wrote about the colonisation of New Zealand through land surveying. She argues that the ignorance of the first explorers about the land resulted in them demanding:

“...local knowledge not as it came, structured in an indigenous way of seeing, but broken down into data which they could then fit into their own geographical scheme. This marginalised indigenous convention by reducing its conceptual structure to ‘information’ and its world-view to ‘a negative “absence”, or “failure” to show what European maps showed” (Byrnes 94).

Byrne concludes that this process of taking and reducing indigenous knowledge for the first surveying of New Zealand was a process of colonisation by “invasion, inspection and inscription” (94). The continued use of western mapping to describe and navigate the world, then, is a continuing process of colonisation, especially as Māori have adopted and primarily use this system of mapping today in everyday life.

Maps are a way of describing and defining a nation. Thongchai Winichakul, in work that discusses the colonisation of Siam by the British, eloquently summarises Benedict Anderson’s work *Imagined Communities*, writing that nationhood is a cultural construction, only made possible by the effect of imagining it. He argues that “we can only know about it as long as we employ certain technologies to inscribe the possible sphere. In turn, such technologies create the knowledge of it, create a fact of it, and the entity comes into existence” (15). Therefore mapping, as a digital technology, is a powerful tool for affirmation of cultural identity for indigenous peoples living within constructed colonial nation states. It also offers indigenous people the opportunity to develop their self-determined futures with a basis of accurate geo-cultural data to draw from, but this requires using an indigenous lens to develop the framework of how to map and providing the agency for users to decide what to map, or even whether to map at all.

Before European contact, Māori used only oral cartography to navigate

Figure 3.1: Chart of New Zealand drawn by Tooke-Titter-a-nui Wari-pedo, a priest of that country who resided on Norfolk Islands 6 months. Alexander Turnball Library.

Motu-cowa Inhabited by 100 People

Pani-ke Inhabited by 50 People

Here the Daedalus took Toogee & Hoodoo on board

space. In Māori Maps by Jan Kelly, maps made by Māori at the first point of contact with Europeans that employ western methods of mapping were examined. One of the maps, drawn by two captured Māori men, Huru and Tuki, for Lieutenant-Governor King at Norfolk Island in 1793, depicts part of the North Island of New Zealand. The map has important spiritual landmarks on it, for example, the most prominent path on the map is Te Ara Whaanui, the path the spirit takes on their way to the underworld. Kelly's conclusions on the mapping of unusual landmarks were that "[they] were naming the landscape with equal validity in terms of spiritual and mythical qualities, human detail and physical attributes of place – all of these elements being equally 'real' and, while they can be listed verbally, not separable" (20).

Kelly argues that all the maps examined in the paper seem to hint at additional knowledge that was unable to be captured by standard mapping methods of the western world and that they were just the base for a richer sphere of knowledge possessed by the Māori mapmakers, with the intention of using that knowledge in tandem with the drawn maps. "These lines, the only 'Māori Maps' we have, may well turn out to be a framework on which to hang the spoken text, the words, as much as shaped items in their own right" (21).

Understanding the nature of Māori knowledge is an important aspect in the development of a framework for mapping it. Mātauranga Māori is the knowledge Māori brought with them to New Zealand, and it has evolved and changed with them in the time since, being passed down orally through generations. Sir Hirini Moko Mead, a prominent anthropologist, historian and writer described the nature of Māori knowledge:

"Mātauranga Māori is not like an archive of information, but rather it is like a tool for thinking, organising information, considering the ethics of knowledge and the appropriateness of it all and informing us about our world and our place in it" (306).

This could be interpreted as Mead describing the nature of Māori knowledge as being alive, intrinsically linked to the people and places that carry it, changing and adapting with them as they and their environments change and acting as a resource to draw from as a navigational tool not just for space but for navigating identity. A museum or a cultural centre, therefore, is not the right approach for containing this knowledge. The knowledge has to be able to evolve with the people that it resides with. Historically, when Māori lived in close proximity to their whare tipuna (ancestral house), the whare acted as a mnemonic device in a living, working relationship with the residents of the whare, to store, recall and safeguard knowledge. The whare still has this capacity even with the advent of new urban marae. However, with the

urbanisation of Māori, and many Māori forgetting or losing their cultural connections as their lifestyles adapt and change, there needs to be a way to extend the capacity of these architectural typologies to reach across time and space and reconnect with people, and to make new connections. Digital tools provide the ability to bend to the spatiotemporal requirements of the information, and as indigenous nations urbanise and migrate, digital tools provide the ability to connect to people across the globe.

The development of a Māori cultural information model must be, by necessity, a social space. If Māori knowledge is alive, then it is also shared between the living people that carry it. Each individual has a personal stake in the knowledge and therefore also in any map and space that is made to represent its existence. It is important for the individual to be able to form a relationship with the space and the information contained within it. Western culture is highly individualistic, but Māori culture is collective. The current method of mapping, when applied to indigenous data, uses an individualist point of view while trying to map a collective truth – impossible to do with any accuracy.

Henri Lefebvre, a French Marxist philosopher and sociologist, wrote that “(Social) space is a (social) product” (27). If people produce a space, then implicit within that production is control and influence over the nature of the space and the space produced reflects the nature of that society. Lefebvre’s brief but potent statement calls into question the nature of spaces that might have been considered neutral or empty spaces previously. It asks us to consider the social contexts of the spaces we produce. It implies that the architect does not sit apart from these contexts when designing a space but operates within these contexts.

Drawing on Lefebvre’s work, the work of Cedric Price and Anthony Giddens, a new architectural theory called Spatial Agency has been introduced by Nishat Awan, Tatajana Scheider and Jeremy Till. In their exploration of what they call “other ways of doing architecture” they analyse the role of the architect as a spatial agent in the production of social space. They argue that agency implies that the architect has degrees of appropriate actions, depending on the social context of their work and that brings a new way of operating:

“the normal modus operandi for an architect is to add something physical to the world; this alternative suggests that, in the spirit of Cedric Price, the addition of a building is not necessarily the best solution to a spatial problem and that there are other ways of making a spatial difference” (Awan et al.31).

This implies that the architect should not operate as an expert in the design process but that the architect may need to collaborate and find other contributors who have more knowledge on the social contexts than they have.

Spatial Agency places importance on all of the processes of spatial production and not just the built form that is often the outcome of solving spatial issues. The dynamic context that it operates within means that it might be expressed physically as a building, installation, or exhibition or less tangibly, as a map or network, or even as both simultaneously (Awan et al 55).

What then is the role of the architect, when trying to make allowances for spatial agency? Awan, Scheider and Till describe it as:
“...the agent is one who effects change through the empowerment of others, allowing them to engage in their spatial environments in ways previously unknown or unavailable to them, opening up new freedoms and potentials as a result of reconfigured social space” (Awan et al 32).

In this new role, the architect as an authority is cast aside for a more collaborative position. This theory provides insight into how to provide agency to all of the people that will engage with a social space and in doing, so it provides a way to decolonize the design process. The theory aligns well with Hauora Māori and moves, not only the design process but the final design intervention away from being a top-down process to a more bottom-up approach.

Summary and opportunities for Design

Although Māori engage in current mapping methods and use them to their best advantage, the tools do not provide the ability to reflect the entire world view of Māori, as western mapping methods were made for a western ontology. GIS mapping systems, currently the most popular way of mapping, are built within this western ontology. The implications of this is a continued colonisation of Māori space through western mapping methods. However, there is opportunity re-examine these methods to see what they can offer towards creating decolonised mapping methods that reflect a Māori ontology, and that could be a way to connect Māori to each other and their cultural ties.

Spatial Agency offers a process for testing this and may align well with the dynamic nature of mātauranga Māori and the holistic nature of Māori well-being. It provides a decolonised process for presenting a Māori worldview and offers a collaborative, participatory design process.

4.0 CASE STUDIES

Case Studies

“Atlas of the Conflict: Israel-Palestine”. Malkit Shoshan. OIO Publishers.

This book was extremely useful as a precedent for the first design phase. The book sets out mapped illustrations of the conflict between Israel and Palestine.

A weakness of the work was the inaccessibility of the maps outside of owning the book and the difficulty of comparing maps on different pages. This inspired the web-based approach for the first design phase.

Figure 4.1 & 4.2: Atlas of the Conflict, Joost Grootens

Māori Maps | Te Potiki National Trust | Māorimaps.com

Māori maps is landmark work begun in 2007 by Professor Paul Tapsell of Otago University that maps where tribally affiliated marae are in New Zealand.

A weakness of the work is that it is top-down and the residents of the marae are neither collaborators nor contributors. The mapped work is done by administrators of the website, collected from public sources and iwi can only control the information of what is mapped after the fact, by proactively contacting the owners of the website.

Another weakness is that it only shows currently existing tribally affiliated marae. This presents two issues. First is that new Urban Marae and Urban Māori Authorities are excluded. Secondly, marae that historically existed are not shown. This exclusion artificially promotes the importance of tribal marae over urban marae.

Being able to see where a marae is on a map is only the first step to empowering and connecting Māori individuals and communities. Māorimaps.com provides some information about the marae and contact information, but there is no way for a user to actively engage with the marae through the map, so an individual person cannot connect through the maps to their marae dynamically.

OPPOSITE PAGE
Figure 4.3: Still image of
Māorimaps.com

Google Earth | google.com/earth

Google Earth for Desktop is a popular choice of tool for mapping amongst iwi in New Zealand. It is relatively easy to learn to use, and it provides personal and private data storage. However, there is a lack of ability to share data/knowledge with outside parties without giving away information.

The features that made Google Earth popular for iwi to use need to be utilised. These features are the ability to map large sets of data within a landscape and to store metadata about each point on the map. Google Earth also offered the ability to see data within a spatiotemporal context, which is extremely important for understanding the historical context of iwi data, and for simulating potential future outcomes in a variety of scenarios.

In 2012 Google deprecated their Google Earth API for the web browser which has meant that there is no platform for using Google Earth in the browser since. This has seen a recent shift away from Google Earth to other, new web browser platforms. Web accessibility is essential for making a tool that can connect to people anywhere.

OPPOSITE PAGE:

Figure 4.4. Still image of
Google Earth for Desktop.

Wikipedia | wikipedia.org

Wikipedia allows users to enter knowledge on any subject. It challenges the idea of there being one “true” knowledge, as any person can enter anything on any subject. For this reason, academics do not support the use of Wikipedia as a source of knowledge in research.

Facebook | facebook.com

This online social space could currently be considered the most popular form of social networking. For Māori it is one of the only ways to digitally connect with their iwi and hapū, using Facebook groups. Facebook allows Māori individuals to connect to their friends and whanau as well as their wider communities from anywhere in the world. Individuals can keep up to date with current events happening at their marae and post comments on the group’s page.

A weakness of Facebook groups is that they are limited in the way a person can manage memberships, and they are not designed for cultural nuances.

Ancestry | ancestry.com

Ancestry is a private and personal way to browse family links and find family information. Each visitor can create a private family tree to view. Information about people that are still alive is confidentialised to other users. Ancestry.com provides an essential tool for searching genealogy worldwide. Ancestry is a key precedent for developing a way to visualise and share whakapapa information within a Māori ontological framework.

OPPOSITE PAGE:
Figure 4.5. Still image of
a genealogy tree from
Ancestry.com

I remember | Werkstatt & CLM BBDO | I-remember.fr

I remember is a digital space for raising awareness about Alzheimer's. The site engages visitors by inviting them to record a personal memory on the site which is visualised in a "landscape" of dots. Visitors can click into this landscape and read memories left by other visitors. If memories are not added regularly then the site erases memories over time, until none are left.

This project is a poignant and simple way to engage visitors of a website in creating a social space. The ability for visitors to contribute to the site creates a connection with the social space.

I Remember is built on a WebGL platform and showcases the ability for WebGL to build a 3D environment that can have meaning to many people.

Figure 4.6: Still images of *I remember* website.

Case Studies of WebGL projects:

For the second design phase, WebGL was used as the selected tool.

While many small projects using webGL have been done as experiments and can be viewed online at chromeexperiments.com/webgl, large scale projects pushing the boundaries of what webGL can do as a tool are still limited.

Two projects were selected on the basis of having developed user interfaces and the use of the Cesium javascript library (the selection criteria for this is explained in the second design phase chapters).

Australian government map | nationalmap.gov.au

A new mapping system built by the Australian government allows for government and user datasets to be overlaid on a 3D globe. This system uses Cesium and React together and was an important precedent for the second design phase, as there are extremely limited amounts of websites that use these two javascript libraries in combination currently.

OPPOSITE PAGE:
Figure 4.7 Still image of
National Map Australian
Government.

DATA COLLIDA | SENSEable City Lab MIT & Singapore-MIT
Alliance for Research and Technology (SMART) & Univer-
sity of Zagreb & Faculty of Electrical Engineering and
Computing | datacollider.io

Datacollida uses Cesium to power data driven projects. Although the tool itself is not yet available for public experimenting, one project is available for viewing which is Airscapes Singapore.

Airscapes Singapore | eoe.airscapes.io

This project uses crowd-sourced data to analyse air pollution and visualises it in real time. The site describes the purpose of the work as visualising the connection between people and the air pollution in their urban experiences with the intended effect of a behavioural change that minimizes their exposure and the consequent impacts on their health.

This site was an excellent precedent for the spatiotemporal capabilities of the Cesium javascript library.

OPPOSITE PAGE:
Figure 4.8. Still image of
Airscapes Singapore.

5.0 FIRST DESIGN PHASE

Dot Density Maps

The work in this chapter can be viewed online at data.māori.nz

For the first design investigation, current standard GIS mapping techniques were used to explore the existing space and present how existing Māori data currently fits into existing mapping ontologies. The maps created investigated data correlations about the Māori population in New Zealand and Māori land alienation. This stemmed from questions arising from various Māori groups as they undertake new urban development plans and examine the possible investments they can make of cultural resources in their tribal regions. Some of those questions were:

- Where are Māori today in relation to their traditional ancestral land holdings
- Who are ‘Urban Māori’?
- What age groups of each iwi are residing where?

The primary data source was government provided data such as the New Zealand census. The maps created are web-based interactive maps.

OPPOSITE PAGE:

TOP: Figure 5.1 Still image of QGIS interface.

The first map created was a dot density map. The population data for Māori, Europeans and Asians residing in New Zealand during the 2013 census was taken into QGIS software, and the corresponding number of dots (one dot to one person) were overlaid on the correlating mesh-block. The dot map layers were then exported as shapefiles, and raster tiles were generated for each zoom level using the Mapnik toolkit. The tiles were then uploaded to the web server, and the Leaflet javascript library was used to display this in the browser.

BOTTOM: Figure 5.2 Still image of data table in Microsoft Excel.

An experiment of overlaying vector maps showing shaded areas indicating the land dispossession of Māori over a century was undertaken, with the intention to map it against Māori population diaspora. However, reliable

QGIS 3.16.0

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random_points
map_layer

Shortest path

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Clipboard Font Alignment Number Styles Cells

D31 Ngati Tara Tokanui

	A	B	C	D	E	F	G	H	I	J	K
241		1 Northland Region	407 Tuhourangi (Te Arawa)		99 Total people, age group		9 Total people, sex		2013	2013	6
242		1 Northland Region	408 Uenuku-Kopako (Te Arawa)		99 Total people, age group		9 Total people, sex		2013	2013	11
243		1 Northland Region	409 Waitaha (Te Arawa)		99 Total people, age group		9 Total people, sex		2013	2013	11
244		1 Northland Region	410 Ngati Whakaue (Te Arawa)		99 Total people, age group		9 Total people, sex		2013	2013	19
245		1 Northland Region	411 Ngati Tuwharetoa		99 Total people, age group		9 Total people, sex		2013	2013	85
246		1 Northland Region	412 Ngati Tahu-Ngati Whaoa (Te Arawa)		99 Total people, age group		9 Total people, sex		2013	2013	11
247		1 Northland Region	5 Total people, Tauranga Moana/Mataatua (Bay of Plenty) Region		99 Total people, age group		9 Total people, sex		2013	2013	218
248		1 Northland Region	500 Tauranga Moana/Mataatua (Bay of Plenty) Region, not further defined		99 Total people, age group		9 Total people, sex		2013	2013	1
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250		1 Northland Region	502 Ngaierangi		99 Total people, age group		9 Total people, sex		2013	2013	37
251		1 Northland Region	503 Ngati Ranginui		99 Total people, age group		9 Total people, sex		2013	2013	13
252		1 Northland Region	504 Ngati Awa		99 Total people, age group		9 Total people, sex		2013	2013	35
253		1 Northland Region	505 Ngati Manawa		99 Total people, age group		9 Total people, sex		2013	2013	5
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269		1 Northland Region	703 Ngati Kahungunu ki Heretaunga		99 Total people, age group		9 Total people, sex		2013	2013	18
270		1 Northland Region	704 Ngati Kahungunu ki Wairarapa		99 Total people, age group		9 Total people, sex		2013	2013	14
271		1 Northland Region	705 Ngati Kahungunu, region unspecified		99 Total people, age group		9 Total people, sex		2013	2013	32
272		1 Northland Region	706 Rangitane (Te Matau-a-Mau/Hawke's Bay/Wairarapa)		99 Total people, age group		9 Total people, sex		2013	2013	11
273		1 Northland Region	707 Ngati Kahungunu ki Te Whanganui-a-Orotu		99 Total people, age group		9 Total people, sex		2013	2013	2
274		1 Northland Region	708 Ngati Kahungunu ki Tamatea		99 Total people, age group		9 Total people, sex		2013	2013	11
275		1 Northland Region	709 Ngati Kahungunu ki Tamakinui a Rua		99 Total people, age group		9 Total people, sex		2013	2013	1
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277		1 Northland Region	711 Ngati Rakaipaaka		99 Total people, age group		9 Total people, sex		2013	2013	4
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284		1 Northland Region	805 Nga Ruahine		99 Total people, age group		9 Total people, sex		2013	2013	8
285		1 Northland Region	806 Ngati Ruanui		99 Total people, age group		9 Total people, sex		2013	2013	19

TABLECODE8053_Data_eed8a2ba-1ee

READY

digitised census data on populations dating before 1996 was unavailable, and an issue with data availability on the Māori population became evident. Although it would be possible to collect and digitise prior census data, the collection methods for the data differ from modern collection methods, and the maps corresponding to the data collected have changed over time from counties, boroughs, ridings and town districts to geographic units of mesh blocks in 1976. Comparing recent census years with census years prior to 1996, therefore, would create data comparisons that are inaccurate.

A drawback in the use of dot density maps is the possibility for data to be misleading if a dot does not accurately represent the geolocation of the correlating data. In this case, the population data for New Zealand is randomised by NZ statistics to protect privacy. It was again randomised through the process of creating a dot density map inside QGIS, which randomises the dots within the provided area parameters, in this case, the mesh-block map. Population data that could reveal personal details in less populated areas is stripped at the top level by NZ statistics and is not available to the public, creating further possible instances of inaccurate conclusions from the dot map.

OPPOSITE PAGE:
Figure 5.3 Auckland City
dot density QGIS output

Figure 5.4 New Zealand
dot density QGIS output.

Figure 5.5 Wellington dot density QGIS output.

CartoDB Basemaps

- ☐ Dark
- ☒ Light

OpenStreetMap Basemap

- ☐ OpenStreetMap Base

Population Dotmaps

- ☒ Maori population - 2013
- ☒ European population - 2013
- ☒ Asian population - 2013

Māori land ownership

- ☐ 1860
- ☐ 2000

Figure 5.6 Still image of interactive webmap. Auckland City with light background. Displaying European, Asian and Māori population data overlays.

Figure 5.7 Still image of interactive webmap. Auckland City with Dark Background. Displaying European, Asian and Māori population data overlays.

CartoDB Basemaps

☒ Dark

☐ Light

OpenStreetMap Basemap

☐ OpenStreetMap Base

Population Dotmaps

☒ Maori population - 2013

☒ European population - 2013

☐ Asian population - 2013

Māori land ownership

☒ 1860

☐ 2000

Figure 5.8 Still image of interactive webmap. Displaying Māori Land ownership in 1860.

CartoDB Dark

CartoDB Light

Dotmaps

Maori

European

Ownership

1860

1890

1910

1939

2000

Features

Marae

Figure 5.9 Still image of interactive webmap. Displaying Māori Land ownership in 1890.

☒ CartoDB Dark

☐ CartoDB Light

Dotmaps

☒ Maori

☐ European

Ownership

☐ 1860

☐ 1890

☒ 1910

☐ 1939

☐ 2000

Features

☐ Marae

Figure 5.10 Still image of interactive webmap. Displaying Māori Land ownership in 1910.

CartoDB Dark

CartoDB Light

Dotmaps

Maori

European

Ownership

1860

1890

1910

1939

2000

Features

Marae

Figure 5.11 Still image of interactive webmap. Displaying Māori Land ownership in 1939.

Figure 5.12 Still image of interactive webmap. Displaying Māori Land ownership in 2000.

Choropleth Mapping

The second map created was a choropleth map. QGIS software was used to convert census territorial authority shape files into geoJSON outlines while retaining their existing attributes, such as the IDs. Iwi population census data correlating to each ID was converted to JSON format, and then both the data file and the geoJSON were uploaded to a web server where the map dynamically updates based on user selection.

The map displays the population distribution of each iwi as a shaded territorial authority (TA) geographic unit. A drop-down menu lists all iwi that were recorded in the 2013 census and allows the selection of one iwi at a time. Two data normalisation buttons allow for a comparison of iwi population data as a percentage of total Māori population per TA or as a percentage of total iwi population per TA.

The choropleth map revealed that iwi remain densely populated in the territorial authorities that intersect their ancestral tribal regions when compared to the total Māori population. However, when the data is normalised against only the total population of each iwi, there was a dramatic shift to urban centres being the most densely populated.

Figure 5.13 Meshblock map in QGIS.

[illegible]

```

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```

Iwi selection:

Ngai Tahu / Kai Tahu

Data normalization:

% of local Maori

% of this Iwi

Highest percentages:

Figure 5.14 Choropleth Map – Ngai Tahu – Normalised to percentage of Local Māori.

Ngai Tahu / Kai Tahu

Auckland

6600 of 163920 Māori people in this district list Ngai Tahu / Kai Tahu as their Iwi (4.03% of the local Maori population)

These 6600 people account for 12.04% of the Ngai Tahu / Kai Tahu Iwi

Iwi selection:

Ngai Tahu / Kai Tahu

Data normalization:

% of local Maori

% of this Iwi

Highest percentages:

Figure 5.15 Choropleth Map – Ngai Tahu – Normalised to percentage of This Local Iwi.

Ngai Tahu / Kai Tahu

Auckland

6600 of 163920 Māori people in this district list Ngai Tahu / Kai Tahu as their Iwi (4.03% of the local Maori population)

These 6600 people account for 12.04% of the Ngai Tahu / Kai Tahu Iwi

Critical Reflection

Limitations:

While this process highlighted and made connections with Māori as broad populations from the top down, limitations in the availability of data at a finer grain meant that the maps are extremely restricted in their usefulness to the administrators of Iwi and Māori groups, and for individual users to understand their connection to larger communities. Additionally, the process for creating a GIS map isn't an accessible process to a lay person. This means that it is not a democratic or easily shareable tool – it is held by expert knowledge and applied to broad communities.

Further limitations to the specific datasets that were mapped were:

- The datasets were limited to New Zealand only.
- As data was layered up on the dot density map, the lower layers became obscured, and there was an inability to compare large and complex datasets.
- The available information is from groups that aren't Māori, and they are collecting the information for their own reasons. Māori values are therefore not necessarily a priority in their data collection.
- The maps are static due to the nature of the data collection, and therefore they do not reflect the dynamic nature of population movements and the fluid nature of Māori whanau relationships.

Opportunities:

- Revealed the possibility of mapping the Māori diaspora and the effects of colonisation, if the data were available.

- Revealed the opportunity to crowd-source mappable information that is important to Māori.
- Revealed the opportunity for maps to be a valuable tool in a new era of self-determination for Māori in a post-treaty settlement environment.
-

The user experience of the maps.

The objective nature of the method of creating these maps makes the maps an object to be viewed. This created a lack of connection between the user and the map. The knowledge presented on the map is held by an authority and delivered to the user as a fact. The maps created reflect the process Byrnes described of reducing Māori knowledge to data that can be mapped in a western ontology.

6.0 SECOND DESIGN PHASE

Second Part of the Exploration

Following from the findings of the first design phase, it was realised that ultimately, the design would be about the inseparable links between land, knowledge and people. The first phase revealed an inability for maps to deliver important, personalised data to the people that need it the most and also that there is a general lack of data available about the historical and social contexts of the Māori population. Although that data could be gathered over time by researchers, it seemed that it would be much faster just to cut out the middle-man and to create a platform for the people that need the information to be able to provide it themselves and decide what was important. Māori know their genealogies and narratives better than anyone else. Some Māori can recite their family lines back to their original arrival in New Zealand. These recitations are supported by stories and songs that would not fit into western mapping methods and so would be discarded as “data” by western scientists, or mapped separately, isolating them in a way that is the antithesis of the way cultural knowledge operates.

This led to the second phase of the research which explored developing a framework that could be a storage place for indigenous knowledge and social connections. A new approach was needed to map information that, while not always physical, was inherently spatial. A tool was needed that, like the maps described by Kelly, could act as a framework on which to hang the spoken text, the words and the knowledge. It needed to be a collaborative and interactive environment that provided agency to users to choose what knowledge they wanted to store and share, and what the space should be like. The use of a “real” representation of the landscape was required for users to be able to recognise familiar landscapes and to be able to input and tie knowledge to those locations.

OPPOSITE PAGE:
Figure 6.1 Ontological framework concept sketch.

ontological Framework.

Figure 6.2 Māori village,
Whakarewarewa part
of Māori village, Wha-
karewarewa. Alexander
Turnball Library.

Understanding the Meeting House

The carved wharenui of the ancestral marae is a physical embodiment of the relationship between people, knowledge and land. The house is a complexly layered representation of many histories and narratives specific to the ancestors of the house. People are tied to the house, and the house is tied to the land through the layering of names and stories.

“Ancestors are important anchor points in the social system...One can claim a direct link to the ancestral meeting house. The ancestral house and the descendants of that ancestor are indivisible...In addition, a grid of place names is placed over the landscape, and these names also link to particular ancestors, and so reinforce the emotional connection to the land.” (Mead 271)

The whare enables a process of engaging the young generation in learning about their culture, using the Māori language and through tikanga Māori. The protocols surrounding the teaching processes provide a safe delivery system for knowledge that is complex and sensitive. The cultural knowledge is passed down from grandparent to grandchild in some regions. Traditionally, Māori cultural values and knowledge are invested into each person as a child, and as an adult they flow back out into the next generation, weaving a pattern over generations of the passing down of knowledge (fig. 6.3). Each young person is essential in this exchange and the endurance of the culture.

By bringing these cultural values and practices into the development of the framework, the second phase of design aimed to extend the ability of the whare as a device for cultural learning into the digital space.

Developing a method for visualising a Māori ontology / structuring virtual space

The structure of a Māori pepeha (greeting) was used as a way of connecting complex tangible and intangible concepts together. A Māori pepeha introduces the speaker through an hierarchy of genealogical significant landscapes and people. The diagram in figure 6.1 was the initial sketch done to establish a visualisation of the pepeha. A pepeha is delivered from the oldest and most sacred, e.g., a mountain and river, and ends with the speaker saying their name. Before the orator takes a journey through time and recites their lineage, invoking the spiritual realm, they begin with their maunga, their sacred tribal mountain, as a way of anchoring themselves to the land.

OPPOSITE PAGE:
Figure 6.3 Ngā Taonga
Tuku Iho nō Ngā Tūpuna/
The Sacred gifts passed
down from our ancestors.

Ngā Taonga Tuku Iho nō Ngā Tūpuna
The Sacred gifts passed down from our ancestors

Wrench out the heart of the flax
Where would the bellbird get its sustenance?
If you were to ask me what
is the most important thing in this world
I will answer thus
It is people, it is people, it is people.

Māori Whakatauki

The pepeha is followed by a whakapapa which is a recitation of genealogy, and it translates as ‘to place in layers’. In the diagram in figure 6.4 a cloud of nodes represent the whakapapa layers as ancestors branching out from the tribal structure. When Combined together, the pepeha and whakapapa establish identity and relationships with land and people.

This is an example by the University of Otago (“Mihimihi/Pepeha”) of what a pepeha and short whakapapa format might look like:

Ko _____ te māunga
 Ko _____ te awa/roto/moana
 Ko _____ te waka
 Ko _____ tōku tīpuna
 Ko _____ tōku iwi
 Ko _____ tōku hapū
 Ko _____ tōku marae
 Nō _____ ahau
 Ko _____ rāua ko _____ ōku mātua
 Ko _____ tōku ingoa

The mountain that I belong/affiliate to is _____
 The river/lake/sea that I belong/affiliate to is _____
 The waka that I belong/affiliate to is _____
 My (founding) ancestor is _____
 My tribe is _____
 My sub-tribe is _____
 My marae is _____
 I am from _____
 My parents are _____ and _____
 My name is _____

The design for the tool draws from this hierarchy taking the most tangible – the landscape – and moves further outwards from the globe as the data becomes more abstract, for example, people and their names. It uses the marae and the wahi tapu landscape features as anchoring points for the more conceptual structures.

OPPOSITE PAGE:
 Figure 6.4 Developed
 digitised concept sketch
 of pepeha structure.

OPPOSITE PAGE:
Figure 6.5 Concept sketch
of personal connection
through pepeha structure.


```

class marae extends mapitem {
  constructor(api, color) {
    super(api, color);
    this.options = {"height": 4000, "width": 800};
    this.type_name = 'marae';
    this.map.description = this.build_description();
  }

  build_entities(dataSource) {
    this.map.entities.push(
      Object.assign(
        {
          <id> : this.map.id + '-ground',
          <name> : this.map.name,
          <description> : this.map.description,
        },
        this.entity_groundpoint(this.api.pointfield.coordinates, this.map.color, 4)
      )
    );

    this.map.entities.push(
      Object.assign(
        {
          <id> : this.map.id + '-air',
          <name> : this.map.name,
          <description> : this.map.description,
        },
        this.entity_ellipsoid(this.api.pointfield.coordinates, this.options.height, this.options.width, this.map.color)
      )
    );
  }

  build_reference_entities(dataSource) {

```

```

const ground = new Cesium.ReferenceProperty(
    dataSource.entities,
    this.map.entities[0].id,
    [ <position> ]
);

const air = new Cesium.ReferenceProperty(
    dataSource.entities,
    this.map.entities[1].id,
    [ <position> ]
);

this.map.reference_entities.push(
    Object.assign(
        {
            <name>: this.map.name,
            <description> : this.map.description,
        },
        this.entity_polyline(
            new Cesium.PositionPropertyArray([ground, air]),
            this.map.color
        )
    )
);

}
}

class knowledge extends mapitem {
    constructor(api, color) {
        super(api, color);
        this.type_name = 'knowledge';
        this.map.description = this.build_description();
    }
}

```

Figure 6.6 Sample javascript code describing connections between nodes (entities).

DATA

Social Networking and mapping

The tool allows users to log-in and create a profile, connecting themselves through their pepeha visually and dynamically to locations on a map that they are culturally connected to. It also allows users to see their cultural connection to other users. Users can then add their cultural knowledge in the form of songs, korero, videos, pictures and text to places on the map and to more abstract nodes such as tribes and sub-tribes. The tool attempts to allow Māori to have more control over making their worldview and selected knowledge accessible to the public and to also share private tribal data on-line securely through selective processes.

Access to data

It became evident that the back-end database needed to have a spectrum for relationships to reflect the many different social and cultural connection needs of Māori. An individual connecting to a person or a place was not a binary relationship but could be one of many different levels of connection. It was also necessary to have varying levels of access to private social and tribal data that reflected the level of relationship to each place or group. The diagram in figure 6.7 shows the layers of access to Māori knowledge and to Māori social spheres.

Giving name to these degrees of relationships and trying to quantify them in the way a computer could understand turned out to be an interesting process, as not all of the phases of these relationships have specific names and they can be quite fluid. For example, when asked what the name of a person that has been through the powhiri ceremony at a marae but does not whakapapa to the marae is called, Māori Culture Mentor Dayna Eggeling of Victoria University, explained that,

“There is no true name for this phase from membership to full rights and haukainga (keepers of the marae’s mana)/ tangata whenua(people of the land) status, as it is all relative to the individual situation, but these people

in this phase would as a general consensus be called manuhiri (guests with membership to the marae but limited to no rights in most cases to the decision making process for the marae)” (personal communication with permission).

The outcome of this development meant that the tool could visualise the scale of indigenous knowledge, even to those without access to the knowledge. The significance and wealth of knowledge held by Māori can be made known to non-Māori through the tool, without revealing the knowledge itself to parties that it is not meant for.

Figure 6.7 Diagram of conceptualisation of relationships and data access.

Figure 6.8 Diagram of concept for back-end system architecture for pan-tribal data access and data sovereignty.

Adding pre-existing datasets/data layers to the map

Iwi currently collect and privately hold many GIS data layer sets and are creating stores of cultural taonga to preserve for future generations. The GIS system, however, is problematic in that it is inherently limited in representing the nature of the knowledge being stored and that it enforces a system upon the user, oblivious to their cultural needs.

Acknowledging the value of these datasets and the hard work that has been done to collect and curate them, the system needed to be able to provide the ability for a user to add their pre-existing datasets to the map. This was tested by finding large, publically available datasets, sourced from Koordiantes.com, and importing them into the map.

Adding new knowledge and places to the map

A fundamental philosophy of the tool is that it is simply a framework for users to put information into if they wish and to choose, at their own discretion, who can view that information. The familiar system of placing a marker on a map was used to generate a new node on the map. The user can then choose from a drop-down menu what type of node it should be and save it to their database.

Individual User Data Control

The need for users to be able to control the availability of data about themselves to other people was considered necessary. The tool would make it possible for a user to decide if they want third party data about themselves to be shared with their cultural leaders. For example, their census data or medical data could be shared with people that they choose.

Data Sovereignty

Questions were raised during the research about data ownership. If an iwi or an organisation entered data into the system, who did it belong to? And could existing datasets that iwi already have be used in the system? Could they host their data on their own servers and connect to the tool? This coincided with the timing of an Indigenous Data Sovereignty Workshop hosted in Auckland City and the launching of a new book on the subject, “Indigenous Data Sovereignty: toward an agenda”.

Indigenous data sovereignty is very topical, and it led to the development of a system architecture design so that data could be managed safely pan-tribally.

The Digital Framework

Technical requirements for the tool

- Spatiotemporal - The tool needed to accurately reflect the nature of mātauranga Māori – that it is linked to people and therefore it is alive and dynamic.
- Spatial – the tool needed to reflect the way people experience the world and represent a 3-dimensional space
- Accessible – the tool needed to be able to be accessed by anyone from anywhere with as little obstacle as possible.

Several digital technologies exist to present data on a globe, such as Google Earth for desktop, but the need for accessibility and a minimum learning curve for end users led the research towards using a Web GL-based JavaScript library. WebGL (Web Graphics Library) is a JavaScript API for rendering interactive 3D and 2D graphics within any compatible web browser without the use of plug-ins (“WebGL”).

WebGL has capabilities similar to any familiar 3D modelling software that an architect might currently use, e.g. Rhino, Maya, Revit, etc. but with the added bonus that it does it in the web browser.

A mapping library was needed to run on webGL platform to fulfil the need for an identifiable landscape for uses to place markers on and Cesium.js was selected. Cesium is an open source web-based globe and map that can dynamically visualise data. It was originally designed to track and visualise satellite data in real-time, and therefore it offered the spatiotemporal capabilities required for the tool. Anyone with a modern browser and a reasonable PC can connect to a Cesium-based map without the requirement of installing something, fulfilling the need for accessibility.

Using language to imagine a nation

“As a prime technology of imagining nationhood, a language works a nation out in different manners – for example, by a spoken vernacular, the written language, the printing press, a court’s language, a state mechanism like education, or the unified language of a colonial rule. In short, a language enables a certain group of people to think of their community in an unprecedented, spatiotemporal definition” (Thongchai 15).

Making the Māori communities and Māori nations of New Zealand visible meant imagining and conceptualising what that should look like and then using programming languages to describe that. Many languages had to be learned and technologies mastered to develop the framework that would be the foundation for the tool. These coding languages were the building blocks of the tool:

- Programming languages (Javascript, Javascript ES6, Python and extensions such as JQuery and JSX)
- Markup, data-interchange and styling languages (XML, JSON, HTML and CSS)
- Data query languages (SQL)

Various programs used by web developers had to be learned to implement the coded language, with no prior knowledge before the outset of the thesis including:

- Npm
- Babel
- Webpack
- Bootstrap
- React
- The Windows Command line
- Github
- Sourcetree

Thinking like a Web Developer

Entering into the world of the web developer was an unusual and sometimes overwhelming experience. However, the process of imagining and then describing a space through a language was not dissimilar to the everyday practices of architecture; it was merely a variety of different languages than the ones architects usually employ. The creative process of producing code is ruled by logic and efficiency and the necessity to first imagine what it is the programmer wants to achieve before trying to find a way to write it.

Thinking like a Computer

The process of turning a visual idea into something the computer could understand as a database, however, was a more difficult learning curve. Before a coded front-end visualisation of the system can occur, the relationships between data have to be established as a data model so that the computer can understand how to store the data and how to retrieve it. Many-to-one, Many-to-Many and one-to-one relationships were used to describe to the computer the relationships between people, places and knowledge.

It is at this stage that the ontology being used begins to become a tangible data model and the structure of the visualisation is defined, and therefore, for every change required to reflect a different tribal ontology or a nuance on a regional basis, a new database must be developed.

It would be possible to do this differently so that a user could design the structure of their knowledge nodes and cultural ties dynamically within the user interface, but it requires a much more complex back-end system. It would be something interesting to investigate if this work were to be taken further. If a user could place a marker in the landscape and then tell the computer what type of connections it should make dynamically, using a drop-down menu to select existing connections, with the option to type in new ones, then this would be an even more empowering way to visualise indigenous ontologies. The system would then be able to be utilised by other indigenous cultures around the world. The need for a connection to the land is the base layer of the framework that applies to indigenous cultures internationally. However, each indigenous culture connects to the land is unique and therefore each system design needs to be unique.

One-to-One

Many-to-One

Many-to-Many

Figure 6.9 Diagram of relational database structures.

```

class Person(models.Model):
    sex_choices = (
        (<M>, 'Male'),
        (<F>, 'Female'),
        (<O>, 'Other')
    )

    first_names = models.CharField(max_length=254)
    last_name = models.CharField(max_length=254)
    alias = models.CharField(max_length=254, null=True, blank=True)
    sex = models.CharField(max_length=1, null=True, blank=True, choices=sex_choices)
    birth_date = models.DateField(null=True, blank=True)
    iwi = models.ForeignKey('Iwi', null=True, blank=True)
    marae = models.ForeignKey('Marae', null=True, blank=True)

    def __unicode__(self): # Python 3: def __str__(self):
        return "{0} {1}".format(
            self.first_names,
            self.last_name
        )

class PersonLocation(models.Model):
    person = models.ForeignKey('Person', related_name='personlocations')
    from_date = models.DateField(null=True, blank=True)
    pointfield = models.PointField()

    def __unicode__(self): # Python 3: def __str__(self):
        return "{0} from {1}".format(
            self.person,
            self.from_date
        )

```

```

class Iwi(models.Model):
    iwi_name = models.CharField(max_length=254)
    knowledge_items = models.ManyToManyField('KnowledgeItem', blank=True)

    def __unicode__(self): # Python 3: def __str__(self):
        return "{0}".format(
            self.iwi_name
        )

class Hapu(models.Model):
    hapu_name = models.CharField(max_length=254)
    knowledge_items = models.ManyToManyField('KnowledgeItem', blank=True)

    def __unicode__(self): # Python 3: def __str__(self):
        return "{0}".format(
            self.hapu_name
        )

class Marae(models.Model):
    marae_name = models.CharField(max_length=254)
    iwi = models.ForeignKey('Iwi')
    hapu = models.ForeignKey('Hapu', null=True, blank=True)
    pointfield = models.PointField()
    knowledge_items = models.ManyToManyField('KnowledgeItem', blank=True)

    def __unicode__(self): # Python 3: def __str__(self):
        return "{0}".format(
            self.marae_name
        )

class KnowledgeItem(models.Model):
    title = models.CharField(max_length=254)
    text = models.TextField(null=True, blank=True)

```

Figure 6.10 Sample back-end python code describing database models.

Spatial Qualities of the Design & the User Experience

The tool offers a new way to experience Māori culture and knowledge and provides a way to dynamically and visually see the relationships between people, land and knowledge within a representative context of the landscape.

The social interface is the heart of the tool. The personalisation of information is the key feature for tying land and knowledge to people. When a person visits the tool, they can log-in and make a personal connection to the land and culture. The tool forms a relationship between the user and the system. Every person gets a different experience but it is based on context, so their user privileges reflect their worldview and cultural privileges. Each user experience is different, and there is no single way to experience the space or any singular “true” knowledge to be gained by using it.

Examples of Different User Experiences:

Kaumātua and cultural leaders:

For the leaders of Māori groups, the tool could provide a new way to aggregate and manage data and cultural resources. It offers the ability to collect information about Māori on their terms. Instead of relying on government data, Māori could decide what they want to know about themselves and whom to share it with. The tool could be a place to automate the process of data permissions, so that individuals can choose to share their personal data with cultural leaders but also so that the information collected could be shared back into the communities it came from, with an emphasis on what each community is learning about itself. Cultural leaders could understand the spatial and social contexts of data about whanau and organise better responses to the unique needs in their communities.

Data from third parties could also be processed through the tool to communities. For instance, the tool offers the potential ability to understand medical data with a tribal nuance. Medical data is currently unavailable to cultural leaders but could be, at the discretion of each person, permitted to be accessed by cultural leaders so that they could organise resources in response to nuanced tribal data.

The tool could provide a space for discussing information with whanau and space for receiving feedback about initiatives.

Through the tool, it is possible to control the sharing of cultural knowledge specific to an iwi or group. It makes it possible to say to the world “we are here and this is who we are” on their own terms.

Non-Māori:

The tool makes room for non-Māori to understand the nuanced cultures of the many Māori nations in New Zealand and seeks to mitigate the impression of Māori being one homogenous group. A non-Māori person can access songs and stories linked to specific sites that have been made available to the public selectively by Māori. This might foster an awareness and a new understanding of Māori culture that wasn’t available before. This is a vital step towards having an equitable society in New Zealand that values Māori culture.

For Māori, the tool shows a person their personal connections to land. For someone not connected to their culture, it can be awkward trying to figure out how to become connected. Currently, that might involve a phone call to a marae or to join their iwi or hapū group on Facebook or to find support from a Māori community in discovering whakapapa links. The tool offers a new way for Māori individuals to find and claim their whanau connections and to explore their specific cultural ties. This is important for engaging people that have only a passing interest in their cultural heritage. The tool can show them the depth of connection they have to Māori culture and the land through their family links and engage them on a personal level. They can safely and comfortably navigate the tool from a comfortable environment, such as their house, and discover their connections at their leisure. The depth of knowledge that the tool can reveal might be a pleasant surprise to disconnected urban Māori.

Some cultural knowledge is tied explicitly to land, and so a person cannot understand the importance of it until they are in the right place, and can unlock the knowledge through the associated song, story or chant. For grandchildren, nieces and nephews that live overseas, they might be able

to access cultural knowledge through the tool and then when they travel back to New Zealand in the future, be able to understand and experience the knowledge in a relationship with the land for the first time.

For Māori with knowledge that they want to pass on, it can currently be difficult with the long distances that separate people to do so. The tool would be able to act as a storage place for knowledge to be passed down to specific individuals. Many new technologies are in development such as the Microsoft HoloLens, that will allow people to record a 3D holographic representation of themselves and replay it back. This presents the opportunity to record a message for future generations so that they might get to see their ancestor and listen to their stories first-hand.

Future Possibilities for the tool

Visualisation of whakapapa

The spatiotemporal capabilities of Cesium mean that Māori diaspora could be dynamically rendered. The ability to do this would require a dataset about the Māori population going back before any reliable datasets exist. Drawing on the knowledge that Māori people know of their whakapapa going back many generations, the ability for a user to enter their ancestor's information was considered. Whakapapa is some of the most sensitive and closely guarded information in Māori culture. Therefore, the tool will need to be able to protect the private details of the data, while visualising Māori populations anonymously in a useful way for all users.

Building design, implementation and analysis over the span of a buildings lifetime.

During 2016, the Cesium development team announced that they are working on developing 3D tiles that can stream massive, diverse 3D geospatial datasets. The implications of this technological development for the tool in future may mean the possibility of spatially analysing complex three-dimensional data. An example utilising the 3D tiling system is a map of New York City that showcases the ability to analyse buildings by their height spatially. As development of this new technology continues, the possible uses for three-dimensional datasets will increase.

In application to the Māori population, it might be possible to analyse the social contexts of housing.

Market Leading Technology

Many people believe that a shift is currently taking place towards using web-browser applications over software that requires installation to use. If mainstream browsers continue to improve upon their WebGL implementations, then the flexibility and power of WebGL as a browser-based 3D rendering tool will increase. This was an attractive characteristic for selecting WebGL as a framework to build the tool on as it allows flexibility for the tool in future. WebGL has the potential to surpass software that requires installation due to its low barrier to entry for new developers because they can access existing libraries and frameworks to use for building new applications rather than starting from scratch. Additionally, the ability to load a web-based application, using almost any device that is web-connected, without requiring setup or installation, may make WebGL-based web applications the market leading technology in the future.

Figure 6.11 Still image of :
"New York City – Cesium"

Figure 6.13 Still image of tool with an anonymous person selected.

Anonymous Person

Iwi: Ngāti Toa Rangatira

Figure 6.14 Still image of tool with iwi selected.

Ngāti Toa Rangatira Iwi

"The Heke South" Toa Rangatira who was the eponymous ancestor of Ngati Toa, resided at Kawhia on the west coast of Waikato-Tainui rohe around the 17th century. Ngati Toa occupied the coastline from Aotea to Huikomako, about 100km south of Kawhia. In 1819 Te Rauparaha lead a scouting expedition to the Cook Strait. From a well known lookout point, Omere near Cape Terawhiti, Te Rauparaha noticed a trading ship passing through the Cook Strait. After identifying the strategic importance of the Cook Strait as a major trading route Te Rauparaha lead Ngati Toa in a historic resettlement campaign from Kawhia. Te Heke Tahutahuahi (the fire lighting expedition) was the first stage of Te Rauparaha's resettlement which arrived in North Taranaki. Here Ngati Toa was joined by Ngati Tama, and members from Ngati Mutunga and Ngati Awa. Te Heke Tataramoa (the bramble bush) was the second heke which moved south from Whanganui to Ngati Apa towards the Cook Strait. The defining settlement of Ngati Toa in the Wellington region was the battle of Waiorua on Kapiti Island in 1824. Ngati Toa defeated a combined alliance of Kurahaupo tribes and settled without protest from other Iwi in the region from Kapiti to Te Whanganui-a-Tara. In 1827, the battle of Tapu-Te-Ranga sealed Ngati Toa settlement where an alliance of Ngati Toa and Ngati Mutunga defeated Ngati Ira, the residing Iwi on the South Coast of Wellington. Tamairangi, the Paramount Chieftainess of Ngati Ira was taken captive and presented to Te Rangihaeata of Ngati Toa at Ohariu where she acceded to his protection. Tamairangi and her son Te Kekerengu to settle on Mana Island. During the early 1800's Ngati Mutunga and Te Atiawa moved into Whanganui-a-Tara and towards the Wairarapa with the support of Te Rauparaha. Te Rauparaha and Te Rangihaeata allocated land to Ngati Tama along the south west coast (principally at Ohariu) in recognition of their support during resettlement. Following the battle of Waiorua, and Te Rangihaeata continued south leading a number of campaigns gaining mana whenua in the upper South Island particularly in the Wairau Valley, Port Underwood, and Pelorus Sound. By 1840 Ngati Toa Rangatira was established as the pre-eminent Iwi dominating the Kapiti, Wellington, and Te Tau Ihu (northern South Island) regions. Ngati Toa held a maritime monopoly in the Cook Strait including a de facto military, political and economic power in the region acknowledged by Maori and European settlers at the time.

Links

- [Iwi Website](#)

The Essence of Ngāti Toa Rangatira

Whiti Te Rā! The story of Ngāti Toa Rangatira

Figure 6.15 Still image of tool with marae selected.

Takapuwahia Marae

Iwi: Ngāti Toa Rangatira

Links

- [Iwi Website](#)

David Bowie Visits Marae

Bowies Waiata: Ngati Toa Mix

Figure 6.16 Still image of tool with significant site selected.

Significant Site

I tētahi ahiahi, e whakarererā ana a Māui me ōna tuākana i tētahi hāngi, hai hākari mā rātau. Kātahi anō ka mutu ake te whakawera i ngā kōhatu, ka tō te rā, ka pōuri rawa mō rātau. Ka hōhā a Māui ki te kai i ana kai i roto i te pōuri, ka tū a ia ki te mura o te ahi, ka kōrero atu ki tōna iwi.

Figure 6.17 Still image of tool displaying vector lines for all New Zealand Rivers. Imported Data from Land Information New Zealand.

Figure 6.18 : Still image of tool displaying vector lines for New Zealand Rivers and Nga Puhi marae nodes. Imported Data from Land Information New Zealand and manually placed marae nodes from Māorimaps.com

Figure 6.19 Concept image for social interface.

First_name Last_name
Age
City, Country

Lorem ipsum dolor

Consectetur adipisicing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa.

Lorem ipsum dolor

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Figure 6.20 Still image of tool displaying external vector point data rendered as points with metadata displayed in interface.

Archaeological sites from Auckland Proposed Unitary Plan

COMPUTERNU	6075
OBJECTID_1	5568
NZAA_Site	R11_1163
Site_Type	MIDDEN (SHELL)
Category	Archaeological Site
Site_Typ_1	MIDDEN (SHELL)
Cnt_Site_T	2341
Site_Type1	MIDDEN (SHELL)
Significan	1
Buffer	To be buffered

Figure 6.21 : Still image of tool displaying imported dot density maps as data layer.

Research Implications

The tool creates access to indigenous knowledge frameworks and provides ownership of cultural knowledge and the ability to connect and share this knowledge. As networks span the globe, this is a powerful method for understanding the scale of indigenous knowledge and provides the ability to access it in a culturally sensitive process.

The tool brings the real object into the digital realm which provides new opportunities to use cultural knowledge digitally. A person wishing to create, for example, an educational game using Māori narratives particular to a place and people could access the tool and find the relevant confidential data nodes. They could then request access to browse data that might be useful for their project and be able to form a relationship with the owners of that data/cultural knowledge. The owners would then have the option to accept or decline as they see fit. This example of a project using the tool to develop new ways of interacting with cultural knowledge could extend towards virtual reality environments, simulation tools and cultural heritage tools. The digitisation of mātauranga Māori is just the first step towards an entirely new way of understanding and interacting with indigenous knowledge.

The Next Step - Implementing 3-dimensional architectural space as interface

The aim of the tool was not to replace a marae or to create a new one but to create connections between people, land and knowledge. The greatest connection to be made in future is the way Māori interact with and have a relationship with their environments. The tool currently requires a person to sit at a computer or use a phone with a 2D screen to interact with the tool. However, the tool was designed with the possibility of future implementation as a virtual reality (VR) environment so that the natural relationship of

the body with place and land could be maintained. A more fully immersive navigational experience might be possible through virtual reality systems. Another way to develop an immersive experience from the tool would be to integrate technology with physical environments so that the tool can be accessed at specific locations in relation to the tool and the cultural knowledge about that location stored in the tool could be accessed.

Adaptation to other indigenous ontologies

The tool could be adapted to other indigenous ontologies. However, it is important to note that this would require the restructuring of the database and the visualisation of the ontological structure. Each indigenous culture has a unique way of defining and understanding their relationship to land and knowledge. Therefore the tool is not a one-size-fits-all, but rather the framework for giving voice and visibility to indigenous cultures in a digital realm.

```
var camera = viewer.camera;
longitude = 174.7442782;
latitude = -44.2916384;
height = 200000;
camera.setView({
  destination : Cesium.Cartesian3.fromDegrees(
    longitude,
    latitude,
    height
  ),
  orientation: {
    pitch : Cesium.Math.toRadians(-30),
  }
});

var groundpoints = new Cesium.CustomDataSource('groundpoints');

function addGroundpoint(name, latlon, color, description) {
  tempLat = latlon[0];
  tempLon = latlon[1];
  pointheight = 8000;
  position = Cesium.Cartesian3.fromDegrees(tempLat, tempLon)
  groundpoints.entities.add(
    {
      name : name,
      position: Cesium.Cartesian3.fromDegrees(tempLat, tempLon, pointheight),
      ellipsoid : {
        radii : new Cesium.Cartesian3(1300, 1300, 1300),
        material : Cesium.Color.fromCssColorString(color) .withAlpha(0.8)
      },
      description: description,
      polyline : {
        positions: [
          Cesium.Cartesian3.fromDegrees(tempLat, tempLon, pointheight),
          Cesium.Cartesian3.fromDegrees(tempLat, tempLon)
        ]
      },
      width : 2,
      material : Cesium.Color.fromCssColorString(color) .withAlpha(0.6)
    }
  );
}

function addRohepoint(name, latlon, color, description, size) {
  tempLat = latlon[0];
  tempLon = latlon[1];
  pointheight = 40000;
  localsize = 1300 + (size * 100);
  position = Cesium.Cartesian3.fromDegrees(tempLat, tempLon)
  groundpoints.entities.add(
    {
      name : name,
      position: Cesium.Cartesian3.fromDegrees(tempLat, tempLon, pointheight),
      ellipsoid : {
        radii : new Cesium.Cartesian3(localsize, localsize, localsize),

```

The 'real' Object

Translation into the digital

Figure 6.12 Digitising Mātauranga Māori.

Digitising Mātauranga Māori

Critical Reflection

A critical evaluation is problematic due to the scope which limited outside participation in the research. An emancipatory research approach, which the developed design took, is subjective and requires an engagement with participants. However, to test the tool I placed myself within the tool as a way to critique it. The 3D multi-directional navigation of the space, allowed me, for the first time, to see my cultural connections in the landscape. Adding cultural information to the tool meant that I had to explore a variety of media and search for knowledge that could be put into the tool for testing. Unfortunately, without other participants, it was not possible to test an expected outcome which was the overlapping of knowledge from different people and sources that might create a valuable and complex repository of knowledge.

The system that was designed was limited by my understanding of Māori culture, and consultation with other people might lead to a richer development of the tool and a more accurate reflection of Māori ontologies.

It was slightly disappointing that the time required to learn how to code the Cesium environment and make it function limited the opportunity to experiment with the “look” of the tool. For example, the spheres for the nodes could potentially be anything else and were only spheres to test the load capacity of the system. The browser renders them dynamically, and the rendering could be changed to be representative of each location. For example, instead of a sphere, it could be a 3D representation of a marae or a 3D model of a wooden carved ancestor specific to an iwi or hapū. They could also be programmed to rotate or to respond to user inputs such as clicking, by glowing or animating.

It would also have been interesting to experiment with the whakapapa layer of data nodes. There is a Māori phrase that is part of a karakia to acknowl-

edge ancestors, “kua wheturangitia i te korowai o Ranginui,” which means, “to those who have departed and are adorned as stars in the heavens”, which sparked my imagination for what the whakapapa node field might look like, and how it could be animated for spatiotemporal analysis of Māori diaspora.

In answer to the first research question, “How might a CIMV tool help to aid in the understanding of holistic tribal environments”, The tool could aid in:

- Aggregation of cultural resources and provides tools for managing cultural resources & understandings.
- Clarifying relationships
- Making visible communities
- Dynamically visualising the Māori population
- Visualising whakapapa and understanding the diaspora of the Māori population
- Providing interaction that Māori have never had before

The tool allows for overlapping of knowledge, which some people might consider problematic especially where knowledge, histories, narratives and boundaries might intersect. It is something that western research ontologies try to reduce and eliminate in the search for facts and a universally applicable truth. However, the potential conflict in knowledge held by different people and communities is a positive outcome. There is room in the tool for a negotiation of “who we are” and “how we got to be where we are”, and the answers to those questions might involve a cross-over of information between different iwi and Urban Māori in an unprecedented way. This outcome may, in fact, be one of the first times that Māori groups would be able to see their histories and narratives overlap visually and it could raise some interesting questions. Where a western mapping method would require hard boundaries and the erasure of data that overlaps or that does not comply with its stringent rules, the tool provides a much more fluid and dynamic way of understanding and negotiating space and identities.

How can we inhabit and interact with the scale of indigenous knowledge through this tool?

This Research question was one that was raised near the end of the research as a response to the development of the tool and interacting with it. The tool produced not just a database but a new social space. There are unique opportunities in future to develop ways to navigate this new space using digital tools to create an immersive environment. One opportunity that was not explored during the research was the ability to navigate the new social space in a one-to-one environment, similar to Google Street View or as a more immersive experience like a first-person video game. Interaction at this level with the new space would be a next step in the research if it were to continue, as it offers an entirely new experience for inhabiting and interacting with cultural knowledge.

Other Ways of Doing Architecture

It was during the second design phase that the research entered the realm of spatial agency. As the agent, it was a moment of negotiation where the decision to empower others by creating a space for interaction meant acknowledging that the requirements of that space might not be a physical response but a virtual one. It also meant giving up a certain amount of control over the design outcomes. To be able to empower Māori it was necessary to renegotiate some pre-conceived ideas of what an architect's role was and what an architect was meant to produce. "Virtual" seemed, at first, like a dirty word. However, as the research continued, the evidence towards a virtual response to the spatial issues became more compelling, and the idea of designing a built form seemed arbitrary and potentially would have shifted the focus of the project away from the issues outlined in the proposal, resulting in a less empowering design outcome for Māori. The thesis was about empowering Māori, strengthening the existing iwi structures and the emerging new urban communities and aiding in the ability of these communities to self-determine their futures. A centralised building would undermine that. However, a building might be the outcome of a tool such as this in the future. This tool could do more, and sooner, for Māori than a single discrete physical response could achieve.

Conclusion

In conclusion, the thesis examined the spatial problems that are a direct result of colonisation and urbanisation that are leading to a disconnection between Māori people and Māori culture. The preliminary design of the research explored the capabilities of current mapping methods in mapping data about Māori. The result of the preliminary research suggests that current mapping methods are problematic within indigenous frameworks. The developed design stage of the research found that there are opportunities within a WebGL environment to visually express the complex relationships of indigenous knowledge and suggests that a virtual environment could be a valuable tool towards connecting Māori to each other, their lands and their culture.

Glossary

Waka	canoe,vessel
Hapū	Subtribe, pregnant
Iwi	tribe, extended kinship group, bones, strength
Whānau	Family, and extended family unlike the western nuclear family
Marae	Meeting Place, Raised or cleared area in front of tribal house
Maunga	Mountain
Awa	River
Moana	Sea, Ocean, Lake
Tangata whenua	People of the land
Mana whenua	Authority over the land/territorial rights
Papa kāinga	Communal land, Village
Mātauranga	Knowledge
Pōwhiri	Welcome ceremony on a marae
Wāhi tapu	Sacred place, Sacred Site
Mātua	Parents
Kaumātua	A Māori elder
Aroha	Love, affection
Tikanga	Correct procedure, protocol
Taonga	Treasure, culturally and socially valuable resources and concepts

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Source: Ngā huarahi ki te marae: Māori connecting to their ancestral marae – infographic. Statistics New Zealand. Web. http://www.stats.govt.nz/browse_for_stats/people_and_communities/Māori/te-kupenga/connect-ancestral-marae-infographic.aspx

Figure 2.5: Hauroa Māori – Te Whare Tapa Wha. Image adapted by Author.

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Figure 2.6: Deprivation Graph. Infographic by Author.

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Figure 2.7: Suicide Graph. Infographic by Author.

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Figure 2.8: Unemployment Graph. Infographic by Author.

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Figure 2.9: Life Expectancy Graph. Infographic by Author.

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Figure 2.10: Percentage Graphs. Infographic by Author. Data Sources:

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Source: Chart of New Zealand part of Tuki-Tahua.. [Chart of New Zealand drawn by Tooke-Titter-a-nui Wari-pedo, a priest of that country who resided on Norfolk Islands 6 months] [cartographic material].. Ref: 830ap [1793] (1804). Alexander Turnbull Library, Wellington, New Zealand. <http://natlib.govt.nz/records/21973719>

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Source: Joost Grootens. Atlas of the Conflict: Good typography and a well-planned layout sorts and illuminates the complex history of Israel and Palestine. Fonts In Use, Fontsinuse.com <fontsinuse.com/uses/34/atlas-of-conflict>

Figure 4.2: Atlas of the Conflict.

Source: Joost Grootens. Atlas of the Conflict: Good typography and a well-planned layout sorts and illuminates the complex history of Israel and Palestine. Fonts In Use, Fontsinuse.com <fontsinuse.com/uses/34/atlas-of-conflict>

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Source: Orange, Claudia. An Illustrated History of the Treaty of Waitangi / Claudia Orange. Wellington, N.Z.: Allen & Unwin, 1990. Print.

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Figure 5.10: Māori Land Loss in New Zealand 1910. Digitised by Author.

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Figure 5.11: Māori Land Loss in New Zealand 1939. Digitised by Author.

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Data Source: NZ River Polygons (Topo, 1:50k). Land Information New Zealand, LINZ data service, data.linz.govt.nz/layer/328-nz-river-polygons-topo-150k/

Figure 6.18: Still image of tool displaying vector lines for New Zealand Rivers and Nga Puhi marae nodes.

River Data

Data Source: Data Source: NZ River Polygons (Topo, 1:50k). Land Information New Zealand, LINZ data service, data.linz.govt.nz/layer/328-nz-river-polygons-topo-150k/ Accessed September 2016.

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Data Source: Database search. Māori Maps, Māorimaps.com.

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Data Source: PUP Māori Cultural Heritage. Metadata: ISO 19115/19139, Dublin Core, FGDC CSDGM. [Koordinates.com](http://Koordinates.com/layer/6437-pup-Māori-cultural-heritage/). Web. Koordinates.com/layer/6437-pup-Māori-cultural-heritage/

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