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Māori perspectives of trust in technology

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Full Research Paper

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Abstract

As technology becomes ever more present in our modern-day setting, the notion of veracity appealing as a social term with an ethical interface is becoming increasingly worthwhile. However, veracity is a Western term without a Māori perspective and work is required to better understand the term veracity within a kaupapa Māori worldview. Within a western science worldview, the term veracity is a highly complex, not well-understood phrase with associated terms to provide meaning, with words like trust, truth, and authenticity being assigned. This opens two problems for Māori firstly, Māori and indigenous communities are often under-represented or misrepresented when new technology terms arrive in tribal communities. Secondly, trust is a concept that does not necessarily translate directly between indigenous and western perspectives and within current research there isn't a clear understanding of how to build trust from a Māori perspective.

This paper gathers a set of key Māori concepts to match a cultural equivalent version of trust that may represent the same within a kaupapa Māori contextual worldview. By collecting core concepts from published literature, this paper provides valuable insights into words that can be assigned similar meanings that instil trust for Māori users of technology.

Keywords Technology, Indigenous Computing, Māori Data Sovereignty, Trust

1. Introduction

The Veracity Spearhead research project is a publicly funded cross-collaboration project between the University of Auckland, the University of Otago, the University of Canterbury, the University of Waikato, and Victoria University of Wellington in Aotearoa, New Zealand[1]. The project seeks to design and build high veracity digital technology suitable for the 21st century. One where the goal is a transformational nature of digital data on all corners of society as business, government, and personal consumption are in search of a global reaction that requires a level of veracity that is authentic, truthful, and, trusted.

The design, development, governance, and use of information technology today continues to expand the boundaries of society, challenging the notion of being inclusive and a trusted source of use. In Aotearoa, a lack of engagement in the development of IT systems continues to create a disconnect for Māori underrepresented in the growing environment of technology-related development (Blackstock 2016). Furthermore, much discussion continues around the use of technology and the impacts on Māori communities once deployed (Kukutai and Taylor 2016). A return to ancient knowledge is one way to inform current practice in a way that helps advance indigenous ways of implementing research (Wilson 2001) and, through this, decolonising indigenous methodologies (Smith 2000), along with the search for indigenous processes when working with technology (Shedlock and Vos 2019). This paper defines technology as any advancement incorporating data, data storage, and data processing. Trust is often seen as a valuable component of socio-technical processes. However, a challenge is ensuring it involves an indigenous kaupapa Māori language system(Thornton et al. 2022). Implementing such an approach is currently both complicated and lacking in definition.

Taking protocols and practices from the Māori world (Te Ao Māori) provides a valuable blueprint for high integrity, high trust systems that are socially connected and a domain of knowledge that lives in tandem with the real natural world. Through the adoption of language, people's provenance of lineage, and modelling, Te Ao Māori is well situated to deliver a world view of trust. Within a western science worldview, trust is a complex concept that is difficult to give a single clear definition of. In this paper, trust is seen as a way of facilitating cooperative behaviour that is highly contextual and subjective and a concept that spans both the rational and emotional dimensions(Blincoe et al. 2023). Similarly, no explicit understanding of trust exists in a Māori understanding of how the world works. This leads to the question for this investigation, what are essential Māori terms that represent trust within a kaupapa Māori worldview? By combining core concepts from published literature, this paper can provide valuable insights into terms that can be assigned to similar meanings as a platform to instil trust in Māori users of technology and help understand how technology can be brought into a Te Ao Māori perspective.

This study focuses on trust and considers it a term lacking any clear understanding within a kaupapa Māori understanding, presenting the initial problem. This investigation considers a kaupapa Māori worldview of how the world works and searches for an understanding of what trust looks like within a Māori setting. By looking at a selection of tribal papers and collecting their ideas to eliminate, mitigate, or reduce the harm, under/misrepresentation, or systemic mistrust through years of colonialism.

The remaining format of this paper is as follows. A description of the methodology that is used is given in section 2. In section 3, the findings from the literature review are presented in detail. The resulting artefact from this literature review is outlined in section 4, while an evaluation of the process is covered in section 5. Section 6 discusses what these findings and the artefact mean and is followed by a conclusion and future research in section 7.

2. Method

The method for this study follows Design Science Research from Gregor & Hevner (2013) involving seven steps. (1) Beginning with a problem statement that initiates the topic to be investigated early in the research cycle. This is introduced early in the abstract and the introduction (2) Identifying the methodology that the research will follow along with the rationale of the design steps to be followed with reference to existing authorities (Gregor and Hevner 2013) (3)Prior literature is surveyed including any design theory/knowledge relating to the problem as well as artefacts that have been designed to address it. The literature review here uses prior relevant work and theories from Māori experts working with

[1] The Science for Technological Innovation Veracity Spearhead supported by New Zealand's National Science Challenges: https://www.sftichallenge.govt.nz/our-research/projects/spearhead/veracity-technology/

trust to frame an indigenous mode of language during the production phase of kaupapa Māori knowledge and understanding. (4) The design and creation of an artefact that leverages existing knowledge and presents it in a new manner to make new contributions to the knowledge base. The design outlines the nine papers that explore trust or areas that require high levels of trust and maps the common terms within them. The artefact consists of the extracted key kaupapa Māori terms and the frequency at which they are used to determine the level at which they contribute to building trust. The result is a display of the keywords and concepts split into three levels based on their frequency as an architectural blueprint framed as a Māori construct of understanding how to build trust. (5) An evaluation highlighting the value and usefulness of the artefact. Evaluation involves mapping the literature as the design process (meta-design) and the IT artefact as the product development (meta-product) to achieve the requirements of evaluation (Pries-Heje et al. 2008). Evaluation anchors two key themes: the evaluation of literature and the evaluation of the artefact construct. (6) An interpretation and discussion of the results and how they relate back to the objective. Here, an overview of the research topic seeks to aid both the research environment and the related body of knowledge's kernel theories. (7) The conclusion completes the research cycle with findings stated as new contributions to the research topic.

There are two key contributions for any research effort to be successful. The first being the relevance of research that targets the research environment, i.e. research connecting the Māori community to knowledge using technology. The second being the rigour applied to the domain knowledge base under examination in search of a contribution to existing kernel theory (Hevner and Chatterjee 2010).

3. Literature Review

3.1. Impacts of technology on indigenous peoples

As technology advances and becomes more integrated into everyday life with technologies like artificial intelligence (AI) controlled data collection (Sulkowski, 2021) and smart devices, ensuring these meet the needs and concerns of indigenous communities is paramount. One way to measure these concerns is via trust. Do indigenous communities understand the technology they use, and do they trust it? Most literature talks about under-representation or lack of adaption of said technologies, and any concepts that aim to combat these could be considered as building "trust". Whilst this is not always the case, adoption does not equal trust (Ahuriri-Driscoll et al., 2021). This paper presents these concepts as a way of building or displaying trust and notes that trust and perspective on trust is lacking in the current literature, with it being one piece of the puzzle instead of an encompassing idea (Hudson et al. 2020).

The misrepresentation of indigenous communities within technical spaces is widespread, whether through research (Beaton et al. 2017; Claw et al. 2018; Du 2017) or general adaptation of ICT systems (Du 2017; Whaanga et al. 2017). This problem extends to all indigenous communities worldwide. When talking about using indigenous knowledge, current literature states how AI "would benefit greatly from incorporating elements of non-Western worldviews" (Williams and Shipley 2020) and that without indigenous views of the world, AI has the potential to cast aside human life. While this view looks at one extreme, the relationship between indigenous and non-indigenous communities can indicate how relationships with AI may be formed. When considering this relationship between people and AI, Others have looked back at the relationship with indigenous communities to claim that "We have a history that attests to the corrosive effects of contorted rationalisations for treating the humanlike as slaves, and the way such a mindset debases every human relation it touches" (Lewis et al. 2018a). Building on this, it can be argued that "Any commitment to building the responsible and beneficial AI of the future ties us to the hierarchies, philosophy and technology inherited from the past, and a renewed responsibility to the technology of the present." (Irwin and White 2019)

For Māori and indigenous peoples in general, there are historic roots of mistrust from being over-researched and over-surveilled while having very little engagement in many data-generating activities related to them (West, Wilson, et al. 2020). From this end, using imported data methodologies for gathering information resulted in Māori being labelled as savages and brutes with the memory and effects of these methods still present today (Pool 2016). Cases such as the use of predictive technologies in corrections (New Zealand and Waitangi Tribunal 2005) or a Kainga Ora Smart Home Sensor Initiative in Aotearoa have shown that Māori lack control over their data and how it is used (West, Wilson, et al. 2020) while helping reinforce this bias. These issues are further compounded when looking at the effects DNA and genomic research has had on Māori communities where the "warrior gene" incident appeared to reveal the reason behind supposed violent tendencies of Māori people despite a small sample size (Caron et al. 2020) while the inherent biases and CSI effect of DNA profiling have continued to

negatively affect Māori leading to little to no trust as the system "seems" rigged against Māori due to cultural and historical interactions with the justice system (Ahuriri-Driscoll et al. 2021).

3.2 How trust is built from Māori perspectives

Under the treaty of Waitangi (Te Tiriti o Waitangi), Māori maintained control of valued resources (taonga) and can express self-determination (rangatiratanga). While data was irrelevant when the treaty was signed in 1840, the concepts of taonga and rangatiratanga were and continue to be. These concepts play a big part in today's discussion around Māori-Data-sovereignty (Hudson et al. 2017). Māori have a differing view: Data is simply a source of information, not just stored/used by computers. Instead, data can be considered a representation of a source of information. Thus, context is essential in determining taonga (Hudson et al., 2017). Another aspect given to data when considering if it could be taonga is utility. How the data can be used and the reason for its collection plays a significant role in whether it is taonga. Existing research suggests that "all data is potential taonga. it is related to its utility, through technology or usefulness to the collective" (Dewes, 2017, p. 14). This idea of how data is conceptualised through a Māori lens leads to disconnects and issues with how it is collected and used in modern research, with an argument being made that "research is inextricably linked to European imperialism and colonialism" (Cherrington et al. 2020). Within big data, the biases present and the current research principles cannot undo this lack of representation of indigenous communities. In contrast, indigenous communities tend to carry substantial risks in genomic sequencing and receive limited benefits from the research (Hudson et al. 2020). In trying to address these issues, Māori-data-sovereignty advocacy and research has led to a greater focus on how "Māori customs (kawa) and protocols (tikanga) might inform approaches to data ethics and data governance" (West, Hudson, et al. 2020).

To attempt to build trust and address these issues that have stemmed from under-representation and a lack of informed consent and consultation, there are many arguments for a system that grants a central and active role for Māori when it comes to the use of their data and data about them in order to enhance "enhance accountability and transparency, give effect to the Treaty principles of active protection, equity, rangatiratanga and partnership, and also mitigate the disproportionately negative effects on Māori".While this argument has been made in reference to the use of DNA profile databases and the over-representation of Māori in the criminal justice system, the ideas behind it are also relevant to many other areas in which Māori data is collected and used. These arguments help give an idea of the work that needs to be done, and currently, ways of getting there are still severely lacking. The Te Mana Rauranga, Te Mata Ira, and the Ngā Tikanga Paihere frameworks outline what needs to be used to build trust from a Māori perspective with a focus on genome and DNA testing. Research surrounding these frameworks note the inequality of indigenous communities when it comes to the outcome of genome sequencing (Hudson et al. 2020) while taking the position that the DNA is a "takoha"—a gift of responsibilities, which obligates whoever uses the data to deliver outcomes that are useful and continue conducting research in a culturally appropriate manner (Caron et al. 2020). Each of the different frameworks identified draw from Māori knowledge (mātauranga) and tikanga to help build trust and "establish goals, boundaries, and principles to guide and inform good data practice" (Stats NZ 2020). The Ngā Tikanga Paihere framework aligns its tikanga with that of the data stewardship framework "which aims to establish goals, boundaries, and principles to guide and inform good data practice" (Stats NZ Tatauranga Aotearoa et al., 2020) while the Te Mata Ira (Hudson et al. 2016) and Te Mana Rauaranga (West, Hudson, et al. 2020) guidelines frame the issues of Māori research ethics within the context of genomic research. While each of these have different concepts or mātauranga that they are built upon, there are a number that do overlap with origins (whakapapa), authenticity and integrity (mauri), customs (kawa), and the right to exercise authority (kaitiakitanga) playing a role in all of them to help establish protections, especially when data move beyond the "sphere of Māori-control into national and international contexts where tikanga is not respected" (Sterling et al. 2021).

3.3 Understanding key Māori concepts & how they are used with technology

Historical cases show that the best interest of Māori people and their worldview are often not fully considered when developing IT artefacts. Below are ways that Māori are adopting these systems and the ways that Māori are incorporating their own values into them:

3.3.1 Mātauranga

Mātauranga Māori is commonly referred to as Māori knowledge (Hikuroa 2017) however, its exact definition and what it encompasses varies in each piece of research found. Mātauranga refers to the pursuit, application and understanding of the natural environment (te taiao) that follows a systematic methodology based on evidence, culture, values and the Māori worldview (Hikuroa 2017). A way of

perceiving and understanding the world, and the values or systems of thought that underpin those perceptions" (Edwards et al. 2022).

Considering this, mātauranga Māori can be perceived as being a Māori knowledge system that is not only concerned with what is known but also with how it is known. One way to frame and understand this is to label it as a Māori inquiry paradigm that can be understood in terms of three factors – (1) wisdom and understanding (te ao mārama), (2) genealogy (whakapapa), (3) research conducted using mātauranga Māori and Te Ao Māori (kaupapa rangahau).

Understanding mātauranga Māori presents a platform that can nurture the unique relationship that Māori have with the natural world in which everything is interconnected: an unfamiliar concept in western science and philosophies (Shedlock and Hudson 2022). Through this, it is possible to understand that humankind is not the central focus of creation and allows for an understanding of ethical relationships around AI-related development. This difference in how the world is viewed and how all aspects are interconnected provides Māori with an ability to connect directly with learning machines in a way that is fully realised or understood by western perspectives (Lewis et al. 2018b).

Understanding and incorporating this into the development process takes more than just using the knowledge that exists in the Māori world. It also requires the process to engage with and embody that knowledge. To incorporate the knowledge without fully understanding what it represents leaves a crucial part missing. Research by Mingon and Sutton (2021) explains this in the context of work being done to preserve the tradition of haka (a Māori ritual dance) by programming robots to be able to perform it. While the robots can speak the words and do the movements, they need to "manifest the spirit of ritualised activity which, without this spirit, falls into the emptiness of bare repetition" (Casey 2000). This lack of spirit and hollow repetition fails to fully grasp and represent the knowledge and history surrounding haka. Rather, technology can embody this knowledge through the deliberate use and re-use of the practice (Mingon and Sutton 2021).

3.3.2 Tikanga

Tikanga in its most general form can be understood as being Māori protocols and practices however, it goes much deeper than that, and one's understanding of tikanga is often formed by the language one learns about it. How one understands tikanga through learning in English will differ from one's knowledge through the Māori language (te reo Māori) as te reo Māori participants often have prior knowledge and refer to that other participants may not necessarily have (Mead 2016). A better understanding can be found by viewing tikanga as being appropriate customary protocols informed by common cultural values and concepts and as being "more than just 'rules'. They are best described as a form of social control and can guide the way relationships are formed" (Stats NZ 2020). There are very few cases or experiences in life where tikanga does not apply. Birth, marriage, sickness, and death are all firmly embedded in the process of tikanga. When it comes to engaging with Māori, tikanga can be found at the core of most interactions.

Māori have been quick to adopt new technologies. While there is no one way that tikanga can be incorporated and embedded into these systems, attempts have been made to incorporate tikanga Māori into everyday tools. While there are examples of work being done that explores the inclusion of tikanga in technology with cases such as Te Whare o Te Reo or the Ātea project, which both explore pōwhiri in virtual reality with Te Whare o Te Reo being a video game aiming to teach te reo Māori (Poi-Ngawhika Te Rito 2023) while the Ātea project focussing on reconnecting dispersed whanau using virtual and augmented technologies with their wharenui ("Ātea" 2020). Other tools where attempts have been made to incorporate tikanga Māori is social media. These tools have been used to broadcast tangihanga using posts, photos and videos and have received mixed reactions (O'Carroll 2015). Despite this growing use of tikanga being applied in virtual spaces and the positive opinions that some have of this use, there were also significant concerns surrounding how these spaces could encompass the depth and richness of such practices, with participants highlighting issues around feeling disconnected from the spirit (wairua) of the deceased in the case of tangihanga or being unable to conceptualise how tapu can be transferred from a physical and spiritual space to a virtual space while others felt such acts lacked authenticity in virtual spaces (O'Carroll 2015).

3.3.3 Taonga

Taonga, as a term, defies any exhaustive definition. However, if you were to look at Te Aka – the Māori dictionary, it is referred to as 'treasure, anything prized – applied to anything considered to be of value including socially or culturally valuable objects, resources, phenomenon, ideas and techniques' (Te Aka Māori Dictionary n.d.). This broad definition does not fully encapsulate the true meaning of taonga to Māori and its importance. For Māori, taonga refers to both tangible and intangible elements which are

considered to be treasures that are handed down between generations, with examples being the Māori language, waiata, traditional medicine, knowledge, and one's genealogy (Ellis et al. 2023). While the term will bring different meanings and understandings between hapu and iwi, these taonga are often seen as having a whakapapa in their history and the traditions surrounding them and their creator. By inhibiting these elements, taonga can be alive and have a sense of 'warmth'. This 'warmth' refers to the unbroken connections between people and their past, present, and future. When the people related to this taonga are alienated, this connection can be considered broken and the taonga 'cold'. While this concept refers to museum work and physical taonga that are stored there, it is also relevant to the creation and storage of digital taonga.

The most common space for research surrounding digital taonga is within museums and the digitisation and conversion of taonga from a physical realm to a digital realm. While several factors need to be considered when creating new digital taonga, some are only present when converting existing physical taonga to a digital realm. Many of these are related to digital imaging techniques with tangible taonga where being able to interact with, feel and use senses other than just sight play a role in connecting with such taonga as well as exploring how well finer details can be translated (Ellis et al. 2023). For example, while it is possible to create a 3D model of any taonga, how well is it preserved, are all the finer details captured, can the power (mana) and wairua of such an item be transferred, can one still feel the same level of connection or does it become a completely different taonga that reflects a physical copy but has its own whakapapa and mauri (Brown 2008)? Examples of work within this space include the Te Ahua Hiko project (Brown 2007), which explores the process of digitising Māori performances and inserting them into an artificial Māori environment, and the conversion of a whalebone cleaver (wahaika) to a 3D model from a previous digital form (Brown 2008). While these projects allow Māori to reconnect with and preserve their taonga and practices, the use of taonga in these spaces has led to concerns that they may devalue and oversimplify the significance of such artefacts and practices.

4 The Artefact

This literature review initially looked at a total of 73 papers, all with potential insight into the topic. Of these, nine were selected that explored trust. The other papers were rejected as they either provided no insight on trust (e.g., focuses solely on the under-representation, etc.) or engagement with Māori concepts and practices in IT artefacts. In Table 1 are the nine papers that explore trust completed as part of the processing employed to inform the Word Map.

Publication	Author/s	Year
"He Matapihi ki te Mana Raraunga" - Conceptualising Big Data through a Māori lens	Hudson, M., Anderson, T., Dewes, T. K., Temara, P., Whaanga, H., & Roa, T.	2017
Indigenous Big Data Implications in New Zealand	Cherrington, M., Airehrour, D., Lu, J., Xu, Q., Wade, & S., Dunn, I.	2020
Data Ethics and Data Governance from A Māori World View	West, K., Hudson, M., & Kukutai, T.	2020
Māori views of forensic DNA evidence: an instrument of justice or criminalising technology?	Ahuriri-Dirscoll, A., Tauri, J., & Veth, J.	2020
Rights, interests and expectations: Indigenous perspectives on unrestricted access to genomic data	Hudson, M., Garrison, N., Sterling, R., Caron, N., Fox K., Yracheta, J., Anderson, J., Wilcox, P., Arbour, L., Brown, A., Taualii, M., Kukutai, T., Haring, R., Te Aika, B., Baynam, G., Dearden, Peter., Chagné, D., Malhi, R., Garba, I., Tiffin, N., Bolnick, B., Stott, M., Rollerston, A., Ballantyne, L., Lovett, R., David-Chavez, D., Martinez, A., Sporle, A., Walter, M., Reading, J., & Carroll, S.	2020

Understanding Māori Rights and Interests in Intellectual Property arising from Research and Innovation	Sterling, R., Riddle, K., Brooks, R., & Hudson, M.	2021
Te Mata Ira: guidelines for genomic research with Maori	Hudson, M., Beaton, A., Milne, M., Prot, W., Russel, K., Smith, B., Toki, V., Uerata, L., & Wilcox, P.	2016
Indigenous Genomic Databases: Pragmatic Considerations and Cultural Contexts	Caron, N., Chongo, M., Hudson, M., Arbour, L., Wasserman, W., Robertson, S., Correard, S., & Wilcox, P.	2020
Ngā Tikanga Paihere: a framework guiding ethical and culturally appropriate data use.	Stats NZ Tatauranga Aoteroa & M, Hudson.	2020

Table 1: Publications reviewed surrounding trust from a Māori perspective

Within the papers that were explored, it becomes clear that attempts to create engage with Māori in a trusted space have often missed the mark due to either a lack of understanding or misrepresenting the requirements of these communities. While this problem is not new, a new approach is required in this space. As such, the artefact needed to be designed here must provide an understanding on how to work with Māori communities through understanding what needs to be considered to build trust in IT artefacts.

Using an online word cloud creator (www.worldclouds.com), the below word clouds were extracted from the full text of the nine papers that explored trust. Some editing using the website interface is required, such as removing nouns and non-specific words (the, one, page, etc.) and removing any word that appeared less than three times to retrieve terms of low and high frequency while removing the concepts that are not recurring. The terms are presented as a word map to provide a visual observation of key terms. Figure 1 shows the associated English and Māori ideas and concepts helpful in aligning with building trust. Figure 2 displays only te reo Māori text identified as a visual observation of key associated Māori words in the literature.

Figure 1:Initial Word Map with Māori and English terms from the literature identified in Table 1

Figure 2:Second Word Map print of Māori key terms only from the literature identified in Table 1

The keywords from Figure 2 are separated in levels depending on the frequency with which they appear. In doing this, the terms that play important roles in discussions around the use of technology in areas where a high level of trust is required can be extracted. In order to understand what key terms help play

a more significant role in these discussions, the terms are split into three levels, with the first level terms appearing more than ten times, the second level terms appearing between six to nine times, and the third level terms appearing five or fewer times.

1st level words (>10 appearances):	2nd level words (10≤x ≤5 appearances):	3rd level words (<5 appearances):
Tikanga 16	Whakapapa 10	Mauri 4,
Mātauranga 12	Mana 8	Kaitiakitanga 3,
Taonga 11	Tika 8	Noa 3,
	Rangatiratanga 7	Pono 3,
	Kaitiaki 6	Pukenga 3,
	Manaakitanga 6	Tapu 3

Table 2: Similar Trust Associations with Māori Word Terms

5 Evaluation

The process used to analyse and summarise the current literature followed (Bryman 2016). The search was carried out using the following process: used Google Scholar, searching for articles using the following term(s): "Māori, perspective, trust, technology, blockchain, artificial intelligence, indigenous, genomic, research, databank". The abstracts, and conclusions were considered if required and the resulting articles were separated into relevant and non-relevant. After summarising the relevant papers by taking all relevant quotes from the articles, they were categorised into the primary Māori concepts they explored and consolidated down to the recurring ideas across all articles. By using these search terms, papers that are not only related to trust but also those that relate to topics that both require a high level of trust and have historically misrepresented or misused Māori data were able to be identified and provide factors relevant to building high levels of trust.

In total, the investigation looked at and briefly read/summarised 73 papers, 54 of which had little or zero relevance to the topic, did not provide an indigenous perspective or, were hidden behind paywalls and were not accessible. Extracting the keywords that appeared in the resulting nine papers gives an idea of the key terms and concepts related to trust while removing the English terms gives an idea of the keywords more important to Māori. As a result, Table 2 provides insight into some key terms important to Māori for building trust.

On the surface, the terms in Table 2 and the word clouds do not appear to be directly related to how trust was defined earlier in this research. However, when looking at it from a te ao Māori lens, the terms present are critical and represent what needs to be considered to build trusted IT artefacts. For Māori, a deep understanding and respect must be given to how one interacts with and forms relationships. These identified terms align with the literature review findings and show the most important factors that need to be considered. By splitting the key terms into multiple levels based on the frequency at which they occur, the artefact indicates what terms have more influence over the level of trust built from a Māori perspective.

6 Discussion

Within the research identified, while trust is a common point of discussion however, the current body of literature places a higher emphasis on the fact that indigenous peoples have historically been misrepresented and adversely affected by the use of technology. Currently, there is little to no literature that is focused on how the trust that indigenous communities have in technology can be built or what it may look like. From the literature review and the artefact compiled, it has been identified that there is no one defining factor that portrays trust, instead (from a Māori perspective) it is a contextual concept, fostered by several different concepts. Mātauranga, taonga, and tikanga are the overarching concepts that can help build "trust". While these terms identified in the artefact are not the only ones that are important when it comes to building trust from a Māori perspective, the artefact does provide a blueprint that can be considered and built upon in research and the development of IT artefacts.

The concepts with Table 2 are contextual and will change depending on the technology and its use. An example is DNA forensics and genomic research, in both cases, DNA is the input. DNA is sacred (Tapu) and has a high Taonga value to Māori, it is their whakapapa, it is who they are. Both would require similar Tikanga, however, due to the negative impact DNA forensics have historically had on Māori. Their "trust" or perception of this technology is far less than that of genomic research.

That does not mean that genomic research is inherently trusted. Whilst genomic research has a better standing as it can benefit Māori. There was the "Warrior gene" incident, which concluded (from a small sample size) that all Māori have a specific gene that can explain the "aggressive" behaviour demonstrated by the Māori populace. This research was widely condemned for reinforcing inappropriately negative stereotypes of Māori as being naturally aggressive. (Caron et al. 2020)

To combat this stigma, misrepresentation and other issues and concerns around the use of modern technology, three frameworks have been created to help address these issues and concerns and ultimately build trust. These frameworks focus on establishing taonga and tikanga for the use of both big and small data. Which most emerging technologies utilise. Other research notes that data in terms of an indigenous perspective is not the digital only concept it is viewed as in modern society. Instead, "data" is any 'digital or digitisable information or knowledge that is about or from Māori people, our language, culture, resources or environments" (West, Hudson, et al. 2020). This means these frameworks can be applied to any technology that intends to have Māori users or collect/use Māori data. These frameworks are not extensive, giving general guidelines around using Māori data referenced by international researchers (Claw et al., 2018).

Moving beyond these concepts, most research concludes that Māori consultation, inclusion/oversight and transparency is required (Cherrington et al. 2020; Claw et al. 2018; Sterling et al. 2021). Even mentioning how it has helped improve perception when included in similar technologies (Ahuriri-Driscoll et al. 2021). This is amplified when it comes to secondary use of data, where informed consent is often lacking (Garrison et al. 2019). "Current research ethics processes tend to focus on consent in relation to primary data collection and use and provide little assistance to researchers with respect to navigating ethics associated with data management and ongoing secondary use." (West, Hudson, et al. 2020).

This is where Māori data sovereignty is important. Once that data is collected and processed, who retains ownership of said data and has the right to view and use said data? Under Māori data sovereignty, any taonga data remains under the control of Māori. While the current approaches and research being undertaken focus on engaging with and incorporating the different Māori concepts identified, full control of Māori data and the technologies used within Māori space is still severely lacking, thus highlighting the need for Māori oversight.

7 Conclusion

As proposed by Simon (1996), there are three elements required by design science research. The use of prescribed knowledge, a search for alternatives, and the evaluation of the alternatives. In the literature under review here, no single defining concept helps build or instil trust from a Māori perspective. Both technology and humans are far too complex for that. Instead, it is several contextual concepts, the three leading concepts being tikanga, whakapapa and mātauranga. Defining these three concepts makes a "roadmap" to instil and build trust for Māori possible. Through utilising and engaging with these concepts, a Māori connection to veracity can begin to be formed with trust and authenticity linked and built through Māori views of tikanga, kawa, and taonga. By evaluating and respecting tikanga, whakapapa and mātauranga, allowing Māori oversight and control, and respecting Māori data sovereignty, this paper argues that not only is trust possible, but connections to a Māori view on trust can be built.

There are three frameworks aimed at helping define these concepts for providing conceptual, governance, and ethical guidance, the Te Mana Rauranga, Te Mata Ira, and the Ngā Tikanga Paihere framework. These frameworks offer a way to engage with and work with Māori however, no frameworks or guides exist that help lead to the construction of such IT artefacts.

While there is an existing body of research surrounding trust and areas that require high levels of trust for Māori, a common theme begins to emerge, under-representation or misrepresentation of indigenous communities, rather than focusing on trust. This opens future research into the key factors that need to be considered to realign current technologies to be trusted by Māori and develop an IT artefact that could be considered uniquely Māori. The concepts identified here and their significance to Māori provide

a platform for future research to explore the creation of IT artefacts that engage with Māori beliefs and values and aim to build a high level of trust within the communities where they operate.

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Appendix 1 – Glossary

Term	Definition
Aotearoa	Māori name for New Zealand
Kaitiakitanga	Guardianship, protection
Kaupapa Māori	Māori principles and ideas which act as a base for action
Kawa	Māori protocol and etiquette
Mana	Power, authority, ownership, or status
Manaakitanga	Caring and Sharing
Mātauranga	Māori epistemology/Knowledge
Mauri	life force, the essential quality and vitality of a being or entity
Noa	To be ordinary, unrestricted, free from the extensions of tapu
Pūkenga	Skill, expertise
Rangatiratanga	Self-determination, sovereignty
Taonga	Treasure, anything considered to be of value personally, socially, or culturally
Tapu	To be sacred, restricted
Te Ao Māori	Māori world
Te Ao Mārama	A concept relating to wisdom and understanding and the natural world of life and light;
Te Reo Māori	Māori language
Te Taiao	The natural environment
Te Tiriti o Waitangi	Treaty of Waitangi
Tikanga	Māori ontology/practices or Māori governance and intellectual protocols
Wahaika	weapon of bone or wood

Wairua	The spirit or soul of a person that is distinct from the body and the mauri
Whakapapa	Genealogy

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