BEYOND IMPERIAL TOOLS: FUTURE-PROOFING TECHNOLOGY THROUGH INDIGENOUS GOVERNANCE AND TRADITIONAL KNOWLEDGE SYSTEMS

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Australian Aboriginal peoples are the oldest living continuous culture, from the driest continent on Earth. Ancient technology developed by Aboriginal peoples reveals underlying design and development methodologies that reflect a unified approach and value system. Aboriginal social cohesion, well-being, environmental sustainability, culture and spirituality underpins the foundation of such innovation and has been nurtured through systems of governance, commonly understood as Lore.[1] It is these relational, cultural practices which have created the framework for this society and the myriad science and technology developments produced by Aboriginal peoples over millennia. Given contemporary global challenges, it is a critical time to reflect on what we can learn from such frameworks, and to initiate a new wave of technologies designed and developed through a Code of Ethics, embodying the principles of social and environmental sustainability: *Caring for Country, Caring for Kin*. By adopting Australian Aboriginal Lore, ethical technology would help to bring about the changes required to address fractured political, economic and social systems. In the following paper, I discuss how the development of a new Code of Ethics for technology development can be informed by Aboriginal design principles and governance.

The seeds for writing this chapter were planted four years ago through a curiosity to understand the difference trajectories of Aboriginal and Western technologies, and what is required to create culturally relevant and grounded technologies for Aboriginal peoples into the future. During this short time, technologies have continued to extend the influence of an anthropocentric economic understanding of the world, resulting in the acceleration of technologies' drive

to synthesis and commoditise what makes us human: *consciousness*.

The raft of technology ethics frameworks, mainly developed by the private sector but increasingly also nation states, have typically focused on the prevention of artificial intelligence (AI) being developed in ways that may harm human (the individual), economic, and political systems. These frameworks are reactive attempts to respond to the negative impacts of technology which have manifested many times before in recent history, and tend to be limited by the speculative/imaginative ability of those who create them. Meanwhile, ongoing work with Elders and industry practitioners has revealed the values, principles and practices behind Aboriginal technologies designed around social and environmental sustainability. Through this understanding, it is clear Indigenous governance provides an existing, time-proven ethical framework for the development of new technologies. Central to this framework is the development of individual technologies within the context of a wider system of governance, which ensures that broader consequences are not ignored and new developments are not compartmentalised. As Jason Lewis states, *"we do it because we believe that Indigenous epistemologies are much better at respectfully accommodating the non-human[…] ultimately, our goal is that we, as a species figure out how to treat these new non-human kin respectfully and reciprocally - and not as mere tools, or worse, slaves to their creators*[2]*."*

This chapter reviews Aboriginal peoples' governance systems through the reciprocal relationship with land that has informed the development of these innately spirited and conscious technologies based upon inherent principles of sustainability for both humans and the environment. I will detail the origins of these technologies, and the *ensoulment or psychology-of-place*[3] which inhabit Indigenous Techno-Animism. By reviewing the origins of Aboriginal relational interconnection and interrelatedness with Country, and the agency of Western technology and its influences from the Eurocentric, 'man harnessing nature' Enlightenment-era thinking, will reveal the dissociation of humanity and the earth of the Western model. Through doing so, we will contrast how Western cultural and social structures have created the foundations for contemporary technology development and illustrate how Aboriginal design principles embedded in these technologies can assist in the futuring of *Deep Technologies*[4] for the ethical and considered advancement of humankind and our environment.

INDIGENOUS LORE: GOVERNANCE AND ETHICS

Aboriginal Australia is a continent of 500 Nations with discreet languages, territories, customs and laws which are underpinned by Lore (otherwise known as The Dreaming or Jukkapurra). Lore embodies all culture, kinship systems and Country itself. Within these systems, relationships and experiences are encoded in a unified set of values and principles. As a complex society, Aboriginal creation stories typically share a similar focus on how different creator beings brought the earth, the land and waterways, animals and humankind into being. Where Christian creation has Man as transcendent and pinnacle, in the image of God, Aboriginal creation stories position humankind as a derivative part of Country itself. The fundamental basis of Lore is therefore *a law of nature*, with humankind fitting into rather on top of the land itself.

Aboriginal societies developed through a custodial ethic: the repetition of an action such as that, gradually over time, the ethic becomes the norm[5]. These rights, rituals and customs are firmly rooted by a deep, symbiotic relationship to Country itself and are the basis of Aboriginal cultural practices. To fully comprehend this relationship we need to understand Country as an entity, both materially and non-materially. Country encompasses the sky, sun and moon; the seas and waterways; mountains and land; fauna and flora, the earth and everything held within it; the stars and space itself. It's both the subterranean and metaphysics of land and is the one and only single source of Truth. For Aboriginal peoples, Country is the 'Law of Reciprocity'. There are three main distinctions which help to distinguish Lore from Western concepts of Law:

1. Aboriginal Lore is a religion; and
2. a science (it can be likened to a cognitive science or applied psychology);
3. and an action guide to living and understanding reality[6].

INDIGENOUS KNOWLEDGE SYSTEMS: PATTERN THINKING AND PATTERN RECOGNITION

Within the context of Lore, I have previously identified 'Pattern Thinking' as "a system for understanding the complex web of ontology, epistemology and interrelatedness within the Indigenous paradigm"[7]. Furthermore, Pattern Recognition[8] is the deep consciousness that comes from this uninterrupted way of seeing, being and knowing. This is the non-colonial state, and our uninterrupted *old ways*:

> *IKS [Indigenous Knowledge Systems] can nudge the existential compartmentalism of Western techno-science into another realm of interrelationship and interconnectedness; indeed, the current wave of*

> *"new materialisms" bears striking resemblance to, and could benefit from,* indyamarra[9] *[a sense of the sacred; to give honour to; show respect; and to do slowly].*
>
> *Mukgrrngal[10] tells me that 'the rock over there does not exist until its sung into being' and adds that the power of matter interrelationship is such that 'if we stop caring for Country, Country dies, and we die'.*
>
> *In Pattern Thinking, the rock has value, meaning and place, as do human beings and the animal, plant, cosmological and metaphysical worlds combined. All things create the complexity of the Pattern Thinking web in a nuanced relationship of being and knowing entwined.*
>
> *Where once religion informed and influenced all aspects of Western society, now technologist corporations are increasingly informing and influencing our worldviews [...] Pattern Thinking can regulate the delicate balance of all things synthetic and our relationship to them. It is an ethical intelligence and embodiment born from this land, giving meaning and relationship to everything. I take this system, evolved as a streamlined ecology, as the best chance of Australian humanity's maximising its chances of success.*[11]

Aboriginal peoples use a strict code to bind the veracity of oral language for the custodianship of often critical and complex information and the regulation of its transmission throughout successive generations, over hundreds of thousands of years. The vast reservoir of knowledge including fauna and flora, astronomy and space itself required to ensure the health and wellbeing of both Kin and Country meant that Aboriginal people needed to have encyclopaedic memories. So how do those old people recall such vast volumes of knowledge? Through the physical practicing of culture, its rituals, protocols and customs, with repetition reveals the encoded knowledges.

Information bound within the code includes the mapping of locations, such as vital sources of water, food and shelter; complex kinship laws to protect the biophysical diversity for the health of, and interrelationships of clans; how to manage biodiversity of flora and fauna resources for environmental sustainability; trade relationships and the management of sovereign territories for peace-keeping; and the guidance of spiritual and cultural practices for the collective wellbeing and advancement of Country and Kin. Strict protocols exist to ensure the custodian and stewardship of Country and the veracity and pertinence of its knowledges are kept intact through the lived, embodiment of the knowledge system. The custodianship and sharing of any story in Aboriginal culture is regarded as of critical importance; to tell the story the 'proper way' or risk contaminating knowledges and impacting potentially fatal consequences.

For example, a Songline or story to navigate vast territories and distances needs to be sung, danced and or told with the correct intonation, pace, tone, repetition and narrative to ensure current and future generations have the correct information to destinations, such as sacred sites and vital resources embedded within Country for survival in the diverse and extreme Australian landscape. Through a succession of rights and rituals as part of initiations throughout one's life, general, deep and sacred knowledges are imparted. Custodianship of such knowledges is actively practiced through ceremony to embody the spirit and vitality of this Lore and is an acknowledgment of your growing responsibility to Country and your kin.

ABORIGINAL TECHNOLOGIES

Through a millennia-old culture, the ontologies of systems, artifacts and technologies both inanimate and animate, spiritual and manmade, have come into being through their own creation stories. These technologies are founded by a deep relational belonging to place and they are intrinsically entwined within cultural identity and practices designed to *nurture* Country. A stark contrast can be drawn here with the evolution of Western technologies and perceptions of the environment as a product associated with the transformative power and drive for human enhancement.

Following is a conceptual review of Aboriginal technologies. There are no historical records extrapolating their engineering, instead, complex interrelated information is encoded within their stories. Created over a millenia, these stories defy mere mortal inception, attesting their provenance from Country and their creation by primordial animals, and or spirit beings. As Alison Page, an Aboriginal designer from the Yuin Nation reflects:

> *It's the weaving of spirit, Lore, ceremony and story that imbue Indigenous systems, artifacts and technologies […] the story embedded within the intricate decorative design of a carved shield is layered with highly nuanced meaning and knowledges that is both didactic and spiritual.*[12]

Some Aboriginal technologies are so perfectly in sync within Country that to the untrained eye, they are invisible. The transformative power gained through technology - generated by and through Country - is a cultural and spiritual feedback loop for Aboriginal peoples. This is the sophistication of a Lore of reciprocity, it is the Lore of the land.

Following are three stories of Aboriginal technologies and examples of how they can inform new emerging technology design, developments and applications.

The Boomerang: A Returning Stick by Asymmetrical Shift

An Australian cultural icon, the boomerang's design ingenuity and innovation originates from the curvature of this wooden device, typically made from either mulga or wattleseed timber (see Figure 1). There are two types of boomerangs, returnable and non-returning sticks. The former are used for the herding of birds into a net, and the latter is designed to hit the target animal, such as a kangaroo or wallaby with significant force to strike or kill. Both are designed to perform one of the most complicated acts in aerodynamics: asymmetrical lift. Informed by this design, Aboriginal engineer and inventor, David Unaipon stated in 1914, twelve years before the development of the first helicopter:

> *An aeroplane can be manufactured that will rise straight into the air from the ground by application of the boomerang principle. The boomerang is shaped to rise in the air according to the velocity with which it is propelled, and so can an aeroplane.*[13]

The boomerang is also used as a multi-purpose hand tool and musical instrument when clapped together with another boomerang. The boomerang developed in various formations over most of Australia.

On Mornington Island, the boomerang's existence is born from the creation story of *Thuwathu*, the Rainbow Serpent:

> *Thuwathu came as a human from the south-west via the Georgina and Nicholsen Rivers making waterholes containing mermaids and water lilies. He was a high-degree law man with many power songs to provide him with strength. His origins are vaguely associated with the snake dreaming. After building a large wet weather shelter for his sacred objects, Thuwathu's sister Pulthuku has a young baby daughter, Kintitpu, Willy Wagtail, who was getting wet since she had no shelter. Pulthuku asked Thuwathu if she could put her child in his 'humpy', but he was tired and sleeping and did not answer. She made a fire to warm her. She observed a number of spaces inside Thuwathu's shelter, but each time Thuwathu replied to her successive requests by saying that a particular space was for his big knee or for his elbows, his ears, spine, feet etc. Eventually the baby died of exposure and Pulthuku mourned and cut herself. She made a bark torch and set fire to Thuwathu's shelter all around it. He was trapped inside and badly burnt. When he rolled out in pain, he cursed his sister. Thuwathu crawled away singing whilst undergoing a biological metamorphosis. He was transforming from human form into that of a serpent. As he moved, writhing in pain, he physically altered the landscape. He dug up the ground in the vicinity of his camp that by now was all on fire. The area became submerged and was extinguished by the sea. He travelled inland leaving a deep groove in his wake which is today the Dugong River.*

His back-and-forth movements made all its tributaries. Deep water holes were left at the many places where he rested. In other places, his rib bones broke off, going into the ground to become kurparra trees (Acacia alleniana). Thuwathu's blood turned into red ochre on the surrounding tidal flats, and he vomited up many animals [...] 'every place Rainbow Serpent (Serpent) travels he leaves a young Rainbow (Serpent),... he leaves his seed'.

Thuwathu's bones grew into kurparra trees, and energies are said to be still inside these trees. This tree is a most important raw material to the Lardil, used for boomerangs, spear prongs, fighting and digging sticks, etc. […] when obtaining kurparra for making boomerangs, one must weep next to the tree and be sad at hurting it, as well as singing special songs. Boomerangs are 'sung' into be[ing] powerful for fighting and hunting, and also take on an important role in the male tjarata ceremony (obtaining the love of a woman). These special songs aim to harness the energies inside the boomerang to aid the owner […] 'they say that the old spirit, the spirit of the tree he always come and see whether you are doing the right thing or not, according to our law'.[14]

Figure 1

The Fish Trap: The World's Oldest and Largest Human-made Structure

The fish traps of Brewarrina, known as the Ngunnhu[15] by the local tribe and custodians, the Ngemba people, are the oldest human-made structure in the world, dating more than 40,000 years. Created by Baiame, a creator spirit who threw his fishing net across the Barwon, to give the shape and design of the fish traps, which his two sons, Booma-ooma-nowi and Ghinda-inda-mui then built the dry stone weirs and ponds. Biame then gave each of the traps to different family groups for their maintenance and use.[16]

As the oldest and largest structure of human origin, the fish traps are a remarkable example of dry wall construction, water ecology, animal migration and geography, engineering, hydrology and fish ecology. They are sophisticated in their simplicity of design, adaptive and responsiveness to the fluctuating highs and lows of the seasons and the river. The fish traps are made up of twelve tear-drop shaped pools spanning half a kilometre, varying in height, and a collection of stone walled weirs designed to manage the flow of fish herded into the opening of each pool before close-off (see Figure 2). Designed to ensure the flow of the river was never disrupted, whilst also resisting damage from high water flow.

Figure 2

Archaeologists have stated that the Aboriginal peoples who designed, built and created the technology behind them must have possessed advanced knowledge of differing fields of environmental sciences. However, defying Western concepts of knowledge and provenance, the utilisation of the fish traps was guided and inspired by the pelican and the hunting techniques of this Australian bird. As Ghillar/ Michael Anderson recalls:

> *There was a long drought and the people were suffering from famine. But they were saved by the pelican, which showed them how traps work by using its large beak to scoop fish out of the river. After that, the pelican became a sacred creature. If anyone hurt or killed one, that'd be the end of them. They'd be dead before they got a chance to eat it.*[17]

The fish traps were also a significant meeting place for approximately twenty neighbouring tribes including the Morowari, Paarkinji, Weilwan, Barabinja, Ualarai and Kamilaroi peoples and their international[18] governing of affairs, trade, corroborees, initiations and ceremonies.[19]

Spinifex Resin: The World's First Thermoplastics

A sticky resin extracted from the plant spinifex is the world's first thermoplastic resin. Aboriginal people have been using spinifex resin for millennia for a multitude of purposes, including mounting stone heads onto spears and woomeras, repairing tools, stone walling, smoke signals and house construction. Spinifex grows across 20% of mainland Australia in dry and nutrient poor soils and hot climates (see Figure 3). The resin is extracted through a process of threshing, beating the harvested spinifex till the resin drips from the dry, tough fibres. Traditionally, the droplets are then collected and applied to heat, sometimes in the form of a burning hot rock to heat and mould the resin into a malleable mass. Aboriginal people from nations spanning the mainland of Australia have utilised spinifex resins in the production of the woomera - a spear thrower which has four times the kinetic energy of an arrow from a compound bow. The resin sets like concrete and is acts as a binder for making paint from ochre.

Spinifex has recently been developed by non-Indigenous scientists in partnership with the Indjalandji-Dhidhanu people, to extract nanocellulose for a super strength, lightweight, natural material for the production of more durable and thinner latex[20] products. There are also opportunities to develop the resin into bio-alternatives to more conventional petroleum-based polymers, including a biodegradable stretchable paper. Research is being conducted to test if the spinifex resin can be utilised to revolutionise the current $12 billion (USD) market of 3D printing and replace the reliance on conventional plastics:[21]

> *It is the Dreaming of the Indjalandji-Dhidhanu people and the spiritual importance of spinifex (Triodia) as a resource, which underpins all new developments into new nanotechnology research and developments. 'Increase' ceremonies are believed to have been passed down for many generations from Ancestral Beings of the Dreamtime. The function of such ceremonies was to catalyze the healthy increase or reproduction of various animal, plant, or meteorological phenomena which constitute totems in the Indigenous religious belief system, and by consequence, the total food supply. Through their ritual actions, the participants believed they connected with the Altyerre or Dreamtime dimension, and renewed a spiritual energy linking this dimension of the Ancestors with the world of mortal humans. Aspects of the travel of the Ancestral Beings were retold or re-enacted in the ceremonies through song, ritual and artworks with musical accompaniment […] These sacred histories of Spinifex Dreaming connect or relate to the Red Kangaroo, Wild Bee, Freshwater Bream, and Black-Headed Python totems joining distant groups in the wider region. These sacred histories provide an epistemological foundation to the regional intellectual property over traditional spinifex technologies utilised for architectural, engineering, material and medicinal functions.*[22]

Other examples of technology innovation can be seen in the development of watercrafts, fiberworks, message sticks, spears and woomeras, stone tools and the earliest forms of medicine, agricultural cultivation of bush plants for food, architecture and fire-stick farming for hunting and land management.

Figure 3

BEYOND IMPERIAL TOOLS

Borne out of imperialist roots, modern and postmodern technologies are far from culturally neutral. For the most part, the design and development of Western technology is predicated upon the logic of extractive colonialism, whereby natural resources are drawn from the environment, regardless of associated impacts in order to control conquer and dominate worldwide economic markets. Reviewing the intention and purpose of Western technology design and development reveals its position as being, *"above society both in its structure and evolution [...] seen as a source of solutions to problems that lie in society, and is rarely perceived a source of new social problems where […] society, culture and people are required to adapt to incessant progress of disruptive technology rather than technology adapting to values of equity, participation and social and environmental sustainability."*[23]
Defining technology beyond its common, often limited conception as an artifact of progress and/or progression of knowledge offers an opportunity to analyse its constructs through an Indigenist and feminist lens. Within Aboriginal worldview, humankind fits into rather on top of the land itself, shaping and forming the base teachings of Lore. From this basis, we can identify Aboriginal technologies as matricentric: flat and non-hierarchical social and cultural systems that are in symbiosis with nature itself. These are the foundational practices for Aboriginal technology creation, design and developments. Extending our cognition, sense of self and consciousness, to be at one with Country, through a mutually sustaining feedback loop. Aboriginal Lore is a reciprocal law of nature, *if we do not care for Country, it dies, as do we.*

The culture of colonial and neo-liberal thinking that has driven the development of technology has led to a field of technologies that fuel inequality and unsustainable usage models. The formulation of an Indigenous-led, universal technology ethics framework requires a positioning external to the imperial and patriarchal systems which currently inform international and national policy and economic markets. Aboriginal Traditional Knowledges and governance exists within an alternate paradigm so it is imperative to firstly understand this context and the constructs that such ancient technologies have and continue to reside within. By contrasting the current drivers of new, deep technology development with their imperial and colonial states, we will see how a holistic system of governance can ensure technology development embodies the principles and practices of sustainability while ensuring universal human and environmental rights now and into the future.

Ancient technologies developed using this system are valuable in a contemporary context as they embody sustainable solutions to timely problems. There are bountiful benefits to reap from the noted cross-cultural technology practices between Aboriginal peoples, their Traditional Knowledges and pioneering

historians, anthropologists, researchers and technologists bringing cultural-tech innovations into the mainstream. Spinifex is one example, but this growing awareness is evolving and transforming attitudes and perceptions, and is the basis for genuine partnerships with quantifiable socio-economic outcomes.

The custodial ethic of *Caring for Country, Caring for Kin* emphasises the importance of a deep, ecological understanding of how technologies fit into the world, suggesting a shift in focus of the design and developments of the synthetic code for deeper, more nuanced human technology inter-relationships, information sharing and knowledge transfer, and social and environmental sustainability. In this way, *Caring for Country, Caring for Kin* can inform how corporations and technologists can the adopt universal strategic mandates to inform social and environmental sustainability agendas, politics, policies, initiatives and innovations.

A unique alignment within both non-Indigenous technologists seeking new ways to make meaning of their work,[24] and the new wave of Indigenous technologists embracing their Traditional Knowledges to reform the foundational properties within advanced technologies is reason for optimism. These cross-cultural collaborations can do much to progress new advancements in technology. Applying Pattern Thinking to these technologies can refine hyper-local and contextual coding of Geospatial Information Systems (GIS) and Global Positioning Systems (GPS) technologies; mapping space and design of narrative structures to work with spatial complexities within Virtual Reality (VR) and Augmented Reality (AR); organisation of information for Information Architecture (IA); advancements in complexity systems theory for Machine Learning (ML) as part of Artificial Intelligence (AI); cradle-to-cradle approaches for advanced robotics; closed loop cycles for natural resource development and relational systems context for nanotechnologies - all for the advancement of socially and environmentally sustainable technologies: *Deep Tech*.[25]

CONCLUSION: NEW DEEP TECHNOLOGIES AND FUTURE DREAMINGS

From the cultivation of agriculture, mechanisation of labour, the information age and now, to the ubiquitous infiltration of technology, the 2nd, 3rd, and 4th revolutions have instigated shifts within social and cultural structures, impacting significantly on Western ways of seeing, being and knowing. What has eventuated is the increasing disconnection within community and a self-serving relationship to the environment. Yet, new design methodologies are responding to market demands for technologies that are socially and environmentally sustainable. Practices such as iterative design, human-centred design (HCD), circular economies, the blockchain and the sharing economy, are each affecting 'business as usual' and are driving new business models. Can these new design and development practices create conscious, spirited technologies if there is no shared story to ritualise and unite people to the places we connect with, both virtually and physically?

The patriarchal and hierarchical nature of systems design in AI developments, such as machine learning and deep learning are the basis of the dominant, contemporary human-technology interrelationships. Within these foundational systems is situated a precarious imbalance and subservient drive for human progression, inevitably at the cost of society and nature. The imperialist origins of Western technology should be further reason to caution new evolutions in AI: *deep learning, sometime referred to as machine consciousness or synthetic consciousness*,[26] where the self learning machine - intended to replicate human consciousness - is also expected to superseed human cognition, and evolution. In short, what good can come from the technology sector prophesying the rules of engagement for autonomous intelligent agents and systems designed to mimic and extend the phenomenal and cognitive evolution of consciousness when the politics for such developments are purely economic?

There is much to learn from Indigenous epistemologies and ontologies within Aboriginal Lore and its purpose to ensure technology evolution is a symbiotic process attuned to the nature of things, delicately balancing the needs of Country first, and then kin. Blackfoot philosopher, Leroy Little Bear observes: "the human brain is a station on the radio dial, parked in one spot, it is deaf to all other stations […] the animals, rocks, trees, simultaneously broadcasting across the whole spectrum of sentience"[27]. In this regard, Aboriginal technology design and development processes could awaken the consciousness in technology design and expand relational experiences of time, space and mass through their interrelatedness and interconnection with all sentient beings. Through Indigenous Techno-Animism resides opportunity for Pattern Thinking to not only govern the ethics of technology development, but to inform more nuanced, complex systems for new technologies and its development processes.

So how do we achieve true innovation through Deep Tech developments? Through radically shifting the development process beyond the economics of imperialism at the heart of human-centred design. Our company have developed a process to resolve these issues: *Country Centered Design.*[28] The questions we pose to define the problem space insist on cultural leadership, and both personal and collective accountability within the design process. The technology development which follows safeguards a reductionist approach by the series of questions and decisions our technologists make, informed by the protocols, rights, rituals and customs based on *Caring for Country, Caring for Kin*. In this way we curb traditional modes of technology design and software development based on self-interest, short-term gain and isolated impact. Embracing the story of the Country you are part of to create shared intention, purpose and meaning breaks knowledge silos, individualism and engage a philosophy and practice of interconnection and interrelatedness beyond the Eurocentric 'flourishing of human' to the nurturing of Country, and kin.

And what if we don't act? The increasing amplification of existing biases and prejudices; increase of data mining, loss of sovereignty and civil rights; extractive industries mining raw and precious materials with mass environmental and social impacts and increasing effects of loneliness impacting critically on the social structures of societies, communities and the health, wellbeing and life of humans. Kombumerri philosopher, Professor Mary Graham observes, "the most basic questions for any human group, despite advances in technology, have not changed much over time; they include:

> *How do we live together without killing each other off?*
> *How do we live without substantially damaging the environment?*
> *Why do we live?*[30]

I propose the following three guiding principles as the first steps to develop an Indigenous Technology Ethics Framework to future-proof technology development, drawn from the Lore of this ancient Country, knowledges and stewardship of Aboriginal Elders:

1. Development of humans through sustainable environmental resources
2. Transparency and accountability for all development practices
3. Technology rights equal to that of humans and the environment.

Bipartisan support from the technology sector and nation states would enable worldwide Indigenous Elders and cultural technologists to conceive, initiate and unite new Dreamings for nurtured growth and respectful and responsible development of autonomous machines, and how they reside within our society and our environment. The current imperialism within technology ethics only reinforces the human-economic center of our current social, environmental and

political crises; and so, it is through an Indigenous Technology Ethics Framework we can design and build better systems and governance based on the Lore of reciprocity to grow the next generation of technologies that embody the spirit and consciousness of this land and the earth at large.

Angie Abdilla *Trawlwoolway* (Tasmanian Aboriginal), founder and CEO of Old Ways, New, leads the team of Indigenous consultants and technologists, developing social and environmental sustainability through integrated research, service and product design, and the development of deep technologies - all informed by our *old ways, new*. Angie is a Fellow of The Ethics Centre and regularly lectures on human-technology interactions and interrelationships at the University of Technology Sydney.

BEYOND IMPERIAL TOOLS NOTES

1. Otherwise known as The Dreaming, and or, Jukupurra, and akin to Law.

2. Lewis, *Making Kin With The Machines.*

3. Jackson 2Bears, *A Conversation With Spirits Inside The Simulation Of A Coast Salish Longhouse.*

4. Technologies which solve problems through meaningful scientific or technological innovation.

5. Graham, Some *Thoughts About The Philosophical Underpinnings Of Aboriginal Worldviews.*

6. Ibid.

7. Abdilla & Fitch, *Indigenous Knowledge Systems And Pattern Thinking: An Expanded Analysis -Of The First Indigenous Robotics Prototype Workshop.*

8. Otherwise known within A.I as related to the field of machine learning where patterns and regularities within data are recognised through unsupervised learning.

9. From the *Wiradjuri* language

10. Mukgrrngal / Wayne Armytage, Elder and Lore man.

11. Abdilla & Fitch, *Indigenous Knowledge Systems And Pattern Thinking: An Expanded Analysis Of The First Indigenous Robotics Prototype Workshop.*

12. Alison Page, in conversation 2018.

13. Kidman, *The Australian Da Vinci: How David Unaipon (Almost) Changed Our Nation.*

14. Lardil Elders Kelly Bunbujee and Jackson Jacob speaking in Memmott, Paul. "Rainbows, story places, and malkri sickness in the North Wellesley Islands." *Oceania* 53, no. 2 (1982): 163-182.

15. Pronounced noon-oo

16. Office of Environment and Heritage.

17. Ibid.

18. I.e. meeting of localised languages and governance systems, known as Nations.

19. *Office of Environment and Heritage.*

20. White, *Native Spinifex Set To Bring Big Returns To Australia's Outback - Via Better Condoms.*

21. *Global 3D Printing Market Size 2018/2021 - via Statistic.*

22. Memmott, *Nanotechnology and the Dreamtime Knowledge of Spinifex Grass.*

23. Vandana, *Biotechnological Development And The Conservation Of Biodiversity.*

24. In conversation propositions for Pattern Thinking adaptations: Crighton Nichols, Steven J. Taylor and Josh Harle.

25. Chaturvedi, *LinkedIn.*

26. Deep Neural Networks.

27. Don Hill, *Listening To Stones: Learning In Leroy Little Bear's Laboratory: Dialogue In The World Outside*

28. Old Ways, New.

29. Ito, *Resisting Reduction: A Manifesto.*

Graham, *Some Thoughts About The Philosophical Underpinnings Of Aboriginal Worldviews*

BEYOND IMPERIAL TOOLS FIGURES

Figure 1: Boomerang (Musée d'ethnographie de Genève), Attribution: Rama (Wikimedia Commons User) / CC-BY-SA

Figure 2: Photograph by unattributed studio. Tyrell Collection, Powerhouse Museum, Sydney. 85/1286-721,00g0003

Figure 3: Tussock at State Highway 94 between Mossburn and The Key NZ, Attribution: Ulrich Lange

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