Sustaining a Culture of Innovation Delivery in Society.

A Practice-Led Study of the Role of Design Thinking Frameworks.

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Foreword:

Introduction:
This study explores how innovation is adopted and developed within design, education and business contexts. It also examines social practices of knowledge sharing and social acceptance of innovative practices. The foundation of this study is also built upon insights I have gathered from a diverse array of design practitioners spanning a quarter-century.

For this study I followed a constructivist approach to understand and evaluate design innovation from a Human Centred Design (HCD) perspective. This lens allowed the scope of the study to widen beyond business and education, both areas where the practice of innovation normally resides, to consider the values innovation could hold for society.

I consider it is critical for industry and educators to continue to question how to innovate and explore best practices. Within this thesis I explore why designers have a vital role to play within the process of innovation development and knowledge transfer and how best they can contribute to ensure this culture of innovation is sustained.

Framework and Structure:
The structure of this thesis is guided by Vijay Kumar's framework called the Design Innovation Process (2013). Kumar's framework encompasses seven distinct modes of design thinking, as described in detail within chapter four. This thesis also employs Kumar's methodology as its guiding framework for the chapter structure. Chapter 1 defines what is innovation and focuses on Kumar's modes of People and Context. Chapter 2 is the literature study and analysis of my research for this thesis and applies Kumar's mode of Design intent. Chapter 3 explores case studies and applies Kumar's mode for generating Design Insights. Chapter 4 profiles my own Interrelated Innovation Framework (IIF.). This came from the synthesis of the research and case studies guided by Kumar's mode Design Concepts & Solutions. Chapter 5 concludes the thesis and explores where the IIF. could be used to advance innovation, guided by Kumar's mode of Realisation of Offerings.

Vijay Kumar is a design consultant and educator. His methodology resonates with my own professional journey, straddling experiences within industry and education over the past decade. However, this study unveils a dimension of limitation within Kumar's approach, revealing that the knowledge his framework generates often exhibits an extractive nature, placing emphasis on adoption rather than adaptation and sharing of innovation. This thesis challenges this interpretation and also offers a novel framework for nurturing the growth of innovation.

The research approach undertaken in chapter three includes action research as a method to engage a social audience. Employing this methodology across three of the five case studies within this chapter offered insights on the possible strategies for fostering collaborative knowledge sharing. It was appropriate for my research due to "the cyclical nature of action research methodology involving group discussion, trialing of ideas, reflection, evaluation, and action in an iterative, evolutionary design process" (Swan, 2002).

The experimentation in chapter 3 led to the development of my own innovative framework, the Interrelated Innovation Framework (IIF.). This design framework is explored in chapter 4. Although the IIF. developed within this study has yet to undergo external validation by industry or academic teams, it has already begun to significantly shape my teaching methods and industry practices. I consider the future holds promise for comprehensive testing and validation of the IIF, ideally within a innovation research project that links industry and academia, as unveiled in the chapter 5.

I believe the design of participatory systems such as the IIF, in which more people can effectively communicate around common values, will be essential in the future, not only for design but also for our society as we go forward.

Know People
Know Context
_Kumar, 2013

1.0 What is innovation

Why is it important to really understand innovation?

This chapter explores the current structures that innovation lies within a creative and business perspective as well as the relationship and cultural values that allow innovation to support growth across whānau (extended family) and communities.

Within New Zealand society there is a general lack of understanding around innovative structures and design thinking. This stems primarily from lack of education and also understanding within the business sector (Raine, Teicher & O'Reilly, 2011).

We are a young nation (Oba, 2018), and have had limited exposure to larger movements of knowledge and social engagement that comes from wisdom and elders handing down knowledge, with the exception of Māori, the tangata whenua (indigenous people) of Aotearoa who have passed down te mātauranga (knowledge) for hundreds of years.

Governing leaders across Europe and America can reflect on thousands of years of technology and understanding of social engagement around innovation, creation and adaption so can see growth and stewardship over generations and culturally accept change takes time and is worthy of longer term investment and exploration. Internationally, innovation post the industrial revolution has led to the creation of large corporations, but today these entities are being overtaken by new nimble firms able to apply innovation to their processes. This allows younger nations, down to communities with smaller financial means to achieve great things when they embrace innovative practices. This is where New Zealand has an opportunity to thrive but is currently failing to keep up due to lack of integrated alignment between industry, education and government knowledge around innovation (Raine, Teicher & O'Reilly, 2011).

Chapter 1 explores the definitions that a designer uses when developing an idea. This chapter also explores how knowledge is currently shared to allow for innovation to come from society and new platforms that support this growth.

1

1.1 Understanding design and innovation structures

There are three common terms used within the creative sectors: Design, Creativity and Innovation. These three terms can be interchanged in common conversation but to the trained professional these are as different to those of a vet and a doctor.

What is design

Design incorporates thinking tools and iterative processes that allow designers (and in many cases their potential users) to reframe problems and solve them in creative ways (Garbuio et al. 2018).

Activities of design continually develop within the context of economic, social, technological and global change (Buchanan, Doordan & Margolin 2010). The term Design can be considered both as a verb and a noun as it provides a bridge between theory and practice that can be applied in many different areas.

A designer is considered a professional, "stemming from the practice of design itself: this includes all the body of professional knowledge that is specific to design and capacities necessary to provide high standard design services"(Design-Ing, 2023).

What is creativity

'Creativity seams to emerge from multiple experiences, coupled with a well-supported development of personal resources, including a sense of freedom to venture beyond the known' (Edwards, Gandini & Forman, 1998).

It is the approach, filters and perspectives engaged that allow for voids across information to be examined and explored (Edwards, Gandini & Forman, 1998).

It can be an individual pursuit and is often not mappable or transferable in expression. Creativity, at best, is the translation of ideas and synthesis of disparate values to extend thought. It can lead to delight, surprise and unintended outcomes and influence without being something of fiscal value or ultimate completion. It is a skill that some "trained designers" may never explore, yet for others, can define their existence as a designer.

What is innovation

Innovation is an externalisation of creativity and design beyond the designer. It is where the knowledge, process, training, are accepted by others and tested. Within an organisation this requires the "diffusion of innovation"(Rogers, 1995). The adoption of the innovation and how it can disseminate across an organisation requires trust ultimately. It is shown to have faster and higher speed transfer within service and not-for-profit organisations (Damanpour, 1992). This could well be due to the alignment of values the contributors of these organisations have over a solely profit based organisation.

The innovation itself may be a process, technology, application from a different environment so may not necessarily be novel but in a new context it may allow for improvements in efficiency and or wellbeing that previously wasn't possible against the same resources and training.

Innovations create unknown outcomes, so can lead to failure of the initial idea during testing and validation. This is the core challenge for many businesses and political leaders as innovation is often critical for change and future opportunities to be realised, but the process of adopting a new innovation is often hard to manage in regards to time and investment, requiring a high level of respect for the design intent held within an idea as it develops.

As innovation is an expression of creativity that is externalised it is also process that involves new knowledge, adaptation by others. When framed as an optional engagement that allows self-input to add value to the idea. (Roger, 1995) describes this type of innovation as a "collective innovation-decision". He also proposes this is the best way for innovation to be diffused across an organisation. This approach of collectively developing

and adopting an idea also allows for the collective knowledge of the people within the organisation to customise the idea to their specific environment or context and therefore be in a position to communicate it to others within the organisation. (1.3 System Innovation).

Gauging if an innovation is accepted or rejected at the time of its communication is on the whole extremely hard to do and does not allow the impact or value of the innovation to be truly validated. To do this treats the innovation as a completed outcome. As with design outcomes there is always iteration, development, adoption and also adaptation by the next user of the idea that could allow the innovation to have extremely high value in a different context or when offered to a new designer to further. Rogers' Diffusion of Innovation theory (1995) terms this element as the Social System. Where he considers the "Opinion Leader" (Designer) critical to the communication of the idea and also that they stay in the centre of the design process as it is adopted (4.4 FARRA Metals - Project).

What is enterprise

Enterprise is a financial term that often refers to the commercialisation of an idea, often a service or a product (MBIE, 2023). Sustainable enterprise often refers to the capacity of an enterprise to sustain itself and has little to do with sustainable goals or measures as understood in wider society (Gbadegeshin & Heinonen, 2016).

Within this delivery the term enterprise is more focused around "a project delivery itself", whereby the innovation or novelty of an idea that generates income is an exploration of how innovation can ultimately sustain more innovation (Kumar, 2013).

What is entrepreneurship

The origin of the word entrepreneurship stems from the French word entreprendre meaning "to take into one's own hands". The critical role of the entrepreneur was first recognised by the eighteenth century businessman Richard Cantillon (Hebert & Link, 1988,1989).

Elizabeth Chell, professor of entrepreneurial behaviour suggests that during the entrepreneurial process the entrepreneur actively "shapes and creates" or constructs opportunities; further to this, "the entrepreneur cannot be isolated from context' (Chell, 2000,2008).

The core difference between innovation and entrepreneurship is that the latter is motivated by profit. This affects how opportunities are ranked within any design decision process.

"Innovation within a system may be to break down silos of communication and create transparency to allow others to see the patterns and exchange ideas".

_John Randal Saul. 2012

"No vulnerability, no creativity. No tolerance for failure, no innovation. It's that simple. If you're not willing to fail, you can't innovate. If you're not willing to build a vulnerable culture, you can't create".

_Brene Brown, 2010

1.2 Intellectual property (IP)

One of the core factors around innovation dissemination in business is the approach and consideration of structures that define how and when ideas can be shared in the future. The definitions around protected intellectual property are globally universal under the Nice Classification 1957. These classifications currently define goods into 34 classes (Class 1-34) and services into 10 classes (Class 35 - 45), (WIPO, nd).

The limitations to this protection are geographical territories and time, so once placed within the registered frameworks of Patents, Trademarks, Registered designs etc, these limitations play heavily on how ideas are developed, controlled, shared and ultimately released to the public.

New Zealand has a very Euro-centric approach to design protection that allows for our design ideas to be protected quickly within multiple territories under the Madrid Protocol.

New Zealand is part of the Madrid Protocol such as Canada, UK, Australia and most of Europe. Whereas China, the USA. and Japan run their own systems for registration of IP, requiring separate registrations per territory.

In China and the USA. there is a stark difference in the process of ownership as they use the "first to file" consideration making it irrelevant if the company or IP being registered was created by the originator. This allows for an individual or company to file a trade name or brand name in China for control of that territory irrelevant of their association with the initial owner of the idea or brand.

This first to file process has seen New Zealand lose valuable intellectual property. One of the most well known is the loss of the brand name Kiwifruit from the New Zealand market. This led to the development and subsequent registration in all markets of the Zespri brand in 1995 (Zespri, nd).

Reflection:
My experience with IP strategies has given me insight into the consideration that the coexistence of a copied good can be positive.

If that copied good is of an "equal quality", it can increase market sales of the original good as the customer sees the competition as validation that the original must be excellent and worthy of copying. This allows customers that chose quality and reputation as part of their value analysis to then purchase the original, paying more for the original product over the copied product.

1.2.1 Patents

The function of a patent is to allow the holder ownership of an idea or product to profit for a limited time, provided they disclose the details of their innovation and allowing others to share and improve it at a later time.

Across the past 30 years, the use of patents has had less to do with improvement over time, and more to do with controlling competition as globalisation has used these IP tools to control and limit market access. Doing this stifles future innovations as knowledge is "locked up" with no intention of being released until the ideas are fiscally beneficial.

The issue with patents in particular is to do with the time and expense required to enforce the registered protection as the license holder is limited to their own finances. Should a large business choose to copy the idea, their financial clout is often enough to dismiss challenges.

In respect to the Global Covid19 pandemic in 2020, there was an international release of patents around drug therapies to allow for India and other less wealthy nations to access knowledge from world leading scientists and generate local supplies of vaccine. This extreme response was to aid humanity but also displayed massive innovation on a global scale.

Freedom to operate (FTO),

Freedom To Operate (FTO) within the design process is when an idea can be freely worked on as it has yet to have any market barriers around it from existing IP registration. FTO allows the designer to develop a market or sell an unprotected idea without fear of infringement.

Patent enforcement

The IP process ultimately limited the performance of the wireless platforms WiFi owned by the Australian Government under their research and development body, the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

This came about as the licensing fees due from large multinationals weren't paid. Rather than investing in new advancement, the Australian government was tied up in court conflict that lasted several years and multiple firms going under as a result. This process of enforcement hurt the technology sector as the IP challenge took away income and time that could have been spent on developing new improvements.

In 1839, the French government bought out Louis Daguerre's patent for photography and then made it freely available to all, unleashing a burst of creative innovation.

In contrast, the recent expiry of 3D printing patents has delayed business activity that could have come a decade earlier should they have been bought out to allow for global distribution of the technology. Given the scale of consumable materials in technology, it would have allowed polymer and metal suppliers around the world to jump years ahead in their material offerings, whereas exotic's such as carbon reinforced nylons and titanium metals are still some time from being mainstream.

1.2.2 Open innovation

Open innovation is where ideas that have been formulated, sometimes tested and validated are openly shared across the community to improve the delivery of a product or service.

A leading global industry that has benefited from the mindset of open innovation (open sourced knowledge), is the computer sector. The initial development of silicon chips, the control code, process of manufacture and technology breakthroughs made the concept of IP registration redundant, as in many cases any registration would be broken well before the registration would have been filed and approved.

In the early 1960's across the hardware and software sector in the USA, the shear speed of development was such that the IP structures based on historical production lead times and factors such as material processing became redundant, opening up a new concept in research and development called open-source.

Matt Ridley, states there is no evidence that patents are helpful let alone necessary in encouraging innovation (Ridley, 2020).

> "The justification of the patent system is that by slowing down the diffusion of technical progresses it ensures that there will be more progress to diffuse Unfortunately, this is often not the case".
>
> _Sterkx. 2006

Patents tend to favour inventions rather than innovations: upstream discoveries and principles, rather than downstream adaptations of devices to the market. The USA semiconductor chip protection Act of 1984 resulted in more patents and less innovation as the firms created "war chests" of patents to deploy in disputes against each other, often termed patent thickets, or property hedges that block progress.

Innovation is something that everybody favours in general, yet many people will have reasons to be against it in particular cases. Innovators have to struggle against vested interests of incumbents, conservative beliefs, barriers to entry raised by patents, regulations, standards and licenses.

1.2.3 Creative commons

Creative Commons is a sharing space for images, files and knowledge. This space requests attributes for shared content to be acknowledged in most cases and has some rules around the rights on use and has been running for the past 20 years only. This platform provides knowledge and evidence that communities can share and provide the basis for people to not only contribute, but to co-create content and support each other.

3D File sharing

Across the same period, product design as a discipline has had significant changes in practice as technology has allowed for remote manufacture with extreme accuracy due to video conferences and universal 3D software platforms. In the past 10 years, there has been the dawning of the fourth industrial revolution brought on by the extension of distributed manufacturing and also 3D printing called additive manufacturing.

Globally, the file sharing of 3D models under creative commons licenses are being expanding daily. One platform, Thingiverse, is equivalent to a free shopping market space where any household item or automotive accessory is available for free downloading. In many cases, files that are shared are improved and offered back to the global community to expand the offerings available.

1.2.4 Employment innovation

Following the third industrial revolution there have been many innovations in industry to enhance efficiency of staff time and manufacturing processes, but there has been little consideration or training around how to capture and nurture an idea in the same sector.

Innovation within companies, education and government is limited to the structures in place around governance and direction of policies, funds and time allocated allowing for sustainable practice over time. Many companies lack any way to generate new ideas for future development, with the core focus being on operational tasks and having limited funds to risk the exploration of ideas which without skilled mentorship and balance can jeopardise the innovative process. (1.4 Risk from Innovation).

It is for this reason, many larger firms contract in skilled people to not only manage peak workload tasks but also to steer ideas in a new direction. This outsourcing can provide significant gains with new insights but can be hard to build on as successive creative teams and creative leaders move through firms and often move out of reach in the longer term.

Few companies have any policies to allow for employed staff to benefit from innovative ideas that could further the business they work for. Yet, many companies will pay higher rates and

possibly enter into profit sharing options with 3rd party design innovators for new ideas.

A common limitation within employment contracts is that all IP (1.2) being generated by the "staff member" is property of the employer during their employment. This common clause inhibits the incentive for growth of new ideas and also ensures minimal innovation will be shared during the staff members employment.

This fundamental governance requirement within an employment contract transfers the intellectual property of an employee to that of the firm they are working for is the fundamental limit to true innovation and accelerated development in all cases. Ideas are externally developed outside of normal working hours creating professional conflicts and possible psychological pressure on an individual.

There are many cases of innovations leading to new business ventures following the termination of any business contracts when an individual or team go out on their own, as their previous structure had no support for innovation.

In contrast, the self employed "design innovator" has the freedom to offer a new idea, but has limited finances to allow for medium or long-term time investments. For projects of higher calculated risk, these designer innovators will offset their losses with additional projects to allow for their wage to be absorbed internally.

They will be exposed to internal financial loss but over time may benefit from this longer term gain as long as the idea comes to market within a time frame where it can gain sufficient value.

Employment Reflection

I believe there is an opportunity to create a process for ideas within larger industry to generate successful innovations that can allow for both incremental and radical improvements in products and services.

Restrictions from current employment contracts require the need for some employees to remove themselves from committed employment should they have a possible innovative idea. This group of currently employed creatives has potentially the largest knowledge network to draw on and could often have projects that could benefit their original employer significantly should they be able to innovate beyond their job titles.

Within the current employment market and government structures which are primarily set up for the sustainability of a business entity and that of its trading constituents to be "managed and controlled" on time and costs, there are very little considerations to how business could "co-create" for design innovation while working within standard business structures.

One structure that has been proven to work is that of a co-op. Across New Zealand Fonterra is a market leader that proves shared and co-contributed knowledge and co-invested structures can benefit the larger industry.

Reflection

In the case study of the SouthMED-Suzy Hood CPAP (Chapter 3), there was both an accelerated and co-design sprint engaged as all parties were clear to develop the hood without contractual conflict. In the cases where existing contracts limited involvement, those needed to be negotiated prior to commencement so as not to jeopardise the project and the IP

1.3 Car 2.0 System innovation

System innovation can be allowed when a radical, not incremental change happens at the product level or when the change can be clearly delivered and enforceable to a confined audience at a single point in time. Such as in the lock down in 2020, when all New Zealand residents were advised to change their behaviour around access to goods and services in response to the Covid 19 pandemic.

A production example of system innovation being applied well in the past 20 years is that of Tesla Motors Inc, formed in 2003. A firm that six years later created its first transport vehicle for sale. The product knowledge was not innovative on release, as it was run using current technology and had known users' needs (Wikimedia Foundation, 2022). What was significantly innovative was the focus on the broader services around energy, distribution, management, and end of life options to multiple users over the lifetime of the batteries that included the electrification and integration of the transport network and Tesla home Powerwall in 2015.

In this example, the system design was the innovation. The communication of the Tesla system was part of a very clever strategy concurrently showing new directions in energy management along-side their development of the Tesla solar roof tiles, 2021.

Figure 1

Car 2.0 connected energy system

Image Redacted.

https://www.ted.com/talks/shai_agassi_a_new_ecosystem_for_electric_cars?hasSummary=true

© Agassi, 2009, April 10.

Tesla's installation of high speed charging stations across the USA was a catalyst for major automakers to change their products and services for Plug In Hybrid options and also to commit to introducing pure EV vehicles within their range.

Today, consumer behaviour and knowledge has led to acceptance of limitations and also responsibilities around transport behaviour and possibly, this is the real innovation in play across society beyond technology or energy itself.

Car 2.0 Product system innovation

The precursor for the Tesla success was the company Project Better Place, founded by Shai Agassi. He founded Project Better Place in Israel in 2007 after negotiating relationships between Nissan and Renault to form the Nissan-Renault alliance which went on to create the hybrid Nissan Leaf (Agassi, 2009).

The Nissan Leaf was initially intended to be one universal design for global use. This business model took the principles of Fordism around efficiencies and economy of scale as well as standardised parts. The initial concept was that the Nissan Leaf was one car, one battery, one motor. This was not innovative as Henry Ford had proven this design with the Model T and later Model A cars could also produce these efficiencies (Wilson, 2013).

Following the global collapse of Project Better Place in 2013, the Leaf was tragically commodified and offered back to public for individual sales with options of battery, engine and control systems that nullified many of the product design innovations within the original design such as the quick change battery.

This "normalisation of the design" effectively limited the easy transfer of batteries or engines at end of life due to software locks, changes in battery terminal connections, KW power variations between models and also years of production.

Car 2.0 Production system innovation

An integrated part of the Project Better Place innovation within the Nissan Leaf story was to have Nissan build and export production facilities globally to manufacture the Nissan Leaf car itself. This planned roll out started in Yokosuka Japan 2010, Tennessee U.S.A 2013 and Sunderland U.K 2013 (Nissan, 2017). The opportunity of this Nissan vision was around the ability for local markets to manufacture and remanufacture, regionally removing the necessity for import, export and other freight costs for the Leaf vehicle from Japan. This production facility roll out was halted following the global collapse of Project Better Place.

The project failed to deliver for many reasons including supply issues of the initial vehicles and battery production following the Fukushima disaster in Japan in 2011 (Ydstie, 2011).

Car 2.0 Government system innovation

Globally, the government innovation involvement in the Project Better Place design was to consider each Nissan Leaf battery would be part of a 24 hour a day nationally distributed energy resource (Figure 1). The system goal being to build the world's first Electric Recharge Grid Operator (ERGO). This considered both active batteries and also batteries in storage as part of the 24 hour a day quick change system which were all connected to the grid and would allow for peak gains and loads to be managed across the ERGO.

The first country to sign up to the project was Israel. The memorandum of understanding was signed in January 2008 between the Israeli government and Project Better Place, with the planed roll out in 2011. This agreement planned to have their government offer charging stations across the country and tax incentives for zero emission cars (TheAutoChannel, 2008).

This innovation failed to deliver as the scale and complexity of this system design change alongside technology delivery delays lead to loss of confidence, funding and management as Project Better Place went into receivership in 2013.

1.4 Risk from innovation

Innovation is full of risks primarily due to humsan resources. How do you know that a particular resource is the one to solve the problem and secondly, who can you work with to validate that the idea is viable, feasible and desirable?

Innovation is easy within a startup. There is little financial risk as often the innovator(s) are initially bootstrapping the cash flow for an idea. This type of innovation does not often lead to success and according to the Ministry of Business, Innovation and Employment New Zealand (MBIE) with 58 percent of Kiwi businesses created 2010 with no employees ceased to exist by 2015. Those with up to five employees, the figure was slightly better at 43 percent. (Baker, 2018).

Therefore a large percentage of start-ups with lots of innovation in new offerings fail to move beyond the start-up phase. This could be due to the lack of knowledge to manage the stages of development beyond the initial concept.

This business metric is not necessarily a negative one regarding the value of innovation as ideas have been validated, tested and proven and these could well inform and grow into new ideas at a later time.

Conversely, innovation in a larger and more conventionally established firm with larger cash reserves is very risky, as the scale of the project innovation and associated innovation team along with the more diverse skill-set of those innovators may be hard to gauge and manage purely by the nature of the process.

Lockead USA. set up Skunkworks in the 1960s as a way of allowing their business to take innovative leaps within supersonic flight. This required a team of design engineers to be disconnected from standard operational tasks and allow them to run remotely without a preset brief. This model has been successfully adopted across many sectors in the past 50 years and is a proven way to accelerate ideas.

The challenge in management is how to allow for innovation to continue past the initial success. One core requirement is to allow the innovation team to hand over the idea to the development team, allowing the innovation team to move ahead onto the next task.

A management requirement to allow for a "skunkworks" model to work is to have a skilled leader that can recognise and assign the correct technical expert(s) to a particular field for the task, basing the decision not solely on technical competence, but also alignment to an innovative design process also.

1.5 Risk of entrepreneurship

William Baumol is an economist who writes about how innovation and inter-firm collaboration allows for the creation and use of innovations and where no firm within an innovating industry is left behind. This is the case of Silicon Valley circa 1970 and the rise of living standards in countries from America to Germany and Japan. These where living standards have risen exponentially over the past century due to the rise and growth of IT technologies.

What this has done, however, is affect countries that did not engage with the "Innovation machine" (Baumol, 2002). There have therefore been negative affects on communities unable to keep up with the changes led by innovation.

It is often assumed that an economy of private enterprise has an automatic bias towards innovation, but this is not so. It has a bias only towards profit (Hobsbawm,1969). William Baumol writes about "rent seeking" where entrepreneurship activities do nothing for productivity often using litigious systems to legitimise takeovers and undertake tax evasion and avoidance efforts which often also generate huge awards in court (Baumol, 2002). This is when lawyers become more valuable than innovators, inducing the entrepreneur to first sue others before they can counter sue.

This change of focus is one that Linbeck observed. He stated that "the problem in high-tax societies is not that it is impossible to become rich there, but that it is difficult to do so by way of productive efforts in the ordinary production system" (Lindbeck, 1987).

As such, William Baumol proposes that where rent-seeking actives are likely to be found, that is, where policy designers of the "prevailing law" focus, to divert entrepreneurial talents into more productive financial channels such as litigation, not innovation (Baumol, 1990).

Reflection

Against the framing of this study, the New Zealand Business and Innovation and Employment (MBIE) uses the term Innovation but practices only enterprise and should therefore represent itself as Business of Enterprise and Employment.

The practice of innovation and the massive knowledge and technology gaps found in current structures that innovation works within are mostly unmappable and unquantifiable to an untrained audience, especially for specific funding stages. This means for the government to assist in business around innovation there needs to be a pool of designers able to assist in these critical tasks.

The concept of having innovation within a government structure would be incredibly rewarding for higher risk enterprises and critical for supporting new blue sky concepts, but realistically, this would require a new entity to be formed with clear strategic directives that could work between private industry, universities and government departments as discussed in Government Innovation (5.1).

1.6 Innovation from a bicultural perspective in Aotearoa

Innovation from a Eurocentric perspective primarily assesses opportunities using financial modelling first and foremost. Most of the value's innovation is assessed against are fiscal and therefore uniformly understood across the investment and banking sectors. By only applying these criteria solely there is no consideration of longer-term value for the family, or larger social growth this is in direct contrast to a bicultural perspective within Aotearoa.

In contrast, exploring innovation values with a Bicultural lens within Aotearoa generates a new perspective around value, relationships and history and the interplay between these words and who the characters are that play these roles allowing for innovation within an indigenous cultural framework to be understood. Where value also comes from wisdom and experience of the elder.

The Māori world is viewed through a genealogical matrix of complementary but different counterpoints known as generative dualism and is symbolised by the spiral of Takarangi (creation), (Tapsell, 1995). This complex double spiral embodies moments in time where two disparate streams interconnect to generate new consciousness.

Indigenous entrepreneurship incorporates both social and economic entrepreneurial activity and explicitly acknowledges the particular historical and cultural context from which they arise. It includes enterprise-related activities of indigenous people in pursuit of social and cultural self-determination as well as their economic goals. Tapsell and Woods researched Māori entrepreneurship and found that "entrepreneurial activity is that of being underpinned by social activity to improve wealth and wellbeing for the community, rather than the individual" (Henry, 2007).

The main characters that balance movements in the spiral of Takarangi are the rangatira (Chief) and the pōtiki (last born or youngest). Tapsell and Woods discuss core layers of this relationship as the whānau (extended family), which is combined under common ancestors forming the central social, economic and political units of Māori society called hapū (autonomous sub-tribes), (Tapsell & Woods, 2010).

The interplay between these two characters in the Māori community illustrates the double spiral (Takarangi) of innovation (Creation) that occurs at and between the edges of chaos and stability (Tapsell and Woods, 2008a).

Rangatira are mandated to represent mana (prestige) and the ability to provide manaaki (hospitality) while embodying hapū history (Tapsell, 2008).
They undertake customary Māori roles to administer resources, generous hosting of guests, protecting tribal estates and serving the manaaki (kin group), (Tapsell and Woods, 2008b).

Pōtiki are opportunity-seeking and therefore forward-focused and so are a complimentary counter point to that of the Rangatira. They have a corresponding paired relationship, as shown in the double spiral (Fig 2).

Cultural values within the narratives of Māori culture are that pōtiki are quick-witted, intelligent, resourceful, cunning and fearless (Walker, 1990). These values without balance of a Rangatira, would lead to chaos but with the balance of leadership and wisdom from the Rangatira the values of the pōtiki are strengthened and focused to access new opportunities.

The metaphor of balance and movement was considered by Schumpeter in the Theory of Economic Development. His theory has corresponding pairs of opposites working to balance changes within a circular economy. He profiles three types of paired opposites being, Human Capital (HC.), Soical Capital (SC.) and Material Well Being (MWB.), (Schumpeter. 1934).

Figure 2

Takarangi–Māori double spiral of creation.

Image Redacted.

https://www.researchgate.net/publication/233205868_Social_entrepreneurship_and_innovation_Self-organization_in_an_indigenous_context

Tapsell and Woods draw on this theory of opposites and focus on the interactions that occur within Māori tribal communities between the pōtiki (young opportunity seeker) and the rangatira (elder heritage protector), (Tapsell & Woods, 2008).

They suggest that innovation can be usefully thought of as a Takarangi double-spiral, combining the twin flows of pōtikitanga (opportunity) and rangatiratanga (heritage).
These flows contract and expand at the central point of creation-collapsing time-enabling future and past to meet in the present as represented by the marae (meeting house), out of which self-organisation and innovation emerges.

Māori Knowledges

I spoke with Dr Diane Ruwhiu from the University of Otago, who said that "Māori Knowledges is always growing and that this knowledege is different to knowledge from an individuals experience as they come from the past, our ancestors and will be transferred to future generations". She continued to state that a person does not have a single knowledge of their own. It continues from what was gifted to them and theirs to gift on when they pass. She also explained that the knowledges are not merely that of skills but are spritural and of health, the stars and the people. (Diane Ruwhiu, lives in Dunedin, New Zealand, personal communication, 13 June, 2022).

In addition, Iwi taonga connect the knowledges of the people to the place and this knowledge of place will be specific to the people of that place.

Reflection

Throughout my journey as a professional designer I have been advised and supported by several design professionals who facilitated my path towards sustainable business practice. This leadership and knowledge transfer allowed me to increase my personal productivity as well as achieve business success.

Over the past 13 years with my own company, I have for the first time experienced generational wisdom where my business partners were able to expand my thinking and approach to developing ideas and conducting business.

In Māori culture, the knowledge of elders is captured and shared to a larger audience including the business community. In my experience however, the wisdom I have gained will only be transferred within my direct teaching practice.

Reflecting on how companies in New Zealand induct and train new staff, I consider the Māori practice of having elders or retiring employees train new staff members to be extremely valuable. It is a way for businesses to sustain innovation as learnings from past failures would be shared and not lost over time to be repeated in the future.

Across the various sectors of education, health, and in particular the manufacturing and primary industries in New Zealand, new staff are often appointed after older staff with the "institutional wisdom' have retired from practice. If this transition was a planned process that offered new staff the support and mentorship of the senior under a transitional period, there could be significant added value in terms of staff wellbeing and performance.

I have had multiple experiences where senior staff depart organisations and handover of their files and knowledge may only happen on the last day, across a few hours at best. This often leaves the new staff member within a team feeling lost as they attempt to establish how and where they fit into the organisation and unsure of the expectations others have of them. This unsupported process of induction is not sustainable to an organisation as it leads to staff anxiety and loss of productivity.

To sustain innovation within an organisation, knowledge transfer needs to be considered as part of the value being managed. This should be a bicultural practice where the exit of staff is planned, allowing transitional time and training opportunities within any organisation in Aotearoa. Appointments can be identified earlier and more time allowed for knowledge to be transferred.

1.7 Culture, education and society.

It is widely recognised that research and innovation not only have economic impact but also social impact. Social innovations are innovative responses to unsolved social problems and needs, which have not been successfully tackled by the state of the market, (Platform, 2020).

Social innovation is needed because many social challenges are resistant to conventional approaches to solving them. They require novel approaches, inventive actors and new forms of co-operation among them, thus bringing together different kinds of expertise, skills and tangible and intangible assets.

"Social innovation's major aim is therefore to tackle complex social challenges by providing innovative solutions" (OECD, 2011).

As a result, modern economic growth must be linked to societal progress. Social innovation and impact are ways to reconcile these two forces, bringing economic growth and social value at the same time.

In our first world economy we teach process, methods and structures and generally the practices with these skills can lead to a level of success in society through business. A part of the post-industrial revolution we have excelled

in is educating people to work for companies producing goods and services and extracting efficiencies from materials and processes in the name of growth.

Yet as a society we have youth poor in the management of land, detached from nature and seasons, how to grow food or care for animals. This is requiring innovation that can address our cultural and social engagement to ensure these skills also grow and can nurture future generations.

We need to allow for systems and knowledge to be openly sourced and to operate with freedom to provide platforms for those that work in an organisation or live in a space together, to freely resolve their queries, problems or insights. This is the essence of sustainable innovation.

Our global education system and working industry is in the midst of a revolution, as the physical and virtual ideas are creating new values and opening up the world to open-source sharing of knowledge, reference and content. It is critical as these changes happen that the awareness of social engagement and cultural values are included so we can achieve truly sustainable opportunities for all parts of our lives.

Our access to written knowledge has changed enormously in the past 200 years. We have moved from only the wealthy having access to books to only 60-100 years ago individuals with wealth having a private library. Today, any internet connection can offer private searching from a large amount of published and recorded texts in any language that have been created or recorded.

We are currently on the edge of an educational revolution where multiple universities in the USA offer content via an AI computer platform (Watson Assistant, or Watson Tutor) from International Business Machines (IBM). This platform can offer marking of exam scripts, structure feedback and also alter future readings to improve the experience of following learners (IBM, 2020).

In 2020 York University released a Student Virtual Assistant (SAVY) for marking and student course design AI. It was able to offer personalised tutoring to 50,000 students at the same time (York, 2020). Undeniably we are now looking at a new world of knowledge transfer - not just the recording of knowledge. The opportunity now is to focus on how we can productively use these new tools and how they can help society grow.

The release of ChatGPT on 30th November 2022 was globally significant. Unlike SAVY, ChatGPT allows anyone world wide who is interested, the ability to access to an AI assistant. It allows the user to generate text using prompts relating to document length, format, style, subject, level of detail, and language.

"Chat GPT stands for Chat Generative Pre-Trained Transformer and was developed by AI research company, Open AI. It is an artificial intelligence (AI) chatbot technology that can process our natural human language and generate a response (Hetler, 2023).

The CHAT GPT platform has already challenged educational institutions world wide regarding the assessment of student work as "there is a difficulty in differentiating human versus AI authorship within academic and educational communities" (Dwivedi et al., 2023)

"There is more to life than increasing it's speed"

_Mahatma Gandhi, 1964.

"Sustainable innovation involves making intentional changes to a company's products, services, or processes to generate long-term social and environmental benefits while creating economic profits for the firm."

_Adams et al., 2015

Reflective questions

A. How can a society be educated to be more flexible with "distruptive" practices?

B. How can education advance social values and elevate the value of people beyond fiscal wealth and profits?

C. How can we change behaviour to allow for innovation and failure to be cherished and valued at the same level as "success"?

1.8 Wiki educator

The concept of Wiki Educator was created by Wayne Mackintosh while he was at Otago Polytechnic and launched globally in 2006. Wayne is still currently the UNESCO and ICDE Chair in Open Educational Resources (OER).

The term 'Open Educational Resources' (OER) was first coined in 2002 and refers to learning, teaching and research materials in any format and medium that reside in the public domain or offered under an open-source copyright license. This license allows no-cost access, re-use, re-purpose, adaptation and redistribution by others. The creation of Wiki Educator today allows for knowledge to be shared for the betterment of all learners globally.

Some tertiary education providers have content on this platform that is part of normal paid course content allowing non students to also access and contact the publisher directly. It opens up knowledge previously only available to enrolled students.

This Wiki Educator platform answers questions A & B of the previous reflection and is what I consider the primary innovation achievement of the 21st century as it is sustainable, scalable, has freedom of access, as well as being collaborative with opportunities for feedback and co-design.

Waynes' mentor, that he says led to the creation of WikiEducator was Kim Tucker and her Design Thinking. In a post to Kim, he said

"The general public may not be aware of this but your leadership thinking around the concept of "free knowledge communities" which evolved to liberate communities was an instrumental catalyst in the foundation of WIkiEducator. Thanks for the inspiration!

_Wayne Mackintosh, 2016

Figure 3

WikiEducator logo

PUBLIC DOMAIN WikiEducator.org

1.9 Open design movement

The open-design movement goal and philosophy is to develop physical products, rather than software (FLOSS, 2022). Open design is a form of co-creation where the final product is designed by the users, rather than an external stakeholder such as a private company.

As objects require technology (processing equipment) there ultimately is a business sustainability imperative to allow ideas to be made that support larger business communities.

The largest opportunity lies in high-tech, open-sourced solutions being offered beyond any single company or countries resources to inviolve networks of people, as there is no copyright mechanism stopping collaboration.

Wayne Mackintosh's design motivation:

"I believe that all educators and learners should have the freedom to use the technologies of their choice. Education, is a fundamental right of all people, yet sadly 4 billion of the world's six billion people are under served educationally. There are some things which belong in the commons and education, is one of them. If we are serious about widening access to knowledge and education we must foster and promote the creation of free educational content combined with the rights for everyone to use, modify and distribute this content in an unrestricted way. In this way knowledge becomes inherently scalable.

For many years I have advocated the use of free software and the collaborative development of free content for education. I have lobbied institutions, encouraged the adoption of FLOSS technologies at the strategic management level, talked about (Free Libre Open Source Software) FLOSS during presentations and advised colleagues and friends on the merits of open source technologies based on well-founded business arguments."

_Mackintosh, W. n.d.

1.10 Tertiary education & MOOC

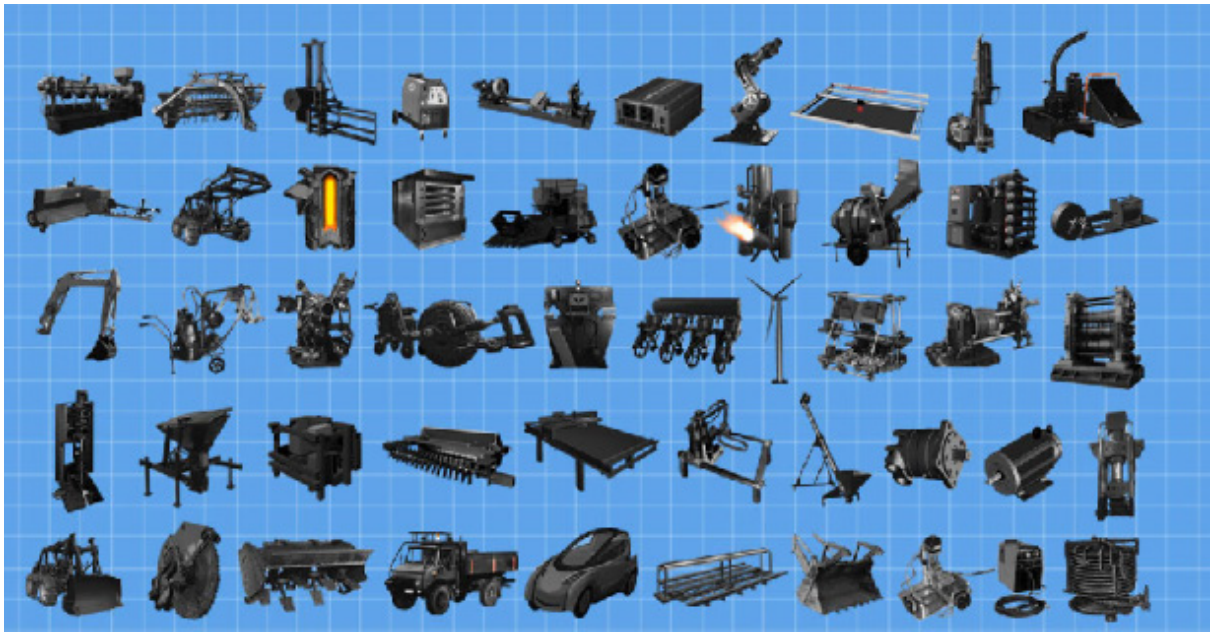
In 2008, Massive Open Online Course (MOOC), as founded by Harvard and MIT as free on-line education courses where educators could offer resources and access to research databases previously limited to the privileged within university courses. This model was innovative and disruptive to the world of user pays education. To date, 35 million learners have used these programmes across the past 14 years to increase their learning. "edX" is a more recent part of this project it allows the learner to get an accreditation from some assessed deliveries for a fee. This business model generates some revenue for the open sharing, but the model has now partitioned some of the original content, limiting the free learners experience. (Mooc.org, n.d.).

1.11 Social innovation challenge

The greatest challenge in allowing ideas to move ahead is the management of the knowledge between the idea generator and the next person to add value though validation, testing, approval or reflection. This invisible process is the reason companies succeed or fail and unlike a business that may have a team with common working styles, motivations and values to allow for these transactions to bear fruit, a social exchange is significantly harder as there may only be a few common goals or motivations for reference to communicate an opportunity. The higher meta level issue with innovation is the construct that the best people

Figure 4

The Global Village Construction Set (GVCS)



opensourceecology.org

to design the next water heater, the next electric car, or the next battery already work in a single company as a team. This is where the risk originates from. In the design process that looks to take on large projects for society such as sustainable transportation, as companies compete against each other, rather than create bridges allowing their knowledge to flow. They can end up creating chasms of knowledge. Why is it that all electric cars today can't use the same battery and connection?

1.11.1 Agricultural equipment experiment

The Global Village Construction Set (GVCS) is a set of 50 different DIY industrial machines designed with modular componetry so that communities can create small, sustainable settlements using current technology.

This project was started in 2003 by Marcin Jakubowski and is an example of designing without a business motive. The technology

developed by university students was intended to be open sourced and distributed to benefit growing nations using a common motor and attachments to allow for irrigations and manufacturing efficiencies (Open Source Ecology, n.d.).

The project has run on funding from university research bodies (Kickstarter, 2014), and continues to receive pledges of support for the ongoing development of the kits.

1.12 Innovation being stifled

Ridley writes about how the scope and strength of intellectual property has extended within recent decades and how this can hinder the net effect of innovation (Ridley, 2020).

In relation to copyright, IP extended from 14 to 28 years in the early 1920's and by 1976 this further extended to the life of the author plus 50 additional years. In 1998 it extended to +70 years.

In product design, it is accepted products have life cycles and that registered shapes, configurations and techniques have significantly shorter life spans of only 7 years.

Within the field of product and industrial design, it is also common for the technology embodied with a protection eg: a 1980 tape cassette within a Sony Walkman would have been superseded by a compact disk in relation to a 1990 Sony Diskman. Later in the 2000's Apple iTunes would revolutionise this mobile sound with MP3 players.

These innovations were technological and also system design based. Therefore, for physical devices with embodied technology, a 7 year protection window offers evolution and mass production following. This shorter protection period also drives innovation as it will become public domain after the protection period.

1.12.1 Innovation piracy

Ridley believes the removal of intellectual-property for some creatives, such as through piracy in the music industry, offers no diminished value to the creator in some cases (Ridley, 2020).

Napster, a music piracy website, started offering mass sharing of music files in 1999 that initially diminished the industry's revenue by 75%, but the following 13 years doubled the size of the industry as the industry went back to performing live rather than sitting back and letting the royalties roll in (Ridley, 2020).

This is a unique situation that wouldn't add value to an innovator in many other fields but is an interesting example nonetheless.

1.12.2 Globalisation and innovation

Erixon & Weigel argue that the challenge of capitalism is to break the habits of both companies and governments reluctant to encourage innovation (Erixon & Weigel, 2020).

Economists such as Tyler Cowan and Robert Gordon, likewise argue that we are no longer inventing things that change the world like toilets and cars, but increasingly playing with trivia like social media (Cowan & Gordon, 2016).

Large firms today can often earn more from their investments than their core business of selling goods. The pharmaceutical industry is one of these bodies with their only major spend being in IP war chest defence and argument.

Out of Europe's top 100 most valuable companies today, none were formed in the past 40 years (Ridley, 2020).

In Germany, only 2 companies in the top 30 were formed after 1970, 1 in France's top 40, 0 in Sweden's top 50. Collectively Europe has not offered any digital giant to challenge Google, Facebook or Amazon (Ridley, 2020).

In contrast, China is currently engaging in a new way of working that has Chinese entrepreneurs running 9am-9pm six days a week, with a willingness to play, try new things and take risks. These business values are common in newly prospering societies which

include New Zealand. Reily appears to suggest without stating, that this new direction from China will be stifled by the management of Chinese society unable to allow for the freedom this innovation demands.

1.13 NZ Business innovation issue

New Zealand's Small to Medium Enterprises (SME) total 97% of all businesses in New Zealand (MBIE, 2020). This is on par with Germany (Statista, 2023) and the USA (US. Chamber, 2023) (Fig 5).

Due to the scale of New Zealand SME's being under 50 people (MBIE, 2020), there is a lack of published evidence on how these businesses continue to learn, grow knowledge or support new ideas as they are too lean in staff resources to achieve more than their core daily business activity.

This issue of how to learn and support new ideas for New Zealand SME's is not faced by SME's in Germany or the USA to the same extent, as the scale of these SME enterprises are significantly larger so have more resources to share these opportunities. A German SME is classified as being under 250 staff (Statista, 2023) and a USA SME being under 500 staff (US. Chamber, 2023).

A second point of difference for SME's internationally is within their business culture where they integrate their innovation process with the tertiary education sector (Odense Robotics, 2019). Further evidence of this integrated approach to design thinking used by international SME's is evident from many published references within this study as well as externally published references on design frameworks and methods used by industry (Duberry, 2004).

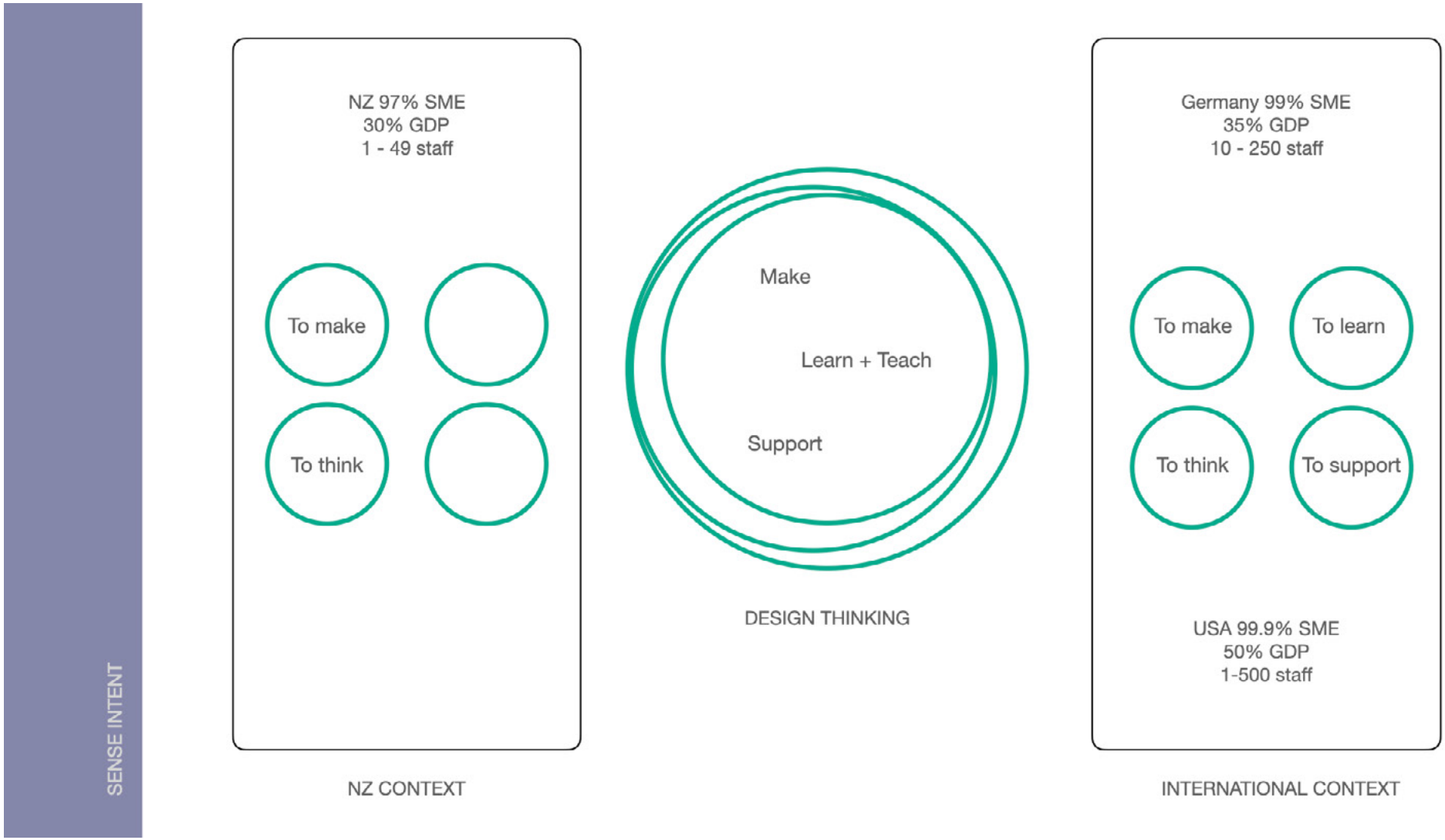
In Figure 5 I have mapped the knowledge landscape for New Zealand, German and USA SME's. This profiles the issue New Zealand SME's have around not being able to service learning and support of new ideas as they are isolated from design thinking skills. As a result these skills are often contracted in on a project only consultant basis which doesn't advance knowledge within the organisation longer term.

Reflection

Possibly due to the geographical distance from international markets, New Zealand businesses have not been absorbed into many multinationals. For our SME's to remain innovative in the longer term we need to link these business entities to our teriary sector to increase learning and support new ideas. This insight is the catalyst to the creation of the IIF in chapter 4.

Figure 5

New Zealand SME vs International SME



Drawing by author

1.14 Chapter one review

Innovation from an industry perspective is often seen as an area of conflict that leads to change and carries a risk that resources, energy and money may not be returned in the short term. As most companies run on tight development cycles and require successful developments to allow future funding to continue, there is often limited investment allowing innovation to offer a change beyond the normal operation and outputs offered by a company.

For existing firms where innovation has limited appreciation or investment offered to support innovation, this loss of new ideas will directly affect the capacity to sustain growth initially and viably in the longer term. This is critical as OECD. economic development statistics show the correlation between R&D investment and GDP growth Raine, Teicher & O'Reilly, 2011).

Over the past 30 years, knowledge sharing mostly via the internet, has required many sectors to change business models. Education, especially in the tertiary sector, has accepted innovative models utilising technology and has new courses to generate income and increase market scale (MOOC.org). It has also allowed sharing of course content and current thinking with Wikieducator (2006). Today, some universities allow parts of their programme to be shared to reach and educate more people and increase awareness of knowledge from a credible source.

Across this same 30 year period, many historically successful firms have lost their hold on the market due to changes innovation has offered competitors willing to accept change. Sometimes they have disappeared from the market completely. Kodak is one of these firms. After developing digital photography and understanding that these images could be digitally shared, it failed to embrace the innovation and focused on print technology to its demise (Henry & Jie, 2009).

A majority of the leadership and advisory roles around IP that historically had been associated with gaining positive returns from innovation through licensing, royalties and control; today, do not offer the same guarantees or a uniform IP strategy. This diversification of IP strategies has moved beyond mere open source learning and has now matured into open-source problem sharing and resource adding to empower the impoverished through to the business expert.

The new challenge for New Zealand academia is to educate industry on how to change and how to use innovation with all its new offerings of co-design, co-creation and open-source learning (Fig 5).

Currently, there is a tension between design and system knowledge creators and the appliers of that knowledge when applied to a current industry context. This allows for new companies such as Tesla (2009), that can look at today's business paradigms to plan new products and integrated systems of services from vehicles to telecomunications.

Nationally, Māori entrepreneurship and associated activities are 'underpinned by social objectives to improve wealth and wellbeing for the community, rather than just the individual' (Henry 2007).

This is possibly why New Zealand has and will continue to have, resilience to large changes and advances in technology that our international business colleagues will not be able to weather so well. We need to ensure we develop innovative strategies that incorporate these bicultural values across all sectors to ensure this foundation is retained.

2.0 Literature study and analysis

There are many design methods that individuals, teams and businesses use to generate and explore new ideas. These methods ensure the idea can be explored in a way that hopefully also minimises risks in cost or time, while also offering a pathway to allow a novel idea to grow. Deign methods can also assist in training and mentorship and support staff employed to explore the idea along their process of investigation.

The six main design practitioners profiled in this chapter are Paul Pangaro 2.1, David Kelly 2.2, Charles Bezerra & Charles Owens 2.3 and Roberto Verganti 2.4, Richard Buchanan 2.5. They were chosen as they all have design frameworks that incorporate users in their process. They are also dual practitioners of industry and education so are broad in their methods. They also have aspects of innovation within their experience that involves humans as part of the outcome so fit well against my own proposition that "innovation is the adoption and adaption of ideas by others" (Author, 2023).

Methods profiled in this chapter have been adopted by other disciplines over the past 25 years and are now common across business and banking discussions. The 2x2 matrix for example is an analytical framework popularised by Bruce Henderson and Boston Consulting Group (BCG) in the 1970s is common place as a part of today's mortgage discussions and the World Health Organisation (WHO) uses Vijay Kumar's design frameworks for funding applications.

Outside of finance, most industries hire consultants to change the "balance of ideas" within a business (1.6 Innovation Spiral). This can lead to new outcomes, and if the consultant can be engaged across the duration of the project, there is also the chance knowledge can be transferred to allow for the internal team to increase their knowledge of the process.

The issues facing designers today have increased in both scale and complexity when working with new ideas. Consequently, the role that designers play has also changed (VanPatter & Pastor, 2016).
Where designers once focused their skills towards the end of the innovation processes in activities such as styling, designers are now involved in innovation processes from the beginning: framing problems, opportunities, assessing needs and deciding what products or systems are needed (Bezerra, 2000, Verganti, 2010 and VanPatter & Pastor, 2016).

Approaches and methods have therefore had to shift along with the role that designers play (Fultron, 2003). This interstitial form of design is an emergent discourse known in the design profession as design innovation.

This chapter studies various frameworks and various terminologies between authors of design thinking and design innovation where the focus of the process is to generate and create ideas at the front end and learn from the design process itself. These methods are not based around product efficiencies or the economics around business ventures. This chapter will therefore discuss some of the key dimensions of this discourse to introduce the language, structures and possible focus of these frameworks.

2.1 Second-order feedback loops Pangaro,P (2002)

Figure 6

Second-order feedback loops.

Image Redacted.
Page 118

https://www.dubberly.com/wp-content/uploads/2008/06/ddo_designprocess.pdf

Pangaros model (Fig 6) assumes a constant goal. That is, it provides no mechanism for changing or refining the system's goal. Typically, such systems are mechanical (or electronic) and require humans to set their goals, for example, defining the set-point for a thermostat. The human creates a second loop in which the action is setting the goal of the first loop. Like the thermostat, the human also measures the room temperature and decides whether to raise or lower the set-point on the thermostat.
Designing involves not only achieving goals but also defining them. This method allows us to improve our model of designing by nesting our original feedback loop within a second feedback loop.

Reflection
Design frameworks: Background and Design practitioner approach.

My initial experiences of design frameworks came after my industry learning from 1994-2006. Across these 12 years I worked mainly in the role of a visualiser through detail specification to deliver a single final outcome. I polished my drawing and technical communication skills, allowing product design projects to run one time with minimal disruptions.

Across the first 5 year period, I worked on multiple projects per week in the field of Point of Sale display systems. I had many expected failures as my interest was to introduce new manufacturing processes to stay ahead of the market's expectation. This affectively made previous solutions appear redundant and dated. In this role I documented my failures then modified my process for the next delivery.

At this early stage of my professional employment, I was not aware I was using a specific design method, but on reflection of the Second-order feedback loops as outlined by Pangaro, would be a fair mapping of the process I was using to continually improve.

Today, as a senior practitioner I see limitations in this process as it does not add external disruptions, knowledge or challenge for radical thinking. This process requires evidence prior to completion so only allows for incremental advances.

2.2 DESIGN FRAMEWORK

Design Thinking David Kelly

The design innovation framework "'Design Thinking', was largely developed by David Kelly, Tom Kelley and Tim Brown. It is based on activities that designers have been carrying out for years: matching user needs with a range of available technical resources within financial constraints (Brown & Kātz, 2019).

Kelley's model (Fig 7), identifies there are three constraints which designers must balance to ensure the sustainability of a project: human desirability, technical feasibility and economic viability (Brown & Kātz, 2019). Balancing these constraints is argued to facilitate customer value and greater market opportunities (Brown, 2008). The "Design Thinking" model profiles that innovation lies where the three circles coincide.

Brown's process in using this framework talks about three phases: Inspiration; where problems and opportunities motivate the team, Ideation; where the team generate, develop and test their ideas, and Implementation; where the product or system are taken to the market. The three circles indicate that the process is interactive and non-sequential.

The USA based company IDEO is a product design consultancy that has unpacked their design process and made it public in books and seminars to both demystify the process of design to their clients and also educate the market around the values product design can offer in developing innovation.

The core of the IDEO process is to have design teams observing and understanding what people want, need and dislike about products and systems (Brown, 2008). As designers explore through scenario planning or forecasting as to how people will respond to future products and experiences, they are required to synthesise a variety of approaches and thinking styles. They search for patterns and from these can form possible relationships to generate insights from. In the case of these ideas being taken further through a design process, they can then be prototyped for feedback and validation (Fulton Suri, 2008).

For exploration of ideas to work well using the "Design Thinking" model, you would require a multidisciplinary team to ensure the perspectives of each contributor has different

Figure 7

Constraints of innovation.

Image Redacted.

https://www.researchgate.net/figure/Design-Thinking-framework-by-Tim-Brown-Brown-2009_fig1_325193604

references, experiences and processes. It is this depth that would add value to the ideas and discussions from which multiple concepts can be generated. It is therefore a process that uses conversation and discussion at the heart of it.

Through this proces's the designers' role shifts to from that of a communicator of ideas to that of a strategic role managing information and inputs to ensure ideas are captured and valued as the discussions progress and the ideas go through various processes of review. Tim Brown of IDEO stated "Design is too important to be left to designers" (Brown & Kātz, 2019), implying creative problem solving skills used by designers should be used throughout organisations and strategic initiates.

Reflection

This method leads towards incremental innovation given that discussions and perspectives will have the design leader monitoring rather than leading the discussions. This process does not allow for a broader contextual application of "what is financially feasible" outside of the process being studied.

This method for example, would not have been able to conceive a community lead initiative such as Co-Bot Denmark (Chapter 4).

2.3 FRAMEWORK Structure Planning

Bezerra and Owen

Charles Owen created a systems based design innovation framework known as Structured Planning. It supports planning and concept development in two main ways. Firstly, it focuses on what needs to be done and gaining insights on why it is so. The process of this phase is to gain an expanded understanding of the user. The systems approach around this phase looks at all users affected by the system, not just the end users (Bezerra & Owen, 2002). Secondly, it uses computer processing to organise information for effective use by designers. Owen argues that conventional design methods fail to take a user centered approach and so fail to offer an appropriate solution.

Owens framework attempts to focus on discovering what solution to offer by identifying four attributes required to develop quality offerings in reprect to design values:

(1) Craftsmanship - where attention is paid to engineering, design and manufacturing performance.

(2) Performance - where attention is paid to users needs, appearance and social and cultural factors.

(3) Competition - where products have to be holistic and appealing.

(4) Integrity - where under analysis, the products have no flaws to give the organisation integrity.

Metaplanning

Structured Planning embraces a set of methods that can be used together or individually (Bezerra & Owen, 2002). It comprises of analytic phases, synthesis tools and concept development phases. The first phase is called Metaplanning. This begins with an initial idea for a project topic or research to develop an understanding of the context within which the project will be situated. Resources such as money and time are considered, as is the recruitment of the interdisciplinary team. Then the Structured Planning is then customised to that specific project. Finally, the major issues of consideration are stated and a "charter" is created. The "charter" contains a project statement, the context, research, guidelines, customised methodology and the issues previously identified (Bezerra & Owen, 2002).

Project Definition
In this phase the "charter" acts as a brief for the project. This includes a list of issues that are then discussed and debated, leading to the creation of a research direction. Team members form positions and write position statements.

This work leads to a "Defining statement document" being created for each issue that arises. Like the "charter", it is a summary document. It summarises the debate the team has had around the issues, the final position taken and alternative positions and discussions with background arguments. The "defining statement document" gives an overview of the project and through a process of synthesis becomes a tool to evaluate the outcome against the original position taken (Bezerra & Owen, 2002).

Information Development
In this phase, actions which will be required are analysed to find three elements:

(1) Functions - which describe the system and its requirements of users.

(2) Design factors - which are the insights about the behaviour of both the system and the wide range of users.

(3) Solutions elements - which are ideas about how to use the 'design factors' to satisfy the 'functions'. The visualisation of this is a 'function tree' that illustrates all the differing levels of information. The levels from the top to the bottom are major modes of behaviour, activities within each mode and then descriptions of the function carried out within each activity. Next, teams assess possible risks with each function.

These three core elements are similar to the mindset filter used in Edward de Bono's, Six Thinking Hats where de Bono profiles a "Black Hat" as a filter to improve a design through negating the negative issues that could affect success (de Bono, 2017).

These insights are turned into a *'design factor document'* which are the qualitative base for the project. From this document, mapping 'Solution Elements' are created. These are the initial set of ideas about fixing problems using insights that take advantage of relationships between users and the system.

Reflection

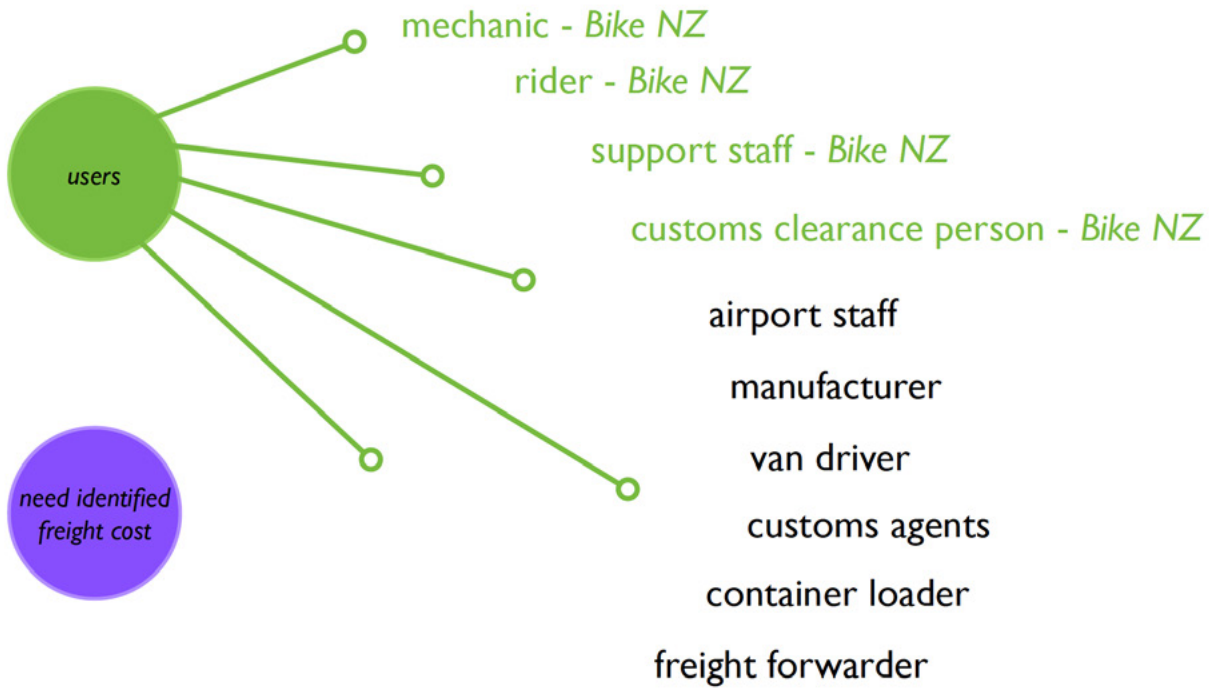
This "Definition statement" is done during the progression of an idea. It requires time for discussion and clarification, as well as documentation, so it is better undertaken within a design environment that allows for strategic discussions and monitoring to be part of the project values.

SouthMED's Suzy Hood (Chapter 4) and its rapid deployment diverged from this "Definition statement" process at thepoint when there was little to assess against, other than the initial prototype. The alignment and opportunity to develop the hood and validate against the "Defining statement" was lost on later discussions. With a focus to produce the original concept, rather than develop it would be the opportunity in a longer-term project.

Two years in, the project today, to some effect remains frozen in development and is a victim of standard production manufacturing processes of not allowing concurrent development to enable a more resolved outcome to come to market.

Figure 8a

Bike NZ System user map.



Drawing by author

This process becomes the basis for ideation (Bezerra & Owen, 2002). Strengths of Structured Planning: Owen advocates that the design offerings generated through 'Structured Planning" are viable in an economic sense. This is due to multiple factors.

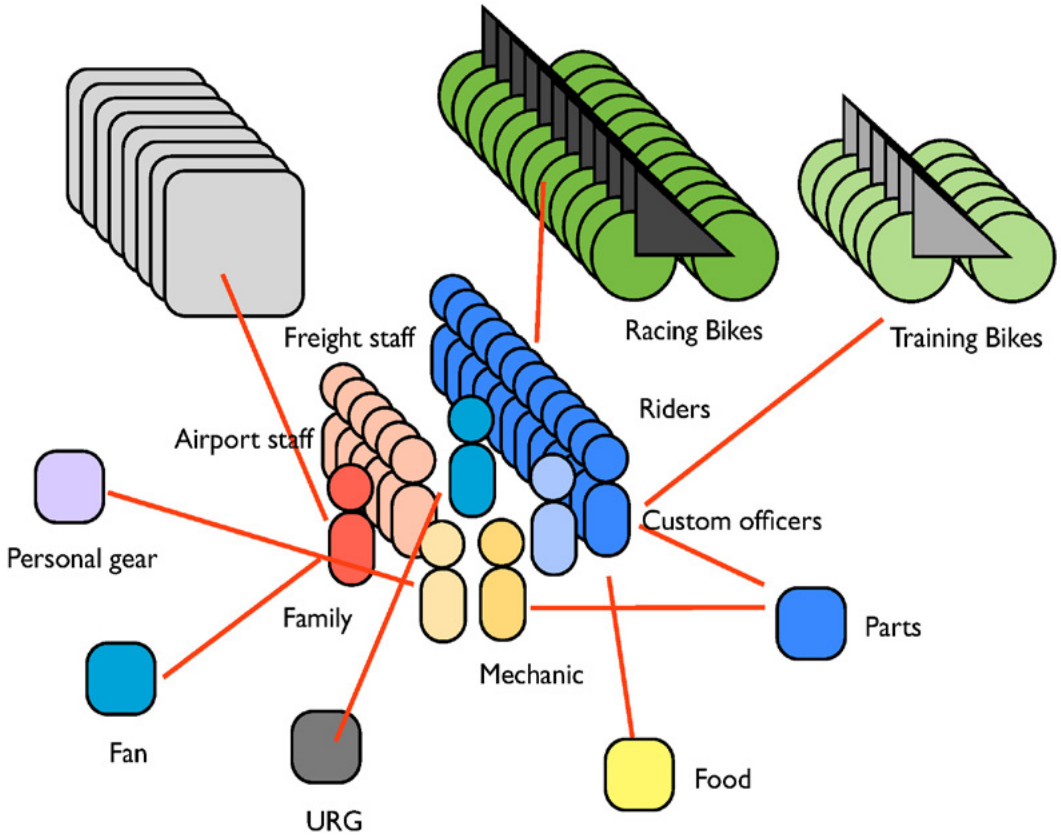
Firstly, the development process is completed efficiently by using simple prototyping techniques and strengthening the relationship between ideation and evaluation.

Secondly, the testing of the solution is improved by utilising user-centered design practices which involve the consideration of ergonomics, physiological, cognitive, social and cultural factors.

Finally, the design outcome has more value to business as the offering developed through Structured Planning are usually highly integrated products and services. These are hard to mimic as the constituent parts are not necessarily able to be copied individually, in particular if the service value is based on deep clinical or technical knowledge (Owen, 2001).

Figure 8b

Bike NZ System equipment map.



Drawing by author

Reflection

While working as a dual practitioner in the design industry and teaching at tertiary level, I developed a bike freight case. For this project, I initially used insights generated from the use of Tim Brown's IDEO methodology then developed the ideas using Structured Planning around each individual user of the freight solution. This method expanded the critical users to producers, freight forwarders, customs officers, taxi and freight carriers (Fig 8a), and hotel staff (Fig 8b). This process expanded the design options to explore the benefits of each solution being informed by each of these users.

2.4 Frameworks of Design-driven innovation

Roberto Verganti

Design-driven innovation is a design innovation framework developed by Roberto Verganti. It centres on the notion that every product has a language of meaning and that designers can radically innovate by acting as gatekeepers of these product semantics across different industries.

Just as the functionality of a product can satisfy user's needs, so too can the meaning of a product. Rather than satisfying the physical needs of the user, the meaning satisfies their unarticulated socio-cultural needs, portraying values, personalities and identity. Verganti states 'People do not buy products they buy meanings'. People use things for profound emotional, psychological and sociocultural reasons as well as utilitarian ones. Thus, to radically innovate the meaning of products, organisations must go beyond functionality and explore meaning.

"every product or service in consumer as well as industrial markets has a meaning attached to it", (Verganti"Design-Driven Innovation", 2009).

Figure 9

Design-Driven Innovation as Radical Change in Meanings.

Image Redacted.

Fig 1

https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-27242014000300007

© Verganti, 2010.

In Verganti's opinion, the radical innovation cannot come from taking a user-centred approach, nor does it come from focusing on technology as a starting point. This is because Design-Driven innovation is neither pulled by users nor pushed by technology, instead it is pushed by designers (Verganti, 2010).

Verganti's framework (Fig 9) illustrates three approaches to innovation. Firstly market-pull, in which innovation attempts to satisfy the articulated, current needs of customers. Secondly, technology push, in which innovation relies on advances in technology. Thirdly it shows an approach to innovation is Design-Driven Innovation, in which innovation is created through manipulating product (system) semantics. This approach that Verganti takes, is one that the meaning conveyed by the designed product is the focus of the designer. Although market-pull and technology-push approaches are not founded on knowledge and product languages, this knowledge is usually

integrated during the process. The products created through Design-Driven innovation ultimately do satisfy users needs (Verganti, 2010)

Verganti's framework identifies three aspects which form the core of Design-Driven Innovation:

(1) Relationships with key interpreters, who are other individuals or organisations who take part in the design discourse.

(2) Internal assets, which can be knowledge or technology or the capability to influence other organisations and the

(3) Interpretation process, in which insights from interpreters and internal assets are integrated.

Thus Design-Driven Innovation can be seen as the generation, integration and application of knowledge. Designers are part of this discourse and help to interpret it. Verganti describes the discourse as a network of interpreters in which people are constantly exchanging insights, interpretations and proposals in the form of conversations, prototypes and products.

(Fig 10) Illustrates the connection and communication with the two-way relationship of listening and influencing. By communicating with interpreters, design innovators can understand socio-cultural phenomena, anticipate trends and influence the meaning of new products (Verganti, 2010).

Figure 10
The Design Discourse.

Image Redacted.

Fig 2

https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-27242014000300007

Listening
Verganti intends to unpack the process of a designer by profiling that a designer listens to the discourse and then interacts with the interpreters to gain access to knowledge about new product meanings and languages. Consequently, this discourse acts as a way of researching new possible meanings for products. To interact in this way, organisations need to know where to find key interpreters and how to use their knowledge (Verganti, 2010).

Interpreting
In this next stage of the framework the organisation must take the new knowledge from the 'listening' phase and integrate it with their personal insights, technology and assets. From this analysis the organisation conducts research experiments and creates new visions and proposals for new product meanings and languages. This consideration of meaning takes place before any consideration is given to form. The organisation also gauges reactions to their prototypes which often signify new ways of living.

Addressing
Finally, because organisations have created radical innovations, the end products are often unexpected to potential customers. Thus, the market has to be prepared before the product is released (Verganti, 2010). To do this, the organisation needs to interact with its interpreters again. Once the organisation's vision has been diffused to the interpreters, they can process all the values it contains to develop technologies, products and services that will make the organisation's offering more appealing to people (Verganti, 2009).

Strengths
Design-Driven Innovation is not a design framework to be used as an end-of-line add on. It works when integrated throughout the entire development process. Verganti adds that Design-Driven Innovation also reinforces the close relationships between manufacturers and designers, which are thought to be the key to success in Italian design (Verganti, 2010).

This is because products that are radical innovations tend to have a long lifespan and create new markets. They foster successful brand representations, customer loyalty and have high margins due to their breakthrough product meanings, which of course are different to the offerings of other organisations. Verganti states that many successful Italian companies such as Alessi, Artemide and Kartell use this approach to innovation (Verganti, 2010).

Verganti argues 'Radical innovation is one of the major sources of long-term competitive advantage'.

_Verganti"Design-Driven Innovation", 2009

2.5 4 Orders of Design

Richard Buchanan

Richard Buchanan is a US. professor of design, management and information systems. He believes there are four orders of design; Signs, Things, Actions and Thoughts (Buchanan, 2019), (Fig 11).

He considers innovation arises when two stories come together that create a spark that crosses between them leading to a possible connection. This concept of an unseen connection is the premiss to my construct of a "thread". *Note: This spark is the "hybrid" within the process (4.3 Interrelated Innovation Framework, Wallace, 2022).*

Buchanans' profound description of intuition states that "intuition is the ability to see the connection and realise that it is so important that you can build a system out of it, you grasp a principle" (Buchanan, 2019).

Reflecting on these statements around stories coming together and realising the connections between them, I propose that Buchanan considers innovation a social activity allowing thoughts to connect.

The fourth order in his framework encompasses understanding the system structure, which is what my (3.4 Design Futures) event engaged. Understanding how an organisation and/or individuals can offer possible collaboration and co-ownership.

Richard's framework talks about dialectical design conversations needing to take place with others where core values are discussed and understood and also to animate the work we do. Here the designer stops being the core influence, steps back and becomes the facilitator of discussions by others.

Figure 11

Four Orders of Design.

Image Redacted.

Fig 1

https://www.researchgate.net/publication/332963793_Exploring_the_Fourth_Order_Designing_Organisational_Infrastructure

Reflection

Aspects of this methodology have underpinned my last 12 years enterprise practice within Bodystance Ltd and is possibly why the Backpod remains a market leader due to the levels of design thinking that strategically allowed growth across the various health and wellbeing markets it is represented in.

The Backpod was always developed as a product imbedded into a service offering. This gives the end customer a unique experience, not just a product to use.

Socially, one of the missions of Bodystance was to support business and employment in New Zealand and the education of design and design thinking and to contribute these skills and networks to national projects. The SouthMED hood was one such project (2020).

These values add to the brand story and further adds to the customer experience of the Backpod as they know the product and its service knowledge has integrity and a sustainable brand offering.

2.6 Design frameworks analysis

Innovation is becoming an increasingly advocated process and can be seen utilised widely across industry and education sectors. It draws its methods from many disciplines including design, business and the social sciences (Bezerra, 2000).

Buchanan considers the integration of understanding, communication and implementation is necessary in order to innovate in a way that enhances human lives (Buchanan, 1992).

Bezerra identifies three main focuses for innovation: What is desirable or acceptable for people, what is technologically feasible and what is profitable. These values are at the core of many publications of IDEO and are defined as desirable, viable and feasible (Bezerra, 2000).

Innovation is considered crucial to all design fields at all levels in order for individuals and organisations to create competitive advantage. Companies are constantly searching for and investing in methodologies, knowledge and expertise in innovation (Kelly, 2001).

Verganti has defined innovation as the result of generating and integrating knowledge but this requires translators to generate the knowledge and integrate it to create the advantage.

(Wylant, 2008) argues that in addition to producing something new, innovation is said to introduce something that becomes widely adopted and (Drucker, 2002) adds that innovation is also wealth producing.

Wylant has advocated three classifications of innovation: Continuous or incremental, where a small improvement is made to an existing solution, and dynamically continuous, where there are dramatic improvements to an existing solution. The third is discontinuous innovation where a significantly different technology or infrastructure is introduced and leads to new users, functionality or behaviours (Wylant, 2008).

2.7 VanPatter - Design innovation

VanPatter & Pastor (2016) argues that the scale and complexity of issues designers face have both increased and with these changes the role of design has changed. Consequently, design innovators are now focusing less on end-of-life activities such as styling and ergonomics and instead are involved in the development process from the beginning, assessing needs and opportunities and deciding what product or systems are needed (Bezerra, 2000). This is in accordance with VanPatter's view of design's growth into a human-centered approach to problem solving innovation.
Bezerra insists that there are certain conditions that can facilitate design innovation. Firstly,

critical thinking must be encouraged. Secondly, strategic thinking is essential. The designers' goals and methods must also be assessed. Finally, a human centered approach is important. Bezerra states that design innovators must firstly examine for whom they are designing, then what the design solution will be and finally how they will implement it. The resulting level of success he concludes is directly related to the value it brings to real users in their everyday lives (Bezerra, 2000).

Design innovation is being accepted as a value beyond a new product or service offering and as a tool to develop organisational capabilities and processes. When correctly applied, innovation frameworks can have measurable outcomes especially in enhanced productivity and financial returns (Wylant, 2008). Furthermore, design practitioners within these frameworks have the capacity to work in an interdisciplinary way and connect innovation goals with real behaviours, helping to maximise communication and innovation within an organisation.

Design innovation also leads to user-focused sustainable products and systems (VanPatter & Pastor, 2016).

Bezerra also considers that innovators that are emerging are no longer specialists but specialised generalists. They focus on problem finding, problem solving, seeing connections and filtering information. To do this they need a diverse skill set that allows them to work in the field with users along with the ability to utilise mindsets of both rational and intuitive processes to develop ideas (Bezerra, 2000).

2.8 Design innovation frameworks

As designers react to the interconnected world of product and systems as well as the ubiquitous access to information and references, their mindset needs to remove their skills from purely tacit knowledge, around the technical creation and execution of an idea and change mindsets to that of a virtual map at a "meta level" perspective, of whole system design to expand relationships and values both behaviourally and financially in most cases.

Hugh Dubberly, founder of the Dubberly Design Office contends there is a need for designers to create a didactic framework in order to educate future designers more effectively. He considers that "universities, professional organisations and practitioners have much opportunity to improve the way designers learn - to develop systems for forming and reforming models of design processes" (Dubberly, 2009).

VanPatter adds that without explicit frameworks, designers' default to old behaviours and old ways of adding value, failing to explore new potentially rewarding models (VanPatter & Pastor, 2016).

Reflection

This connection is what I will discuss later as "interstitial connections" from the case study Dunedin Futures (Chapter 4.0).

Reflection

Innovation frameworks post industry practice:

When I entered the creative industry of Industrial design I was aware of the design process in respect to stages, costs and delivery implications at a manufacturing and process level. Product items that interacted with people needed to include considerations of ergonomics but affectively no design methodology around user centered design was part of the teaching at that time.

Across the past 15 years practicing as a designer educator, I have been influenced directly by design leaders in design theory, psychology and sociology. Exposure to these human sciences allowed me to expand the design process at the start of a project and delve deeper into the nature of a design brief and the opportunities the wider brief offers the eventual outcome.

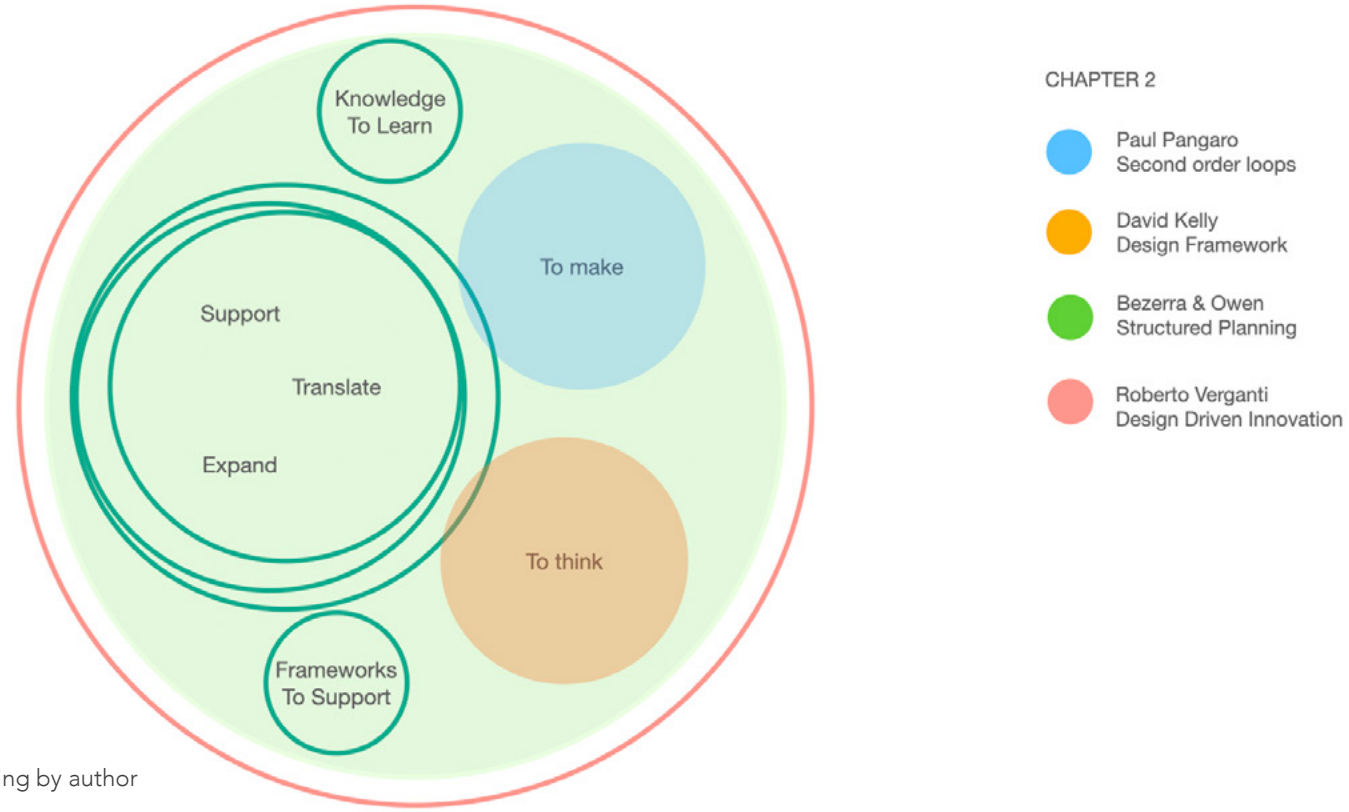
The larger relationships of how human centered design can assist in mapping of products and system design thinking grew out of my exposure and conversations around the specific design, development and knowledge frameworks of various professional individuals and bodies which I used as a guides to allow for ideas to be managed through to completion.

Three initial frameworks of influence are Design Thinking by David Kelly, IDEO, Structured Planning by Charles Owen, and Design-Driven Innovation by Roberto Verganti. These frameworks embody a variety of design innovation approaches, differing in popularity, method, scope, core objectives and origin.

My understanding of innovation as a framework not as an outcome of the design process came much later in my design education and I consider I have only been truly practicing this for the past 5 years. This exploration around innovation includes experimentation, rapid deployment of rough ideas, creation of non-commercial outcomes, co-design and co-creation as processes to ensure innovation is able to be sustained from an initial idea.

Figure 12

Chapter 2 Design methods value map



Drawing by author

2.9 Chapter 2 summary

The published academic works by Owens, Kelly, Pagaro, Verganti and Kumar across the past 20 years have informed industry around the values of design thinking and strategic design. Their methods and processes have advised many industry leaders today on ways to filter and develop ideas to allow for innovation to be identified and supported.

From my own product design perspective, Pangaro (2002) and Kelly's (2008) frameworks offer industry best practice design processes for the Making and the Human Centred design thinking of an idea. When combined with Bezerra & Owens, Structured Planning framework (2013), the design practice is extended to knowledge, support, translation and also the expansion of ideas. (Fig 12) It is this framework that I will be using in Chapter 3.
The framework of Roberto Verganti (2010) moves beyond a single system and for this study is too broad to apply and validate, whereas the work by Richard Buchanan's 4 Orders of design (2019) has informed me when creating my own Interrelated Innovation Framework (IIF) in Chapter 4 and the generation of possible scenarios profiled in Chapter 5.

Explore Concepts
Frame Solutions

_Kumar, 2013

3.0 Case study evidence

3

Against the various designers profiled in Chapter 2, I chose Structured Planning by Bezerra & Owens as the framework to reflect on past case studies, to explore new ways that innovation can be sustained (Odense Robotics, 2019) and to experiment with new ways to communicate what innovation can offer society and business in the regional context of Dunedin, New Zealand.

My goal, using their design framework, was to see how these experiments would be absorbed, adapted and modified by the users and therefore learn how to create better opportunities that would allow innovations to continue beyond the initial generation and designers input with the intent to develop knowledge with others.

Within this chapter I explore case studies where innovation is being sustained outside individual organisations across social, business and the education sectors. These projects are where innovation has shared control, shared ownership and co-ownership which has allowed rapid outcomes with significant and positive social impacts to be generated. The five case studies profiled in this chapter all involve the releasing of an idea and seeing how others will react, engage and develop it further (Fig, 13).

Case study 1, Solar water heater (3.1) and case study 2, New Scientists kits (3.2), are my own experiments with open-source content and the use of WikiEducator as a platform for sharing and developing ideas. These projects ran from 2009-2012 and were based on knowledge sharing for educators and had a social and enterprise focus.

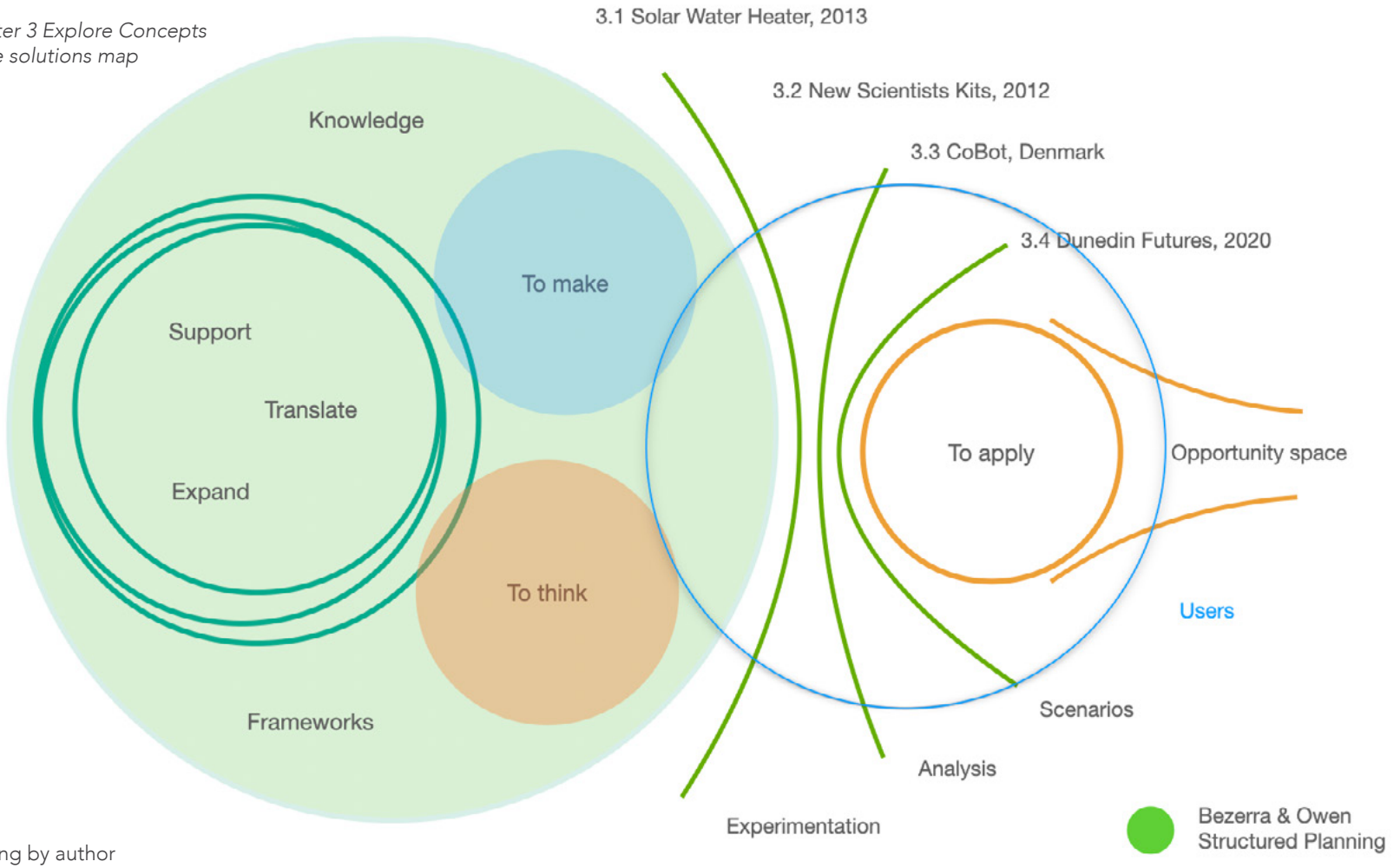
Case study 3, Cobot, Denmark (3.3) is based in Odense. This is a city wide innovation project that has been running since 2005. This case study was chosen against HCD methodology as it allows knowledge to flow across a city allowing the community to work within a single innovation structure engaging in both shared ownership and intellectual property

"Innovation within a system may be to break down silos of communication and create transparency to allow others to see the patterns and exchange ideas".

_John Randal Saul, 2012

Figure 13

Chapter 3 Explore Concepts
Frame solutions map



Drawing by author

and integrating regional universities and local government.

Case study 4, Dunedin futures (3.4), is my own innovation experiment that I started in 2020 with the business and education sectors in Dunedin, New Zealand. The goal was to apply the knowledge gained from the innovation frameworks detailed in this study by transferring it to a wider community in an attempt to start new discussions and create opportunities for growth within Dunedin city.

Case study 5, SouthMED Suzy Hood (3.5), is project that I co-designed and has been running since March 2020. The Suzy Oxygen Hood project became SouthMED Limited and is trading today. The project genesis followed a request from the New Zealand government in March 2020 for industry or academia to offer solutions to New Zealand's ventilator and personal protection equipment shortages as we all headed into the Covid-19 pandemic.

3.1 Case Study 1

Social open-source design, Solar water heater 2009-2013

This self-defined project looked at how individuals could gain heat from the sun to reduce their heating costs. It was targeted at low-income families and the elderly so used non-for-profit innovation frameworks as a consideration of how to transfer the knowledge and how to empower the individual within the solution.

The Micro Solar Reflector project (MSR) (Fig 14) used off-the-shelf materials chosen for their low embodied energy and simple methods for construction and installation to minimise construction and production costs.

The process involved extensive Freedom to Operate (FTO) searches to understand the limits within which an idea could be generated without infringement on other patents. It then went through multiple design stages and testing as well as multiple iterations over a period of 4 years.
The project had a social focus from the outset which presented new values for me as a practitioner to design against. This included considering the customers own skills and motivations as part of the construction process of the final solution as the goal was to offer a kit plan of the entire solution for free.

During this project I was supported by David Quinn, a local philanthropist who guided me though my first experience of social innovation. He assisted in the generation of the story for others to add to by employing a past design graduate I had taught to generate illustrations, allowing the story to be communicated clearly.

Figure 14

MSR Construction Video Part 3.

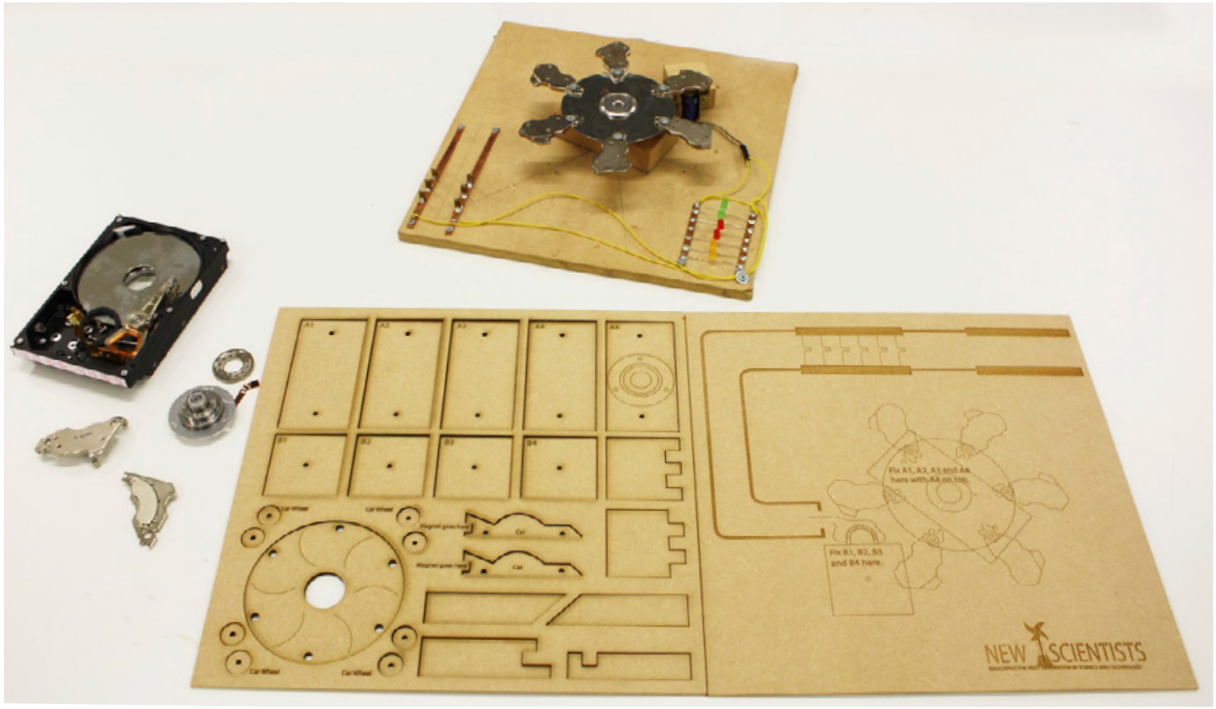
Image Redacted.

https://www.youtube.com/watch?v=P8pjmbwt1S8

David led me though some fundamental design process rewiring where he pushed me to deeply consider my motivations and the impact critical thinking can have on the design process and outcomes. Up to this point in my career I had been taught and always personally sought mentors that had achieved excellence from the extraction and refinement of their own work, not dissimilar to that of a primary industry worker using time to process a resource for personal gain.

David's professional background stems from Silicon Valley in America among the technology industry from 1970-1990. His perspectives from this time of co-sharing and collaboration gave me valuable insights into how innovation can operate beyond a funded "professional construct" where value is extracted from the project outcome rather than adding value through the process.

Figure 15a
New Scientists Turbine.



PUBLIC DOMAIN WikiEducator, Design_is_Applied_Science, 2011.

During the design of the solar water heater, we also recorded video to capture complete step by step guides for public release to facilitate end user participation and success. This work was supported by the late Phil Davison, a close friend, teacher and movie maker whose own values aligned with the project.

The MSR was further supported by Tobias Danielmeier from Victoria University and was initially considered for inclusion within his university research project "The First Light House (2011)". Tobias and I presented the MSR project to Bright Spark Wellington investment group for funding but were unsuccessful as it did not match the business model they had for investment at that time.

Later the MSR design outcome was adopted by an off-grid community in Dunedin. The plans for the design were also later released on an open-source sharing platform for public dissemination. To my knowledge the project has not been developed by others beyond the plans. I consider the project has great potential and can be reviewed with a new team in the future to build on the original idea.

3.2 Case Study 2

Social open-source design, New Scientist kits 2011-2012

A second project I pursued within my professional role as a tertiary design educator was the generation of open-source educational kits for primary school students (Fig15a,15b). The learning goal was to take university students through the journey of social innovation as they generated teaching kits for primary school teachers. The project brief was to offer teachers full class lesson plans, resources, web-links and also physical models to explain physics within the delivery of science with confidence.

The first kit, completed mid 2011, was a hand powered generator made from old computer hard drive parts. The kits were shared across several Dunedin primary and intermediate schools. After feedback from the teachers and school students involved, the project was then modified and released on WikiEducator (Wallace, 2011).

The second iteration followed in 2012 with the new focus on water energy and the construction of a waterwheel, focusing on energy and motion. The need for these educational resources came from Dr Steve Sexton, a lead educator in the Department of Education at the University of Otago. He

believes, "that critical thinking and innovation in society requires primary education teaching to offer deeper knowledge and broader subject content than currently supported".

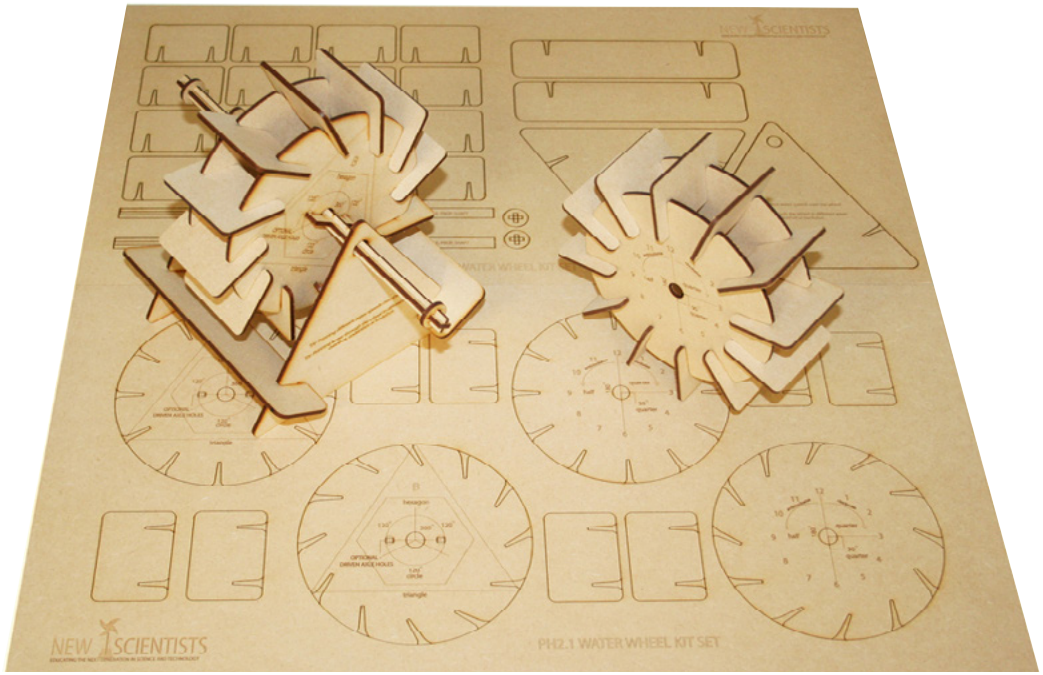
He cited that during their training, many teachers only receive 20 hours of science content across their 3-year degree and that while they can opt in for additional classes they seldom do unless they are specifically skilled in science already. He claimed this leaves a deficiency in the class room for the junior years, where teachers can only draw on references and experiences they themselves were taught which predominately focuses on space and the natural world.

Since this project, the New Zealand government has responded to the concerns of Dr Sexton and other educational advisors and has been investing in science, technology, engineering and maths (STEM) subject areas in secondary and tertiary level education. In 2016 there were national changes around the funding and direction of science programme but this has not extended to the primary level which is still yet to be considered.

Dr Sexton believes that the sciences can influence culture and society and therefore have a critical role in our community. Across New Zealand he sees students missing out on the basic understanding of physics, applied maths and chemistry due to the lack of teachers with this knowledge at the primary level as well as the resources allowing teachers to explain the principles.

Figure 15b

New Scientists Water Wheel.



PUBLIC DOMAIN WikiEducator, Design_is_Applied_Science, 2012.

New Scientists - Design Process

The New Scientists project came following my fourth year as a Practice Fellow at the University of Otago and was a co-design exercise that combined 68 design students at third year undergraduate level. Each student group numbered 5-7 students and pursued a brief generated by each lecturer, in my case physical kits of an electrical generator and water wheel were manufactured and recorded, using product design knowledge.
The experiment within this project from a

Figure 16

New Scientists Process Map.

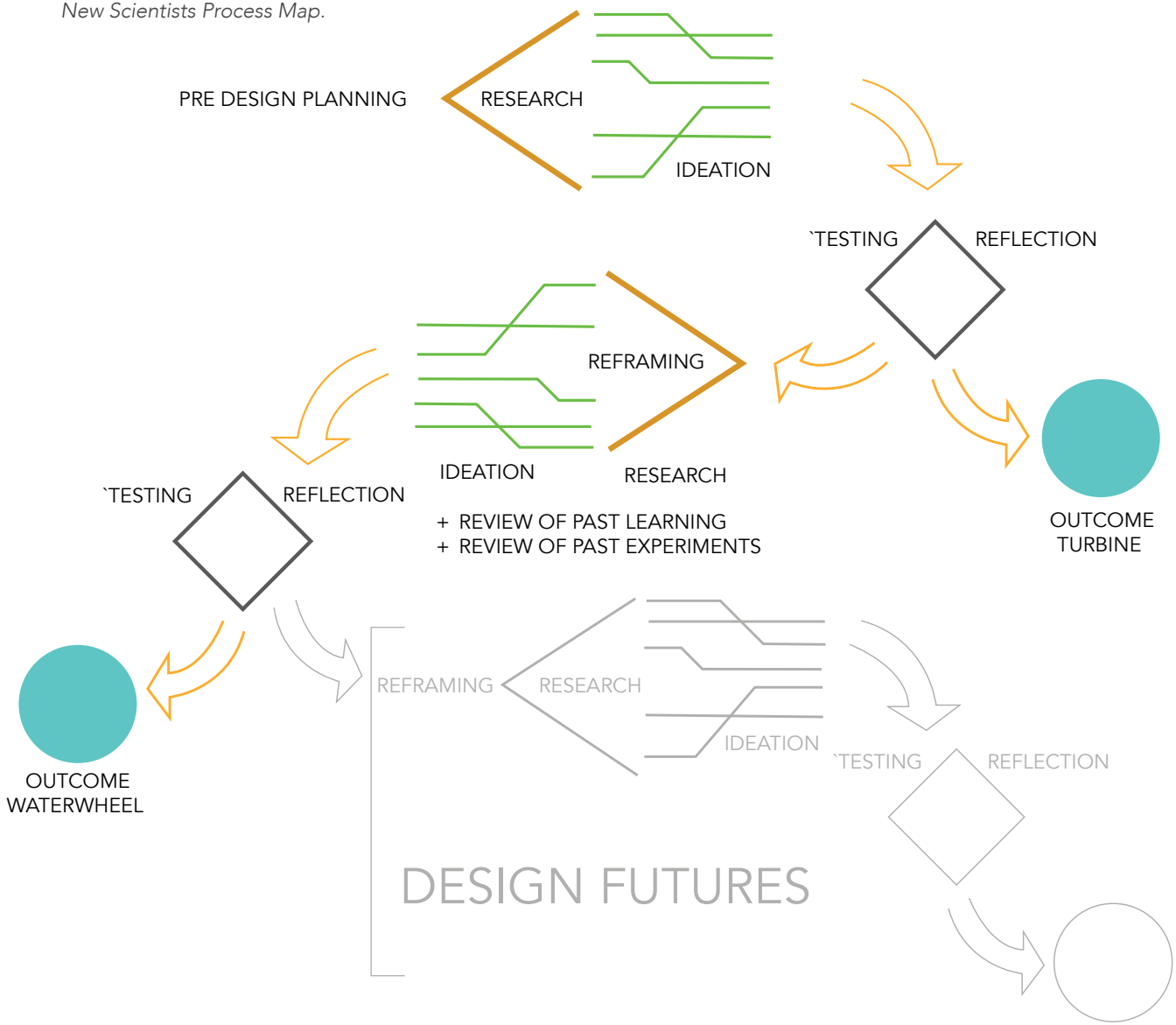


Diagram by author

Reflection

My employment within the University of Otago after 12 years of product design and production in industry was a turning point in my career as I transitioned from a "maker" to a "thinker" using new methods and processes to explore products and systems for the first time.

The new scientists project involved some new teaching practices such as Inquiry based learning and Action research that allowed the projects to have a longer path that ran inside the project over two years and due to the transition of various cohorts this was able to generate multiple project outcomes and explore a broad range of successful innovations.

teaching and learning perspective is that the learning and experimentation from one semester was to be transferred to the following cohort of students. This required the students, as part of their practice, to reflect and map their process well to allow the new set of students to easily continue on and grow with the projects. The project ran for 4 semesters in total (Fig 16).

My design vision was that across time someone would combine the learning outcomes of the water wheel and electrical generator to create a water generator and add this to their teaching resources but this has yet to eventuate. Across the following years I have been contacted by several international academics thanking us for these resources. One personally significant success from this project was in 2016 being invited by Bunker Roy to teach at the Barefoot College in India. Bunker Roy understands how to educate a community for the betterment of all. His college often works with illiterate communities and empowers them by educating selected individuals from each community about solar energy and technology so they can return, share their knowledge and become leaders within their communities (Roy,B.2013).

These project ideas were placed on my WikiEducators page in 2012 for global release. To date the main page has been viewed 7,400 times (Design_Is_Applied_Science, WikiEducator).

3.3 Case Study 3

Danish Innovation Experiment: Cobot Odense

Universal Robots is a project owned by the city of Odense in Denmark that develops robotic control technologies and showcases successful industry engagement around innovation. It was founded in 2005 and within 14 years became the top robotics manufacturing solution in the world.

Odense created a single commercial entity with the design innovation being around shared values. It demonstrates how a mature society can co-create value for its society once that body is educated in the knowledge of innovation and values the methods and processes of innovation within their practice.

The Cobot was the 'object focus' of the innovation and the city of educators, industry, local government was the 'system' to deploy the Cobot.

This system design approach to innovation leadership was revolutionary to my research. As most reseach and case studies focus on individual leadership, ways to chose research teams "Skunkworks" or divested skilled teams "Outsourced" resources to allow projects to have stages of innovation.

From my research it is not clear how the system managed investment and payments within this cluster. There are no published references around trading agreements and fees. One possible option is that it runs as a decentralised autonomous organisation (DAO). This is a structure broadly defined as a borderless, open, transparent organisation that aims to achieve a set of purpose-driven goals most efficiently using independent agents driven by token economic inventive mechanisms. It blurs the line between an organisation, a community and an economy. The tokens are part of block-chain currency, itself an innovation in funds management within the past 5 years, especially within the past years.

Cobot is successfully growing today across the city of Odense, The value of this organization is significant $219M USD in 2020, employing +700 people and +1,100 partners around the world (Fig 17).

3.4 Case Study 4

Dunedin Futures Event, Social experiment 2020

In October 2020 Nathan Berg, Chair of Entrepreneurship at University of Otago and I ran an industry event as a social experiment in innovative education. At the highest level it was to generate discourse around how best to use the minds in society to benefit all. The innovation structures proposed by Verganti that looked beyond the function of a product or service for a customer and deeper into the meaning of how these systems can really work for people (Verganti, 2006). This is how I aimed to set up the "Dunedin Futures" event.

Figure 17

Odense Robotics System Map.

Image Redacted.

Page 5

https://www.odenserobotics.dk/wp-content/uploads/2020/11/OR-Insight-Report-2019-web.pdf

© Odense Robotics, 2019, page 5.

In it I profiled Odense Robotics in Denmark, the social enterprise that co-creates design outcomes to support the community. At 130,000 residents and with a historic heavy engineering background and current port exports in agriculture, Odense had similarities to Dunedin. Its back story was one that was easy to overlay against Dunedin as it too is having to change with society and technology limitations.

The social experiment was to communicate a way in which the entire Dunedin community could lead innovative change for the betterment of all. The design concept was for Dunedin industries to engage with each other to create a business collective.

This would be a large business and therefore able to resource large project opportunities due to the collective assets of people, investment cash, plant and equipment.

The concept preparation was extensive and went through a process of enquiry and validation involving several discussions with key stakeholders within the business community who were independent from each other and worked in different fields so not to create any monopoly for further discussions. Following this process, it was clear that the desire for growth was common as were the limitations for current business and a disruptive and innovative approach was highly sought after (Chapter 5).

A Dunedin Futures industry event was held in late 2020 with an audience of creative thinkers and market leaders invited to discuss shared intellectual property and what co-design and co-ownership could offer the city. The discussion centered on a social value project for shared ownership which I profiled as the being the development of a public vehicle for free transport made and controlled initially within Dunedin with the eventual goal being to distribute the vehicles throughout New Zealand.

This experiment led to short and medium term sustained innovation around new project directions and opportunities between industry and academia including the formation of Otago Medical Design Ltd in 2021. The Dunedin Futures tenet is a case study of innovation that runs across a community and adhered to the aphorism "a rising tide lifts all boats". This experiment has had some outcomes to date that will be profiled across this document.

Pre Design: Framing

This stage took weeks of engagement and planning as I wanted to create an open discussion and accelerate design thinking with the community to support new business practices. One paradigm in particular was sharing of opportunities to strengthen deliveries not isolation, control and competition that ultimately constrains growth as the individual company, firm, team would need to invest in resources, time and equipment to be able to sustain the opportunity in the short term and potentially over-extend themselves in the long term, should a second opportunity not become apparent. Each discussion was mapped using a Political, Economic, Social, Technological, Environmental and Cultural (PESTEC.) analysis with the focus around pain points within their business. There were common pressures within their business practices being, (1) succession planning, (2) obsolescence of their product/ service, (3) innovation and timing (4) up skilling

Reflection

The design process I engaged for the Dunedin Futures event at this stage of planning followed Vijay Kumar's Innovation Planning (2003). This methodology filters the design process into seven mindsets (Chapter 4.0). As a dual practitioner I have often considered my practice has two layers that run over this methodology with the design intent across the process to create "hybrids of opportunity. In the presentation I called these threads of innovation "green shoots" a metaphor for new growth.

The goal of the Dunedin Futures social experiment was to create a flexible network that could distribute opportunities and knowledge across Dunedin with the University and Polytechnic as critical contributors.
It sought to facilitate the co-creation and open collaboration into social and industrial projects that would benefit not only those directly involved but everyone in Dunedin and eventually those further afield.

The premise of the discussion was around a complex problem, that of sustainable transport and the consideration that a new type of vehicle with regional construction, serviceability and management ultimately offers the best solution for a sustainable transport society in the longer term. The design intent from an academic led position for the presentation was far from this, as it was an attempt by Nathan and I to generate discussion and alignment between that of our academic and industry worlds.

The Design Futures presentation in October 2020 profiled my analogy of "green shoots" which is used to encompass possible ideas of hybrid collaboration that could grow under a virtual trampoline across the city, whereby knowledge and resources can increase the speed and strength of an idea when encircled within a culture of shared ownership and trust. (Fig 18).

Figure 18

Dunedin Futures., Presentation Slides.

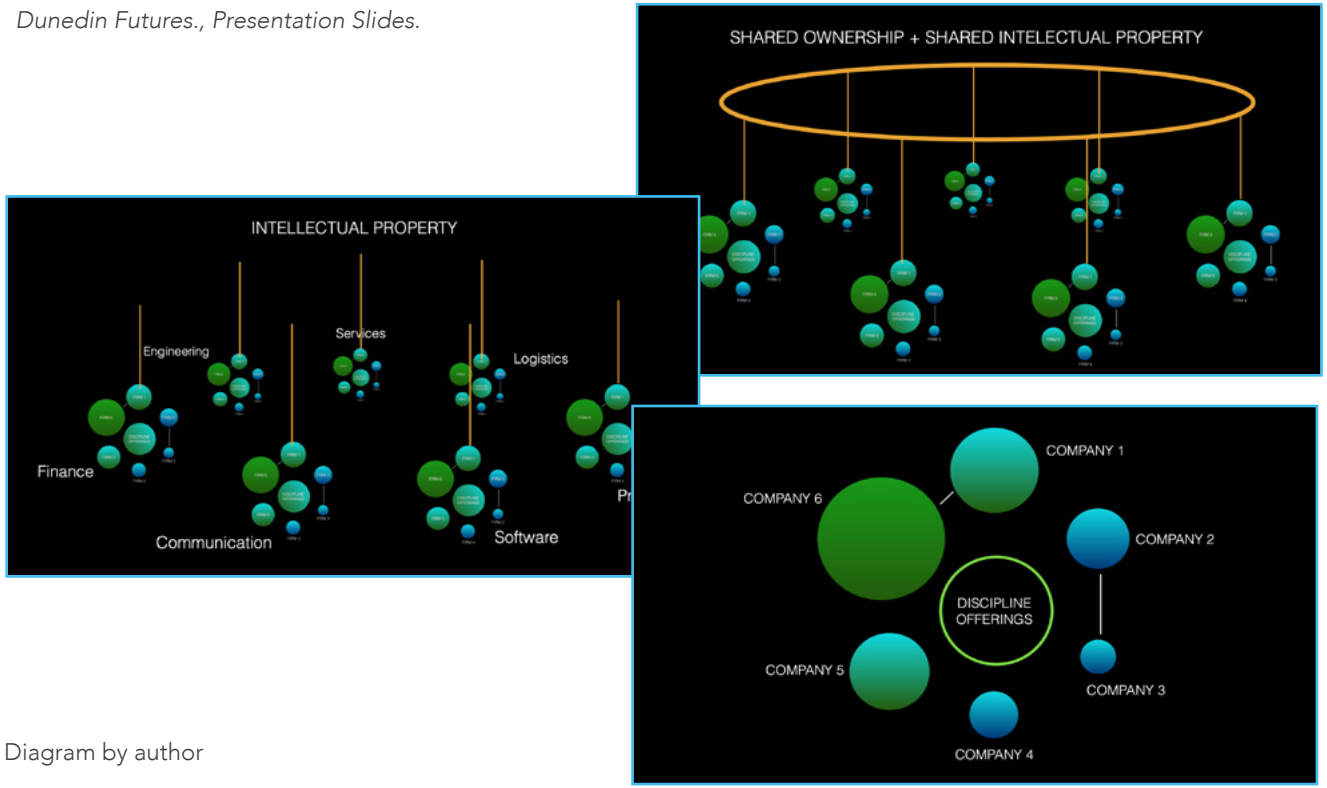


Diagram by author

3.4.1 Summary of the presentation

The presentation planning led to a series of discussions that followed across the following weeks. This included promoting parts of the up coming presentation to the larger community in the Otago Daily Times newspaper. The Dunedin City Council followed up around the initial Bus concept that was the metaphor for the presentation. This was an unexpected outcome of the experiment and was premature so unable to be supported without the following stages of the process being engaged (Bezerra & Owens, 2000). The goal of the delivery was to get the audience to respond with feedback and positively, as detailed below, there were multiple innovations that sprung from this event.

3.4.2 Student Placement

Student Industry placement FARRA

The first "green shoot" was the immediate placement of two undergraduate product design students within Farra Engineering in

Dunedin that led to a new brand being created by December 2020 and full brand launch by February 2021. This brand created a range of outdoor fire products and interior lamp designs that Farra owned under the brand name Janet Joseph. This shoot continued to grow and by August 2021 it has led to an Otago Polytechnic / Client co-design project where year 2 product design students are now developing ideas for the brand for further interior design applications. This shoot organically grew across the following 16 months then slowed due to a lack of ongoing support for additional risks needed to be taken by the design innovators.

3.4.3 Transport discussion

Local Govt enquiry

The second "green shoot" was with the Dunedin City Council. The design futures event pitched an electric bus concept that theoretically could have been locally produced. The hybrid opportunity generated some meetings in the months that followed and the initial generation of a business case for government funding and project team formation is still ongoing. Additionally, this shoot grew into a 3rd year Semester 1 client project in 2021. The project brief was a blue-sky brief formulated by the DCC and led by city planner Glen Hazelton who looked at behaviour, use, ideas and integration of various transport ideas for the DCC for the future. This project generated two design reports and offered a series of possible roadmaps for engagement and change around parking, public transport, personal transport and social behaviour. These are now with the DCC for further consideration, hopefully as a guiding document.

3.4.4 Co-create innovation

Research futures

The third "green shoot" was a new engagement with the University of Otago research and enterprise office. This was led by Nathan Berg, Chair of Entrepreneurship, and a direct result of his support in new ways to further innovation and knowledge. In August 2021 Otago University agreed to explore and allow for a new bridge to be created outside of their control where "old ideas" that had failed to be successfully commercialised be allowed to develop externally from outside of their direct control. This is a similar model to Massachusetts Institute of Technology MIT. in the USA.

3.5 Case study 5

SouthMED Suzy Hood

In 2020 a worldwide COVID-19 outbreak saw New Zealand plunged into a level 4 lockdown to try and stop the spread of the disease. Within 24 hours of the lockdown a team of design and medical specialists from throughout Dunedin was formed and proceeded to work 24 hours a day to produce a ventilator hood to contain and treat a patient with COVID-19.

Prior to COVID-19, ventilator hoods were not stocked in New Zealand and were one of the first PPE items globally to be frozen for export and sale outside of the countries of manufacture. Unlike other treatment regimens, the hoods offered staff and patients within the hospital protection from the disease as the patient's air is managed and filtered within the hood itself.

The Otago Polytechnic EPICentre was used as the development base for the first 2 months of the project and a large multidisciplinary team was formed including myself and William Early from Otago Polytechnic, former Scott Technology CEO Chris Hopkins, mechanical engineers Mark Seaton and Richard Aimers, Dr Alistair Carr and Dr Michael Leaper as well as several other design and industry specialists.

The formation of SouthMED followed the development stages of the Suzy hood which has seen additional improvements across the past several months to meet international regulations and compliance standards.

The rapid formation of the team, the immediate use of the OP facilities and the ability for ongoing support for this project is a credit to the excellent structure and procedures of the Otago Polytechnic leadership team. Also critical to the success of this project were the intellectual property policies at Otago Polytechnic that allowed for open sharing and

co-design across research and industry fields.

NZ SouthMED Suzy hood - Covid 19 2020
The creation of the SouthMED Suzy hood April 2020 was unique as it happened in the midst of a global pandemic, with limited access to materials.

Design considerations had to be given to:
- Local production
- Use of manual or simplified manufacturing techniques and materials
- Designing for integration with off shelf components (non-proprietary)
- Rapid deployment, (to be first to market)
- Sharing of manufacturing resources
- Non-contractural open discussions with suppliers and distributors. (co-design)
- Open access to workplaces - due to disruption in programmed deliveries. (co-creation)

During the month of April 2020 there were innovations around airways, treatments, ventilators, eye protections and masks that used international R&D teams that in many instances had never developed medical goods to generate new solutions in a little as 14 days from inception.

This period of medical device manufacture also generated a raft of new protocols and procedures that allowed for the manufacture and distribution of devices designed within the COVID-19 pandemic as RP "XXX" (Rapid Prototyped - XXX) coded medical devices. The Suzy oxygen hood fitted into this category but when the lock down levels changed from level 4 to level 3 the product was then bound by preexisting structures of business, patents and protocols delaying the release to the commercial market by 12 months.

The Suzy Hood has been selling in South Africa since late 2021 due to the lack of legislative and legal requirements within this market. Therefore, by definition, this society allows for innovation to enhance the health and wellbeing of its people.

SouthMED project:
This project was a live case study demonstrating action research. The design process was rapid and some critical innovation frameworks were agreed upon early in the process that allowed for very rapid deployment, validation and testing to proceed.

We had to establish if the design could be validated within a very short period. Any design directions that required material production calculations often were shelved in preference to testable outcomes even if the outcome was less efficient, that is required more assembly time due to simplification of tooling, which often leading to multiple parts. Whereas the normal process would be to minimise parts and integrate design requirements in parts for production efficiency.

The critical discussion that led to the successful deployment and navigation of the Suzy hood project was early on around ownership and contribution. This was a very honest and frank round table discussion where all parties agreed on why they were involved and agreed on the common goal that society needed a solution and that we could help. This discussion also saw the immediate agreement on what time is worth should the company ever make a profit and if so that it would be required to pay us to work. Shared ownership was also discussed to ensure all parties had an equal contribution and share of what was being formed.

This motivation was shared with the entire SouthMED team and has created a unique working relationship where there are no salaries on offer, but a collective agreement that the various parties who have carried the teams ideas forward will be paid when possible following the lock down, as would the design team, when our contribution can be covered.

Figure 13

Chapter 3 Explore Concepts
Frame solutions map

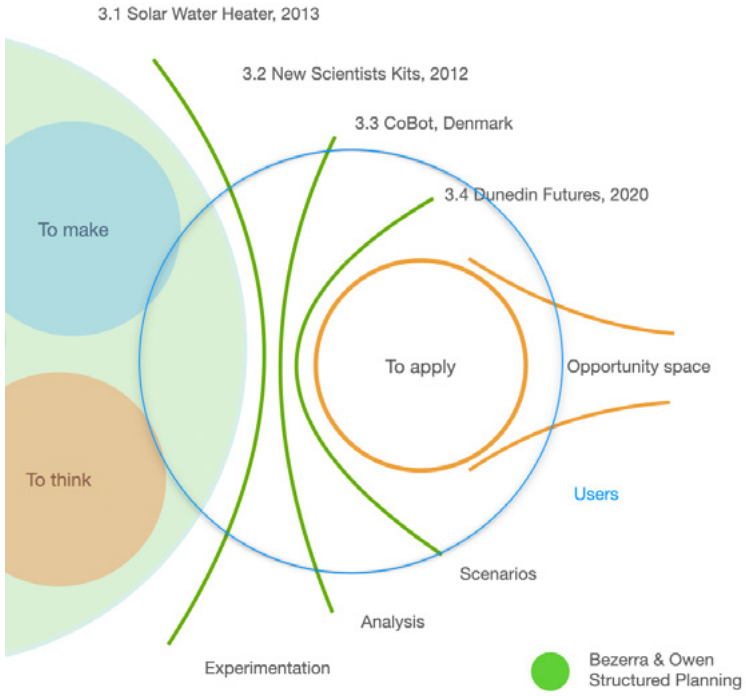


Diagram by author

3.6 Chapter 3 summary

Reframing

In this chapter I looked at experiments where innovation, business engagement and academia were reframed to allow for new outcomes and new ways of working to be explored. The opportunity space that was created from this process analysed how users interacted with the ideas studied and is where the next innovation lay (Fig 13).

There was a common failure within the innovation outcomes from my experiments including the 2020 "Design Futures" social experiment. All of the projects required me as the innovator, to lead the ideas and to also be in a lead role to allow for the ideas to grow and foster new innovations beyond initial discussions and directions. Without a knowledgeable innovation leader across all stages of development, possible opportunities were lost.

Reflecting on the Takarangi–Māori double spiral of creation in chapter 1, there was a critical value missing in my experiments (Tapsell & Woods, 2010). This was the space for the leader, in this case me as the design practitioner, to be coaching my successor while leading. Within the "Marae" however, all members have this cultural experience of the elder delivering knowledge and also training their successor. This allows for the continuation of experimentation and knowledge of the past to be balanced and inform the future.

Therefore, one conclusion to draw, is that for innovation to be successful it is critical the leadership includes the appointment of a deputy in training to ensure continuity and retention of knowledge. This concept within business is less common than within the practice of education, where in job training, support and promotion is supported across the academia. However, the financial limitations of a private company would make it difficult justifing two senior leaders in such roles and hard for many investors to accept, but without this succession plan there are huge risks that institutional wisdom could be lost and possibly business continuity to fail as leader exit.

It is possible this limited resource could be another reason why many companies fail to sucessfully transition leadership, especially within New Zealand and Australia, and that in turn affects regional knowledge and national capacity for growth. This is often the case with privately owned firms often with a niche offering, that close as the founder retires.

Given business has limitations to resources and time and in particular a clear path allowing industry to bridge into academia, it would be advantageous to change the way knowledge is shared allowing both to strengthen each other and in turn society. This is where the Odense Cobot is succeeding as it feeds the risks and exploration into new ideas into academia and also shares current practice and industry knowledge with the universities so their research is informed.

When working professionally in Asia, I noted there were many senior roles that had deputy positions from mid to senior management. I was unaware as a practitioner of design at the time that this was an environment of sustained innovation and that the shared leadership offered this senior position training. In my senior design role in Australia in 2006, this too was evident with the then CEO being mentored by his retired father with the knowledge and experience of his past experimentation and network relationships to grow on.

While working with the SouthMED team developing the Suzy Hood I started to document the operational way that the information flow started to default into a standard business paradigm with the deferral and expectation for specific self-appointed members to carry on the array of tasks and be supported on request, very similar to that of the usual operational business structure we're familiar with. On reflection, I repeatedly saw the innovation within the project leap as the leadership changed over several months. This is part of the cyclic nature of design, but I believe it is critical for the leadership role to change in a regular fashion to ensure the team stays fit. An apt analogy for this process is a team of road cyclists where the leader breaks away after a couple of minutes breaking the headwind and is then carried by the team as they recharge.

Realise Offerings

_Kumar, 2013

4.0 Synthesis and Integrated Innovation Framework.

4

This chapter builds on my primary design principle of ensuring the user is at the center of the design task. The human centred design (HCD) references introduced in chapter 1 and chapter 2 and my learning from the case studies in chapter 3 have given me a greater understanding of how to manage the opportunity space for innovation and proficiently transfer knowledge to new users allowing for innovation to be sustained.

In this chapter I explore how to leverage my practice of Kumar's Design Innovation Process (Kumar, 2013), (Fig 18). I consider Kumar's framework to be an exemplar business and communication tool that extracts value from the design framework, however it only creates a single product or service outcome for the business it is applied to. By adding research from the design theorist Richard Buchannan, looking specifically at the "4 Orders of Design" (Buchanan, 2018), I have generated a new Interrelated Innovation Framework (IFF) for my own practice that I cover in chapter 4 (Fig 19).

Buchanan states "a principle is an idea or value that gives unity to an enterprise, a system, a product and a human experience" (Buchanan, 2018). It is the application of this principle within my IIF that is the second guiding principle for my practice. This is the critical requirement for social innovation to includes users within the innovation process.

4.1 Seven modes of the design innovation process.

Vijay Kumar, 2013

Kumars' framework the "Design Innovation Process", profiles seven thinking modes in its configuration (Fig 19).

Mode 1: Sense Intent

In this mode you study trends that can affect the topic area. You look at changes in business, technology, society, culture and policies. You look at the latest news articles and what effect these may have. This research offers a way to reframe the initial problem and look for new innovation opportunities. It helps us think of an initial intent about where we should be moving (Kumar, 2013).

Mode 2: Know context

In this mode you study the context, the circumstances or events that affect the environment in which the innovation offerings (products, services, experiences, brands etc.) exist or could exist. You focus on offerings that are similar to the idea and see how they perform and their evolving strategies. You look for policies and regulations that could effect the innovation. Broadly, in this mode, you pay attention to what is transforming the innovation context including society, environment, industry, technology, business, culture, politics, and economics (Kumar, 2013).

Mode 3: Know People

In this mode your goal is to understand people (end-users and other stakeholders) and their interactions with everything during their daily lives. The goal is to explore a person's unmet or unspoken needs. An "insight" here is defined as an interesting learning that emerges out of observing people's actual behaviour. Insight is an interpretation of what is observed, and is often the result of asking the question "why?" (Kumar,2013).

Mode 4: Frame Insights

After conducting research, the next step is to bring structure to what has been found and learned from the previous modes. The goal is look for important patterns to identify untapped market opportunities or niches. Many methods are used in this mode to gain multiple perspectives. Guidelines or principles that are generated in this mode help us move to the modes for exploring concepts and framing solutions (Kumar, 2013).

Mode 5: Explore concepts

In this mode you undertake structured brainstorming to identify opportunities and explore new concepts. You use the insights and principles framed in mode 4 as the starting place to generate concepts. Team members build on each other's concepts while carefully postponing critical evaluation. Further, by basing your concepts on the results from previous modes, you ensure that the concepts are defensible and grounded in reality. Mode 5 is also where you construct rough prototypes, either to focus team discussions or to get early user or client feedback (Kumar, 2013).

Mode 6: Frame Solutions

In this mode, you build on the large set of concepts that have been developed earlier by combining them to form systems of concepts, named "Solutions". You evaluate concepts and identify the ones that bring the most value to stakeholders (primarily users and businesses). You ensure that the concepts and solutions are organized into useful categories and hierarchies. You iteratively prototype solutions, and test them in reality. In this mode descriptions of solutions are turned into depictions to give the team, the users and the client(s) a visceral sense of "what could be" (Kumar, 2013).

Mode 7: Realise Offerings

Once potential solutions are framed and prototypes tested, they need to be evaluated to move to implementation. In this mode, you ensure that the solutions are purposefully built around people's experiences and can provide real value. It is also important to make sure these solutions add economic value for the organizations producing them. Once you establish high-value solutions a business case is prepared for prompting further action with clearly defined and specific initiatives the organization will follow to facilitate implementation.

This framework is a merger of other frameworks that I have studied and used over the past 15 years as a design practitioner so as a reference it aligns well with my methodology. I resonate with this framework against my own principles as it has a design intent at its centre and focuses on knowing people and establishing context as

part of the design process.

Kumar's framework does not require a designer to run through its modes numerically. As with other HCD frameworks, only through research of a user and the contextual relationship between them, their environment and their intentions can any clear need and value be defined. Once this is defined then the design intent can be formed. For this reason I often start at mode 3 in my process, to learn about the person and then mode 2, their context. The order of the modes changes in my process depending on the project.

Kumar's framework includes well documented summaries of "mindsets" the designer can use to explore each mode. These mindsets offer prompts and perspectives to ensure the scope of thinking stays broad across the seven modes. In the past several years I have used this framework within my design teaching and also within industry as a practitioner, actively reflecting on the mode in which a particular conversation sits and therefore what mode the next question could sit within to advance the discussion, assist in analysis of the idea or define the solution.

As previously stated, Kumar's framework is excellent in producing a single product or service outcome and is used for businesses to extract value from the process. Therefore, the innovation is the outcome. This is where the framework is limited in my view as it does not allow the user to be part of the innovation process or continue it beyond the solution.

Figure 19

Design Innovation Process.

Image Redacted.

Page 8

https://www.researchgate.net/publication/328861557_101_Design_Methods

4.2 Interrelated Innovation Framework

Andrew Wallace 2022

The Interrelated Innovation Framework is one of the outcomes of my study. This framework allows me to manage complex projects from two modes concurently even when they sit in two different systems. As shown in Fig 20, one system is industry and the other is academia.

After reviewing the success of Cobot in Demark (Chapter 3), it was clear that interrelating these two systems is key to sustaining innovation.

As a dual practitioner I have always been aware how valuable it would be to link these two systems so they inform each other. But as I read "4 Orders of Design" (Buchanan, 2018), I realised these layers have threads of knowledge between them where innovation can lie. Moreover these threads can move beyond product and systems solutions and can include people to sustain innovation within the design process.

Innovation Threads

One insight I gained from the analysis of the Design Futures event (3.4 Dunedin Futures Event), was how crucial it would be to plan possible scenarios that often offer a product, a service and/or a social thread within my process. My process therefore, involves creating additional threads from the core design idea that could allow an additional idea to develop in the future, separate from the initial focus or outcome. I consider these threads are flexible and can stretch allowing for fluid movement between and through each system. For example I could develop a work station with a factory worker who is fixed within industry at mode 3, but the mode of study for an ergonomic workstation design would allow me to move from mode 5 synthesis to mode 7 realisation (Fig, 20).

Interstitial opportunity space

The interstitial or inbetween space provides the environment for the innovation threads to flow and connect. By having concurrent threads within this interstitial space, learning can be accelerated and transferred during the development of each project. This is in stark contrast to linear or cyclic design processes (Pagaro, 2002) where learning can only be applied after completion and reflection of the past task.

One critical requirement of the IIF is that it has this space inside the design process to pause and investigate along the journey. In Māori, distance and time have the same word, wā. It is wā that allows for the threads of innovation to move freely between various modes. It allows for additional ideas to be coded and left within the space for future design projects. It also allows for more discussion with others as the design process has increased space for knowledge to be gained and shared.

Hybrid connections

Hybrid connections for new innovations exist during the design process of moving threads from one mode to another. The threads of any project may cross another and it is at this time multiple values and ideas can be explored. These hybrid connections do not stop the project running and ensures both academic and industry values gain their required outcome but the additional innovation could be radical, disruptive and transformative.

Knowledge transfer

The interstitial space between the systems allows for engagement with others. This is where users are added to the design process allowing for clarification and validation along their path. A good metaphor for this knowldge transfer is that of a bridge. This bridge can be put in place by the designer and allows the users of each system to connect and communicate to each other.

Within a New Zealand context we have gate keepers of knowledge transfer. These are normally lawyers and financiers, as covered in 1.7 Culture, Education and Society. We need a framework that can allow the exchange of knowledge to pass through these gate keepers and their silos of knowledge (Saul, 2012).
I believe the IIF can achieve the goal of social innovation by enabling systems to work more effectively, efficiently and more meaningfully with each other.

> "Innovation within a system may be to break down silos of communication and create transparency to allow others to see the patterns and exchange ideas".
>
> _John Randal Saul. 2012

Figure 20

Interrelated Innovation Framework.

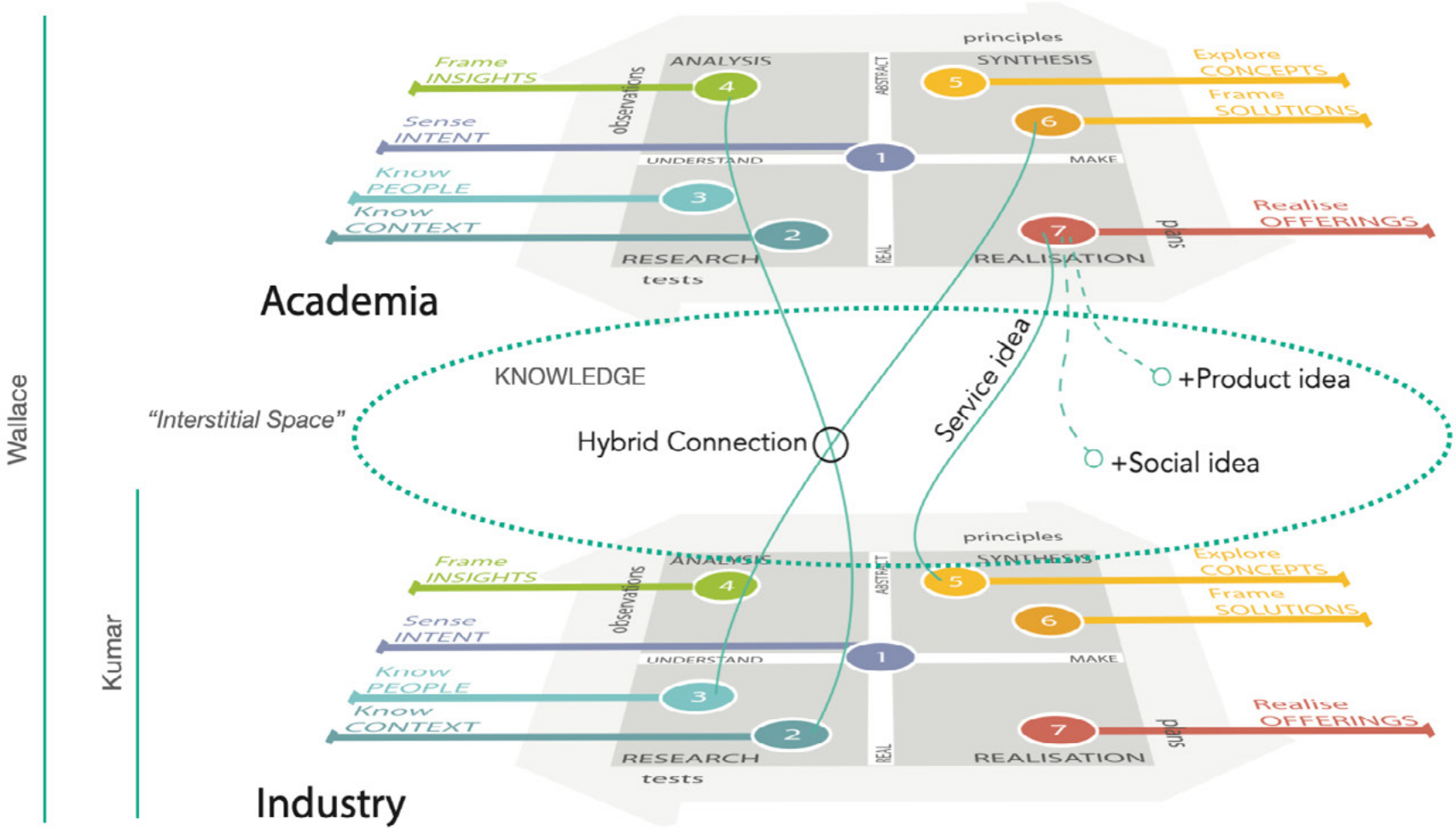


Diagram by author

4.3 Innovation Futures.

Following the Dunedin Futures event (3.4 Dunedin Futures Event), there has been three years of innovation discussions between Otago businesses, Otago University and Otago Polytechnic. The Dunedin Futures innovation map (Fig 21) illustrates the pathways discussions took and the key projects involved. The orange innovation threads highlight initial discussions. The teal threads were subsequent product or service outcomes that followed. The blue thread is my knowledge gained from the event either from reflection or from direct conversation with the various parties involved.

Figure 21

Dunedin Futures Innovation Map.

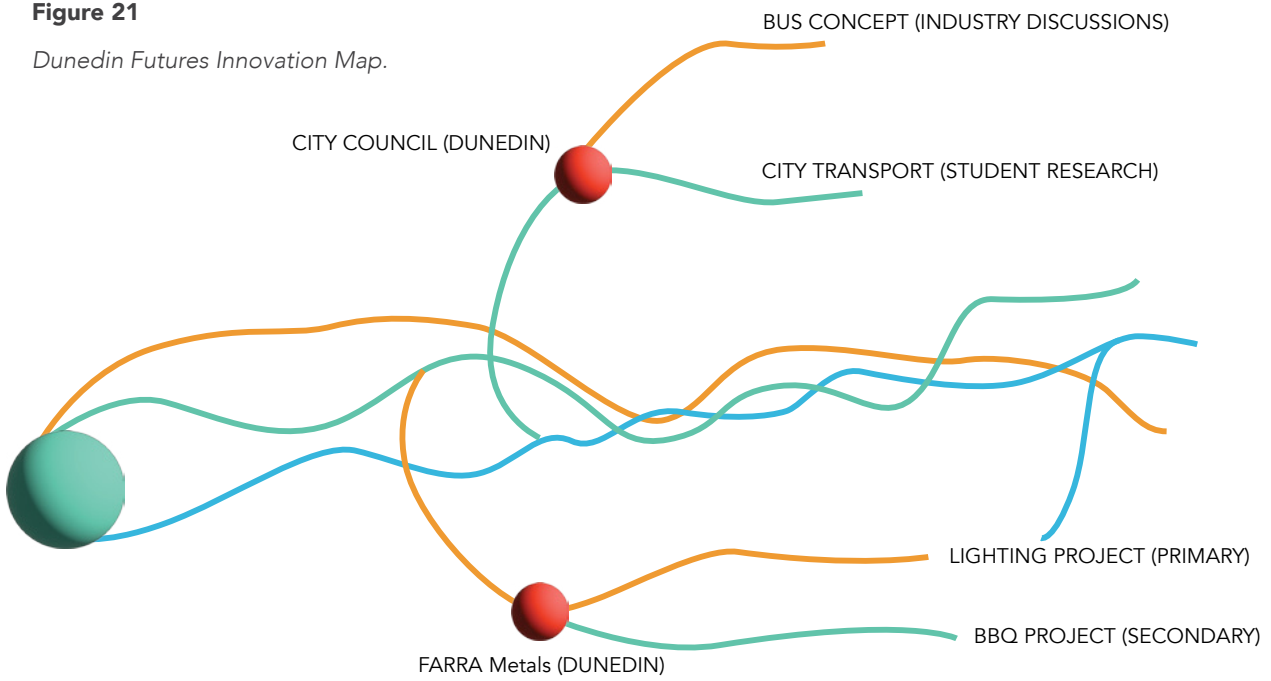


Diagram by author

4.4 Farra Metals - project

Mode 2 & 3

Farra engineering is the largest production facility specialising in metal fabrication in Dunedin. Farra was one of the initial firms in Dunedin that I pitched the Dunedin Futures event to in mid 2020. Primarily my discussions were to first learn about their company, their issues as well as their values and desires. This allowed me to formulate the design intent of the event and also consider how to communicate the ideas of a city-wide innovation opportunity.

I repeated this approach several times with other industries across Dunedin including freight firms, the ICT sector, design agencies and legal and accounting firms.

Following the pitch, they were the first firm to engage and following the event there was an offer to take on two polytechnic students for paid internships across Christmas 2020. At the time, both these students were second year product design undergraduates.

4.4.1 Farra Project Mode 4, 5 & 6

The intention of the student placement was to allow them free reign to explore what projects Farra could consider in the future outside their current business model. Unfortunately, without a senior mentor skilled in managing innovation (1.6 Innovation from a bicultural perspective in Aotearoa) allowing the innovative ideas to be supported, these ideas quickly dissolved and the working relationship was minimised to a design contract relationship where new ideas remained the domain of the marketing manager and C.E.O only.

4.4.2 Farra Project Mode 7

The brand Janet Joseph owned by Farra Metals, was formed from the students work. The brand was an idea within the Farra management team but had never had the dedicated skills and time to allow it to grow.

Janet Joseph is continuing to grow but the profitability and scale of this entity is minimal compared the capacity that was on offer should these enterprising students have been allowed to take the risks they proposed.

4.4.3 Farra Project Mode 2 & 3

This future iteration and learning opportunity for all involved was lost following the students needing to resign from their roles to continue their final undergraduate year on self-directed projects. The opportunity for Farra could have been for them to sponsor and support the learning as well as co-create and develop the ideas across this year. One scenario I had planned across the internship role was that Farra could have had a full design service offering within its services by 2022. This also had no traction as the relationship from Farra's perspective was purely extraction from the primary work done with no cultural change considered or even explored as a way to generate a sustainable business. On reflection I needed to have actively mentored Farra in a consultant role to have allowed this learning opportunity to be innovative.

4.5 Dunedin City Council

Bus concept

This project opportunity followed closely behind the Farra engineering project. I hadn't interacted with the Dunedin City Council (DCC) prior to the Design Futures event but at the event I pitched images of an electric bus I had designed as a metaphor for what the city could make together. The following Otago Daily Times story grabbed the attention of the DCC who were greatly interested in the electric bus itself. This engagement quickly dissolved however as the council is not in the business of making transport vehicles and could not commit to purchasing goods or services without validating compliance and having a set cost structure. In addition, the key industry resources and funding required to manufacture a vehicle in 2020 was not yet set up.

4.6 Dunedin City Council

Transport concept

This second project opportunity came to Otago Polytechnic in 2021 and was led by Glen Hazelton on his return to the DCC as the city planner. He had been handed the past project notes from the initial exploration into the electric bus. He immediately took the opportunity to explore and innovate with the students without a project brief issued by the DCC. This was an extremely rewarding outcome as Glen is a designer in his own right and fitted into the studio for a co-design experience with the students at a time when I could also offer support. The project outcomes were concept visualisations only, so stayed within the Mindset of 2 Knowing Context, 3 Knowing People and 4 Framing insights.

Reflection

People work around problems based on their own experiences. As designers, our experiences include absorbing others methods and practices. This means when we look at the world, we can generate scenarios based on various perspectives and therefore experiences even though these may not be directly experienced, more like mental role play.

The Design Futures event and case study is an example of a focused design outcome that has the potential to lead to growth of knowledge, networks and income within the Dunedin region and shows the value of having multiple parties at the start of a project. Following the Dunedin Futures presentation, I realised how to achieve a reframing of the association between Academia and Industry (5.2 Innovation within Tertiary Education).

This is where I reviewed the culture around the Massachusetts Institute of Technology (MIT.) as it is possibly the global leader for open industry networking with academia, as

they proactively engage in the fluid use of knowledge which in turn fosters innovation.

To visualise the relationship of knowledge more easily it is critical to consider academia sits in two separate bodies. Within the context of tertary study New Zealand education this is differentiated often as trade and degree programmes, which is where there is a further loss of intellectual capital as the insights from practice are not informing the the critical areas of research.

Application of the IIF. applied to New Zealand tertiary sector and industry is presented in (5.2.1).

"A principle is an idea or value that gives unity to an enterprise, a system, a product and a human experience".

_Buchanan, 2019

4.8 Chapter four summary

Within this chapter I explored the design frameworks of Vijay Kumar, Design Innovation Framework and explored references from Richard Buchanan's, 4 Orders of Design. These two frameworks strongly influenced the generation of the Interrelated Innovation Framework, my own framework that expands the space between systems of industry and acidemia. In the IIF. I explore hybrid connections that create innovation. These connections are discussed in (2.5 4 Orders of Design), whereby Buchanan profiles,"innovation arises when two stories come together that create a spark that crosses between them leading to a possible connection".

This study that is created in the IIF. (Fig 20) allowing for users to be part of the design process. I propose it can create virtual bridges for knowledge to transfer from one system to another, ensuring sustainability of innovation as the knowledge discussions initiated by designers of the bridges to allow these threads and pathways to be shared with users to empower them and allow them to continue the innovation beyond the original idea and relationship.

The IIF allows for a deeper exploration of ideas from different modes of thinking (Kumar, 2013) and the opportunity to explore ideas beyond the core brief or project task. In this chapter I explored the case study (4.3 Innovation Futures) and mapped the resulting project innovations threads that lead from this (Fig 21). The several innovation threads that were generated from this event have already created some solutions and will allow for future innovations to follow, possibly by others also.

Sense Intent

_Kumar, 2013

5.0 Reframing futures

5

It is time for New Zealand to embrace innovation and change the way we as a society view innovative thinking so we can benefit from radical as well as the incremental changes that innovative thinking can offer, especially in new ways to share knowledge and work together.

New Zealand has followed the pattern of many developed countries where the risk associated with innovation and the heavy reliance on legal engagement for contractual deliveries is stifling innovation (Ridley, 2020).

Innovation is a daily outcome of small businesses within New Zealand but is currently unable to be directly supported by the tertiary sector as there is limited flexibility around how education and industry can work together.

The opportunities that innovation can offer the government for future earnings is currently untapped with many of the current sectors focusing on shorter term outcomes and incremental changes. This is largely in part to do with cashflow and taxable offsets for research and development. This has allowed private equity and new platforms of collaboration around innovation, but ultimately these are still independent projects not learning from each other, so there is still a role for education and knowledge transfer at the forefront of innovative futures.

In this chapter I propose key opportunities for the IIF. to be applied and scenarios of how to reframe innovation in New Zealand for industry, acidemia and society.

5.1 Government innovation

Application of the IIF. Framework

The New Zealand government has an opportunity to lead change around how New Zealand companies grow ideas and sustain innovation. Primarily this requires grant applications to create a new category allowing for innovative projects to be supported. The current grants require 60% private funding to develop ideas which need to be completed within set timelines, with fixed milestones, evidence and outcomes (IRD, 2023).
These incremental outcomes have limited social, economic or educational impacts, as the knowledge is siloed within each firm and little support is offered to share knowledge or assist beyond the funding by the government or government funded research teams.

This is in direct conflict with the innovative process as it limits the speed of new developments as projects that could be completed quickly are slowed down. For example, a project funded for 3 years, with staged funding for each year has no incentive to be completed sooner as an organisation wants to recieve the full financial support.

A similar short term research mindset drives our universities to slow down research in some cases to generate more Performance-Based Research Fund outputs (PBRF.) from a single body of work, focusing again on outputs not impact as the outputs are the driver of the funding. As outcomes are linked to student study semesters not the outputs capable of a student, often funding opportunities can be missed as students can graduate and leave their course or go on break before a project itself is completed, taking with them project knowledge that may be uncaptured putting a project on pause until they either return from break or another student can continue the project. A staff member leaving or taking a break can also have the same impact. The overall impact is a delay in innovation.

"The NZ Productivity Commission, (2021) did not even refer to the research role in its review. The major research incentive system in the university sector, the PBRF, is built around individuals and bibliometric indices. Yet globally, research performance assessment is rapidly moving away from these two components to look more holistically at impacts by collaborative groups and the behaviour of the institution as a whole" (Gluckman, 2023).

In addition to leading a change in the way innovative thinking is recognised, the government needs a mechanism allowing intellectual property to be managed and held by the government, or to a lesser level, support ownership and have legal advisors that take the risk out of independent teams potentially mismanaging their intellectual property. The current advisory service is little more than a personalised search tool for expensive independent legal discussions that follow.

There is also a functional role the government could play in protecting innovation that would offer scale, networks and intellectual protection at a similar level to innovative teams in Australia, where the The Commonwealth Scientific and Industrial Research Organisation (CSIRO) connects Australian industry with Australian Academia.

New Zealand had this structure in place under The Department of Scientific and Industrial Research (DSIR.) but this was broken into crown research institutes in 1992 and specific sectors were siloed with any knowledge sharing minimised following that. The call to reinstate the DSIR. was made most recently in 2020 by the National Māori Authority Chair, Matthew Tukaki, following a call from the government for support to help rapidly gather knowledge to combat the 2020 Covid-19 virus.

5.2 Innovation within Tertiary Education

Application of the IIF. Framework

"Systems thinking is a great way to analyse a situation, if you want to change the situation you need design thinking" (Buchanan, 2018). I believe this viewpoint can be applied to the tertiary education sector and suggest that research goals, management, funding and investigation that can lead to innovation need to be considered at a system not individual level. The entire PBRF system and the divestment of funds limits co-creation, limits higher risk and longer-term parachutes. As Sir Peter Gluckman says 'we have policy weaknesses in both science and in higher education which are detached from each other'(Gluckman, 2023).

To allow research to lead and offer innovation on a larger scale we need to look at the collective knowledge and methods available nationally at a system level. We should not be limited to a single team or filtered vision of development often disassociated from the environment and people who can enable it.

A short term strategy for innovation to grow in the tertiary sector is for it to be taught by practitioners outside of the design and creative disciplines. This is where Vijay Kumar, Richard

Figure 22

Connecting the MIT. Innovation Ecosystem with The Engine

https://web.mit.edu/ewgreport/ecosystem.html

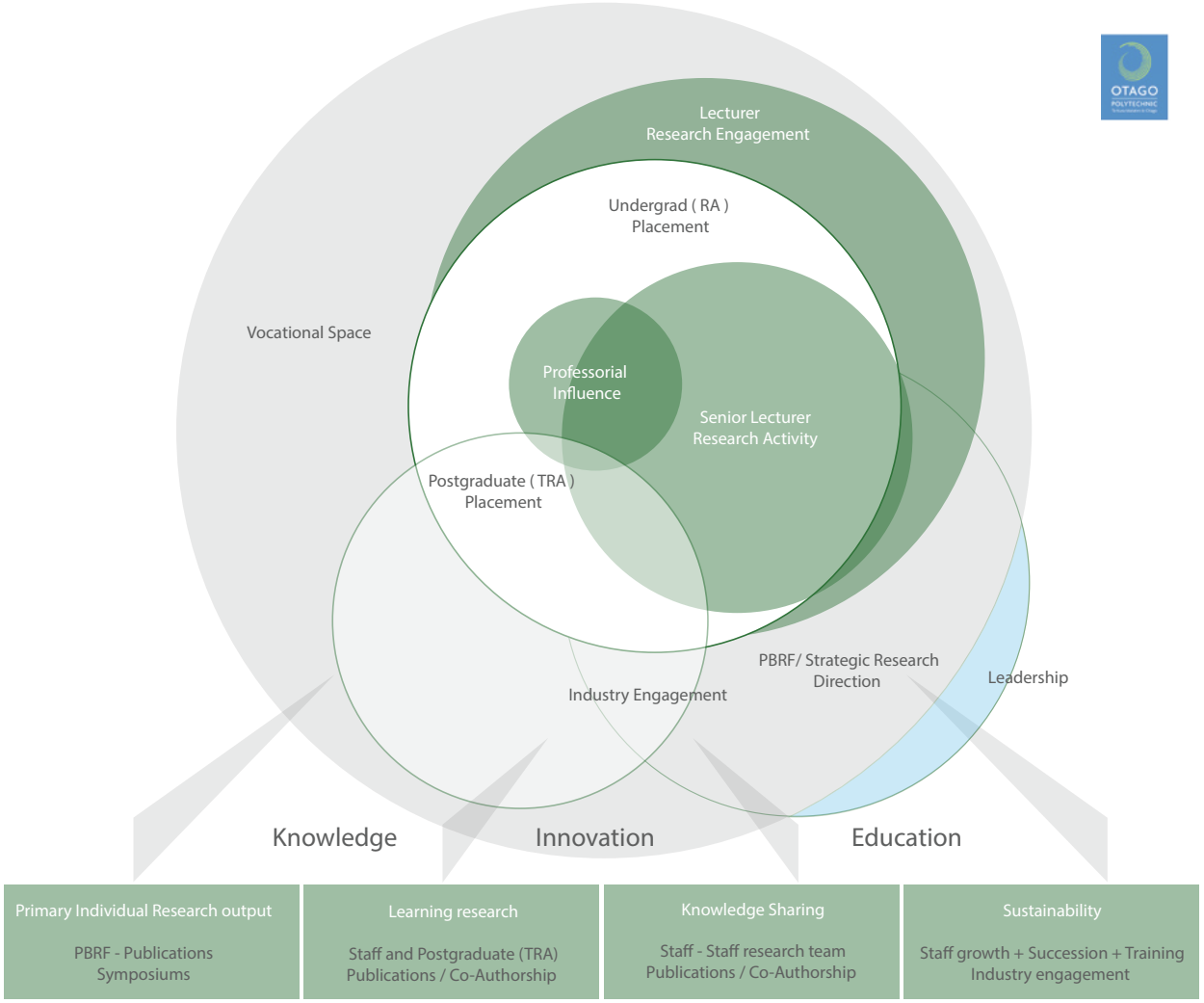
Buchanan and Roberto Verganti contribute to the research environment as they work outside of their industry practice roles teaching in disciplines such as business and health, as well as the broader public service sectors looking at service design in particular.

I have taught in a team that ran design thinking modules (teaching innovation frameworks) across the MBA. programme at the University of Otago for the past several years. This direct involvement as well as mentoring students in the regional Audacious business programme has supported good ideas to become great businesses that are still running today. Yet amongst my colleagues and industry practitioners this role is unique. Instead, it should be expected as it is internationally, such as in Germany where professors are preferred to have industry engagement and act as dual practitioners (Federal Ministry of Education and Research, n.d.).

The approach of having industry and academia sharing knowledge, staff and students in a more fluid space is the core practice of Massachusetts Institute of Technology (MIT.) which has allowed countless new companies and research outcomes to flourish from the ecosystem of design informed practice.

Figure 23

Research Culture Map



5.2.1 IIF. Applied to NZ education

Application

The Research Culture Map (Fig 23) was co-designed by Henk Roodt and Dr. Scott Klenner and is an innovation outcome using my IIF. in practice.

This visualisation was informed by Fig 22 from MIT. and many other conversations over the past year as Te Pūkenga was being formed, an institution created in 2020 by the New Zealand government that gathers all New Zealand Polytechnics, trade schools and apprenticeship programmes together under one amarera (umbrella). The IIF. could facilitate this vision as they are looking to have a learner centred experience where industry and academia can co-create opportunities for learners and sustain a healthy society.

The research culture map (Fig 23) is a valuable reference that is missing within Te Pukenga's change documentation to date. It profiles threads of innovation around service, values, sustainability and succession planning and could allow for growth in knowledge to strengthen our culture as educators and society in the longer term.

The map profiles new relationships of how lecturers could work with each other and students and adds Innovation as one of the 3 pillars alongside Knowledge and Education as being central to learning.

5.3 Innovation within secondary education sector

Application of the IIF. Framework

A longer-term strategy that would directly impact New Zealand society in the next 5-10 years would be the development of a system giving creative thinkers a clear pathway from school to university.

In 1989 Ao Tawhiti Unlimited Discovery was established. This allowed Christchurch secondary school students the option to customise their learning by extending their subject choices beyond the standard New Zealand curriculum. This was a unique and innovative offering that is yet to be developed for students outside of Christchurch. Within this offering there still remains the design challenge of how to assist the non-self-directed learner and how these creative learners would be able to utilise this type of learning environment which in turn could offer them a wealth of value for their learning and wellbeing.

There are many studies that profile innovative thinkers as neurodiverse thinkers and unless they can stay motivated and supported, they often disengage and fail as their thinking process disadvantages them against time based or specific memory-based testing.

There are also creative students that communicate in different ways. More recently there have been increased assessment strategies offered to tertiary learners for Ako Aotearoa, (New Zealand training organisation for tertiary staff development) but there are currently no plans to roll these strategies backwards though the schooling system.

A working party is needed to progress this scheme, allowing innovative thinking to support the learning frameworks that can also add value to these learners.

New ways to assess knowledge is also part of a larger question around the function of testing and how to assess knowledge of a student's learning when today any student can access information instantly via Wikipedia, directly filling the historical IQ "intellectual quotient". Encouraging a new focus on EQ (emotional quotient) and CQ (creative quotient) levels and how they could be explored within the school structure would be greatly beneficial. This would allow schooling more time for ethical discussions and civics education, allowing students opportunities to feel more empowered and connected within their society as opposed to observing the world around them.

5.4 Innovation in New Zealand Business

Application of the IIF. Framework

New Zealand business is innovative and known globally for its agility. Unlike many developed countries, New Zealand does not have a high proportion of large companies over (100+ employees). This is replaced in our market by Small to Medium Enterprise (SME.) firms with less than 20 employees totaling 97% of all

businesses. These smaller firm are limited in cash flow due to the scale of production, stock holding limitations and shipping inefficiencies. The downside of being lean is that it limits the opportunity to strategically invest in the longer term and benefit from the savings gained from higher production runs that international competitors gain.

As we are a business community of SME's, it is time for New Zealand businesses to work together and share in future opportunities. In the past 20 years I have been aware of only one manufacturing cluster working with each other to ensure projects had the skills, resources and cashflow to take on larger projects than they could achieve individually. This cluster totalled 7 engineering and manufacturing firms all based in Auckland and trading internationally as Total Engineering Design. This cluster is no longer trading today. One possible reason for this is that many independent firms are now separately partnering with Asian production houses for outsourced production.

For New Zealand firms to leverage off each other, government support would be required allowing for tax offsets, depreciation and asset sales to be managed inside such clusters. Some employment changes would also be needed giving higher risk ventures the option to offer employment without the longer-term commitments available from stable, incremental ventures. It could be worthwhile exploring the possibility of a new class of contract employment, for example, an innovation contract that could be offered beyond 2 years without having a fixed permanent role allocated by law.
New Zealand business needs to re-embrace design as a value within their practice. The critical design task to achieve this would be to structure an advisory board and ensure the leadership of these programmes are innovative within their management practice. They then need to sustain this innovative leadership to ensure long term value of the programmes, unlike the previous N.Z Better by Design Programme (2004-2011) that didn't survive as leadership and government support faded.

5.5 Innovation in society

Application of the IIF. Framework

New Zealand society needs to be informed of the value of innovation. Dissemination of design thinking, the value of design scenarios and how new ideas can be developed could be a series offered via Radio NZ or TVNZ with the scope to elevate design in the public's eye from that of extraction and production to expansion and generation of new possibilities.
New Zealand as a society limits itself around collaboration as we are a competitive and individualistic culture, often waiting on another party to take the risk rather than actively investing and collaborating. Over the past 30 years, post war businesses in New Zealand have lacked critical investment and collaboration within our primary industries, especially wool and wood management as products are sold in bulk with no value adding processing and finishing. This is in direct contrast to Māori business that across the same time has expanded (1.6 Innovation from a bicultural perspective in Aotearoa).

As detailed, the role of the "Design Innovator" would have allowed for significant innovation in the case of the Farra Metals Project (Chapter 4.3), where I identified the loss of innovation due to a cultural understanding of innovation being extractive not additive.

Integration "Fourth Order Design"is a design framework that can offer new positive future for all New Zealand if embraced (Buchanan, 2020). As discussed, these innovative tasks need to be performed by designers and their roles need to continue while the ideas are developed and refined, co-designed, within the team while the ability to spot future trends and new opportunities is also maintained.

Realistically New Zealand business and academia need to embrace innovative processes as a design task to improve society. These tasks need to be led by designers to allow for a sustained and also rewarding society to prosper.

The experiments in Chapter 3 and continued learning reflected across Chapter 4 are

evidence that design thinking and design opportunities can be communicated to the broader untrained community quickly but that without appropriate financial and governmental support, these innovations can lose momentum quickly (3.8 SouthMED).

5.6 Global Innovation

Network futures.

Internationally, there are new networks opening up allowing innovation to run across borders and outside of government or traditional financial support structures. This is the next evolution from the open-source movement and possibly the most sustainable opportunity enabling innovative projects to access and attract investment and the support to aid radical and significant growth.

There is currently an innovative online problem sharing platform Wazoku.com where individuals, companies and organisations are placing problems and in the same space there are crowd-sourced solutions and funding to support the innovations. Today the space has funded $20M USD of projects with 400,000 contributors from 190 countries (Wazoku, 2022).

This network can benefit individual firms but moves away from a collaborative opportunity as the funds are allocated before the project starts and effectively then locked to the project not allowing future input from new sources of knowledge.

5.7 Global Knowledge Sharing

Barefoot college.

Bunker Roy is an educator who founded the Barefoot college in India in 1972. His innovative philosophy has led to the electrification of countless villages across the world as he looked at the best ways to communicate and change patterns of behaviour in low-income societies. His philosophy serves to empower women and allow their enterprise to bring light to small rural communities. The social impact is huge as it reduces family power costs, allows children to learn at night away from dangerous kerosine and fire lamps and uses education to break the poverty cycle. I hold these design principles, designing for the people, in high regard. To date, the Barefoot College has allowed more than 3 million people to be trained around the world. The are trained as solar engineers, teachers, midwives, weavers, architects, and doctors. The women who are educated through the colleges come from India, Africa and Asia, most with little common language yet they learn, teach and take their knowledge back to their villages and in turn train others how to help society.

(The Dali Lama, 2011) once said to Bunker Roy "now that you have proved the Barefoot college works in practice, lets see if the researchers and universities can make it work in theory."

This is something that academics need to be critical of in their own practice. Change does not have to be led by academics or industry; it can be led by people.

One of my future social pathways will involve supporting the Barefoot college programmes, not necessarily as a teacher but as a developer of new learning tools.

> "Now that you have proved the Barefoot college works in practice, lets see if the researchers and universities can make it work in theory"
>
> _The Dali Lama, Sited in Bunker Roy, 32 minutes, 2011.

"A principle is an idea or value that gives unity to an enterprise, a system, a product and a human experience".

_Buchanan, 2019

5.8 Conclusion

Learning futures

In this study I have constructed the argument how best to sustain the culture of innovation within a social structure. This solution has roles for governmental and legal support to allow innovation freedom as part of this environment but ultimately it is a design task that needs to be led and delivered by designers.

I have shown it is possible to create a framework for the design innovator to work within. This Interrelated Innovation Framework (Wallace, 2022) has two systems, Industry and Education, that can generate social innovation outcomes when space is created between of each system.

This study has changed my professional practice as I can now mentally see design tasks with space between them allowing me the freedom to reframe motivations and tease out new possibilities beyond extracting solutions. It also allows me to generate discussions and navigate new innovations with others within the industry and education sectors.

This clarity has allowed me to confidently reallocate my energy into planning longer term knowledge-creating innovations and retreat from the design practice of short-term extractive outcomes both in my own business activity as well as within my teaching practice.

I am now looking to extend my use of the IIF. and look for national collaborations where this could be applied. Within my teaching practice I can see the Interrelated Innovation Framework (IIF.) assisting with teaching students and identifying new opportunities for industry and education to collaborate for social growth. The IIF. will also assist with longer term succession and professional mentorship within my teaching practice. Working with others and for others to sustain innovation.

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