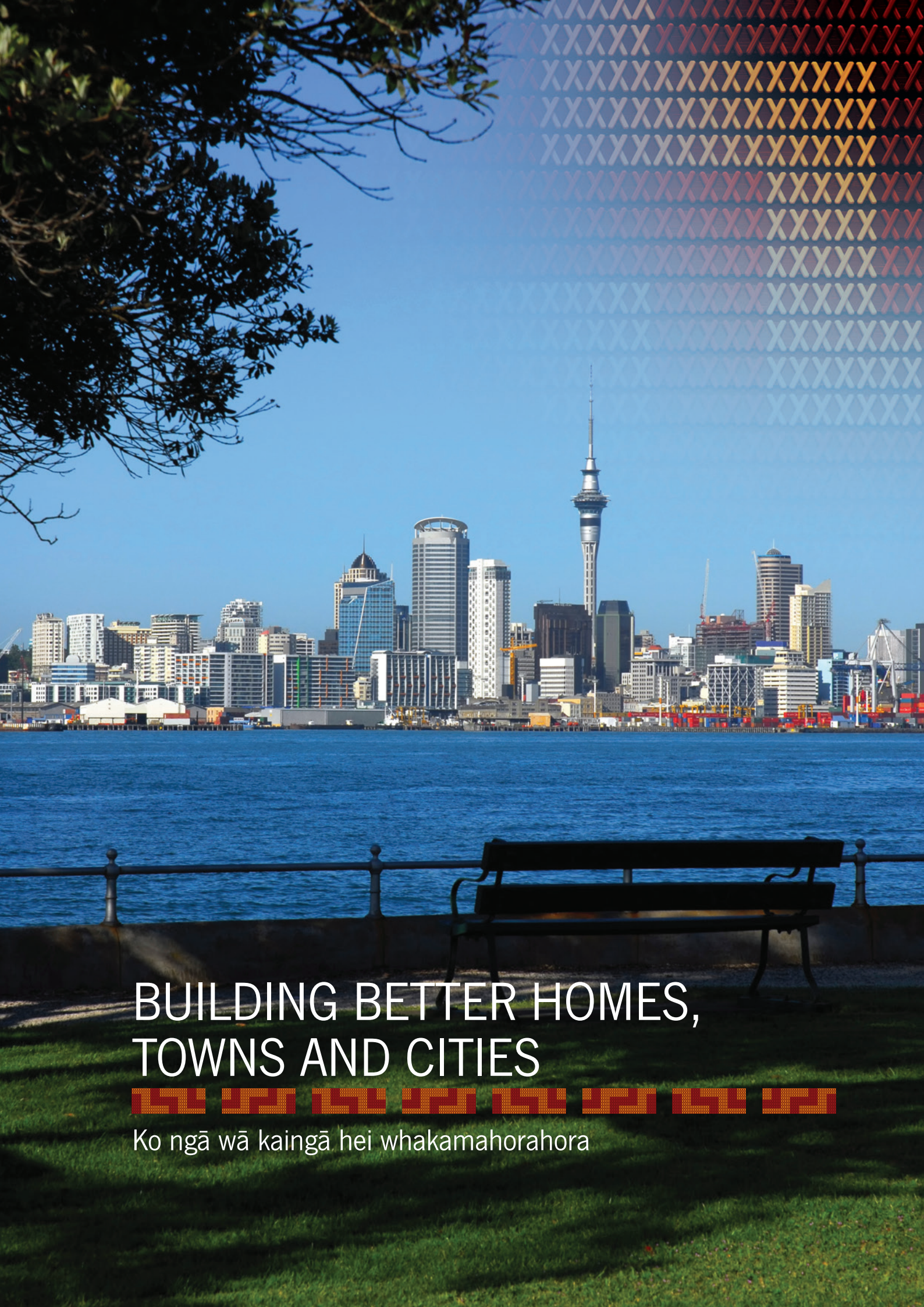

BUILDING BETTER HOMES, TOWNS AND CITIES

Ko ngā wā kaingā hei whakamahorahora

Amohia ake te pou nui, te pou hīhiri, te pou rārama, kia hurihia iho ki rua i te tipua, ki rua i te tawhito. Kia ū, kia tina, kia whena, haere mai te toki, haumi e hui e taiki e!

Patua te pou, tukitukia te pou, whakaraehia ngā pekerangi, ngā tūkupu, ngā tokowaru

o tenei ripoata, o tenei kaupapa.

Kia uea winiwini, kia uea wanawana, haere atu te hau kino, te hau huna, te hau kaitaua,

he toka tūmoana, haere te toki, haumi e ui e Taiki e!

EXECUTIVE SUMMARY

The Building Better Homes, Towns and Cities (BBHTC) Challenge is designed to be a circuit breaker in the New Zealand built environment. It applies a radically different research framework to drive fundamental change in how we create our dwellings, towns and cities. It's vision is *"*Ka ora kāinga rua: Built environments that build communities*".* Many reports have highlighted the underperformance of our built environment and the cost to New Zealand's economy and society. The Challenge aims to deliver solutions to the complex array of interactions which shape this environment and which have proven resistant to change. From the outset, the Challenge research programme has been designed with stakeholders as an exercise in partnership. This commitment to collaboration, co-creation and implementation will ensure that transformation of our built environment can be achieved.

The Challenge is framed by the metaphor of Tane Whakapiripiri ('the trees of Tane bound together'), referring to the wharenui (meeting house) as the gatherer and connector of people. Indigenous Māori communities are integral to the Challenge's research activities and are involved in co-innovation to ensure that solutions deliver communities in which Māori want to live. The principles of Vision Matāuranga underpin all aspects of the Challenge and Mātauranga[a] Māori informs all research. The Challenge will particularly deliver to Hauora/Oranga, ensuring that housing and settlements maximise the health and wellbeing of their inhabitants. It will employ Indigenous Innovation in the co-creation process towards improved communities. A Kāhui Māori will support the researchers to give effect to Vision Mātauranga and guide engagement between researchers and communities of interest involving Māori. Māori researchers and communities are and will be involved in Challenge governance, management, science leadership, research and implementation throughout the life of the Challenge.

New Zealand is home to people from an increasingly diverse range of cultures and backgrounds. Māori and Pacific households are disproportionately impacted by poor housing and infrastructure which does not meet their needs. As a Crown-funded research initiative, the Challenge has focused on Māori, as Treaty partners, in its early development. This focus also reflects the cutting-edge nature of Māori research collaborations within the indigenous research world. As the Challenge proceeds we will build on lessons learnt through research with Māori communities to consider how our homes[b], towns and cities can reflect the needs and identities of all cultures in New Zealand, including Pacific, Asian and other minority communities.

By bringing together the many actors who influence our homes and settlements, this Challenge seeks to break the counter-productive cycles of blame which have hampered the building and planning sector, building consumers (whether householders or landlords), central and local government and communities. The breakdown of trust and loss of faith is manifest in costly litigation, risk averseness and risk shifting, an accumulation of regulation, and a range of costly dispute resolution structures and processes. Ultimately it is evident in a model that is not delivering for New Zealand.

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[a] **Mātauranga** – Knowledge or to be a knowledgable person, a sage, intellect or scholar. Mātauranga Māori is all Māori knowledge that is derived from the source knowledge of Māori with the Māori world view, customs, knowledge transfer processes and approach applied to it.

[b] **Home, house and dwelling** are connected but separate terms. 'Home' is used variously in public discourse to refer to either a place or dwelling to which people are attached and have the experience of 'being at home'. House refers to a particular typology of a dwelling. In New Zealand this refers to semi-detached or detached dwellings and are contrasted to multi-units and apartments. A dwelling is a structure that is for provided for residential use. It includes houses but also multi-units and apartments. They may also accommodate other non-residential uses.

The Challenge cannot alone transform the way that homes, towns and cities are delivered for New Zealand. What it can do, however, is play an important role in providing evidence, tools, new insights and inspiration that can be used by the building sector[c], householders, building owners and communities to take the initiative and change their own environments in a way currently not possible. It provides an opportunity to look beyond a primary reliance on regulation to deliver better outcomes. It is about new solutions, moving beyond re-stating known problems or blaming others.

The Challenge's research platform involves many of the leading researchers from a wealth of New Zealand organisations that are the Challenge partners: BRANZ, Auckland Council, CRESA, GNS, Scion, AUT, Lincoln & Massey University, Universities of Auckland, Canterbury, Otago, Victoria, Waikato, Opus Research and PrefabNZ. Targeted graduate and postdoctoral funding, as well as upskilling of early and mid-career researchers, will raise capabilities in the sector and provide a legacy beyond the life of the Challenge. The participants have a wide range of international connections which will ensure activities remain at the forefront of world leading research.

At a high level the Challenge will be connected with the International Council for Research and Innovation in Building and Construction, the Fraunhofer Institute, the International Energy Agency, the Australian Housing and Urban Research Institute and the Australian CRC for Spatial Information. We are developing partnership arrangements with Ngā Aho – Network of Māori Design Professionals, and Te Matapihi He Tirohanga mō Te Iwi Trust – National Māori Housing Organisation. The Challenge will grow linkages with some of the other Science Challenges, particularly Ageing Well in relation to housing for older people and Resilience to Nature's Challenges regarding hazard-related data and resilience of our houses and settlements.

BRANZ Ltd will be the contract holder for the BBHTC Challenge. An independent Governance Group is being established to oversee the Challenge's strategic direction and support the Director and Science Leadership Team. Dynamism and refresh will be ensured through renewal at the levels of governance, management, evaluation and review, new ideas and 'Challenging the Challenge' colloquia.

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[c] **Building sector** is used to refer to the full range of private/public/community institutions, systems, industries and professions that participate in, regulate, and are integral to settlement systems as well as the supply and quality of housing where Housing and housing stock refers to the stock of dwellings or buildings providing private, residential accommodation either through rental, owner occupation or an intermediate tenure. It includes stock owned privately, housing owned by the state, housing owned by community organisations.

The Building sector includes the building industry where Building industry refers to that part of the building sector concerned with the design and construction of buildings and infrastructure including those involved in the manufacture or distribution of building materials and products) and the professions that support the design and construction of infrastructure, buildings, and dwellings.

The Building sector also includes architects, designers, surveyors and engineers, but also banks, insurers and other financial institutions, and property developers. The building sector involves private sector, public sector, and community organisations. We note in particular, the number of iwi and hapū who aresignificant players within the building sector.

1 OVERVIEW

1.1 Transforming the Sector

This Challenge is designed to be a circuit breaker for the New Zealand built environment, applying a radically different research framework to fundamentally change how we create our dwellings, towns and cities. It is about making a better future possible by raising expectations, and empowering the actors who create and live in the built environment to meet these aspirations.

Current Status – The Problems and the Promise of Getting It Right

The significant difficulties in our built environment regarding housing supply, the quality of housing, and the vulnerabilities and underperformance of New Zealand's urban environments, have been highlighted by a succession of reports, many arising from government inquiries (Productivity Commission, 2012, 2015; MBIE, 2015). If the solutions to problems were self-evident or easy to solve, they would have been implemented. If the evidential base and tools arising from the existing research platform were identifying and driving forward transformational opportunities, there would be no need for this Challenge. However, this is not the case:

- Over a third of New Zealand households are dissatisfied with their dwellings or neighbourhoods (Statistics New Zealand, 2012). The burdens of poor housing and urban residential and commercial environments impact everyone, as market and regulatory incentives discourage the building sector from supplying low-cost dwellings. However, the most vulnerable individuals, families and households are disproportionately affected. These include people with low incomes, families with young children, older people, new settlers, Pacific people and Māori.
- The range of issues evident in the building sector, such as failures in building systems and infrastructure, are symptomatic of deeper issues (Hunn report, 2002). Reporting displays persistent problems in the quality of new builds, retrofits, renovations, maintenance and repair, across a wide range of infrastructure, including dwellings. Cost over-runs are persistently reported and these have a range of spill-over effects. The costs of compensation, managing claims and disputes, and associated litigation are borne not only by the immediate protagonists, but by taxpayers and ratepayers.
- There is profound public anxiety around the future of housing in some of the towns and cities in which we live, fuelled by: over-heated house prices, an expanding intermediate housing market, under-supply of affordable housing, a limited range of dwelling types, poor dwelling performance, neighbourhoods that are poorly connected to transport networks, and costly, attenuated, carbon-hungry urban systems and infrastructure (Productivity Commission, 2012).
- The building industry tends to attract workers with low levels of literacy and skill, who often work in poor conditions with long hours and low pay (Built Environment Skills Strategy, 2015). Like the dairy industry some years ago, the building industry is not seen as a place for energetic young people with aspirations but as one of the least attractive workplaces with high accident rates. It is not seen as a sector in which to gain managerial skills or to bring or access advanced technology. The building sector, and particularly the building industry, tends not to attract women or high achieving tertiary graduates. It is an industry where a cycle of boom and bust, with all the perverse behaviours this leads to, has become an accepted part of business. Understanding how the existing dynamics can be changed and how the industry operates within a complex and changing social and economic environment is crucial if such systemic problems are to be relegated to the past.
- Councils are finding themselves increasingly stymied by significant politicisation and/or litigation when seeking to develop and implement district plans which address issues of intensification, changes in land use, and identifying and/or restricting uses on vulnerable sites. There are also unresolved inefficiencies and misalignments between the processes councils use to manage land use and development and the building regulatory processes (Productivity Commission, 2013 and 2015).

The social, cultural, environmental and economic benefits of a well-functioning housing market and smart and attractive urban environments extend well beyond housing markets themselves (Finance Minister Hon Bill English speech September 2015). They affect the economic performance and living standards that are attainable for all New Zealanders (MBIE 2015). The scale of significant interdependencies between housing and the macro-economy have been revealed in recent years, both in New Zealand and other economies such as the USA, UK and Europe (Zhu, June 2014). These interdependencies are two-way dynamics; macro-stability affects how housing needs are met and developments in housing markets impact on the economy as a whole. Much has been written about the economic benefits of urbanisation and agglomeration economics, and the benefits of well-functioning urban economies. Towns and cities

offer advantages in terms of variety and the sharing of inputs and risks, the matching of buyers and sellers, and from the learning that occurs in larger settlements.

Good homes in good places are the platform for cultural, community and civic participation. Good homes rely on good dwellings. Well-placed and well-performing homes have been demonstrated here and overseas as having a wide range of social and economic benefits. They are crucial to life chances, the care of vulnerable people, the reduction of inequalities, and the ability of people to participate in work and be independent.

A Circuit Breaker

The wide range of interacting industries, systems and institutions which shape the New Zealand built environment means that the sector's supply, quality and underperformance issues will not be resolved through incremental change in current practices. Indeed, a combination recognised socio-demographic trends e.g. ageing population, and natural hazard events and threats e.g. Canterbury earthquakes, suggest that 'business as usual' will not even maintain the status quo. The combination of systemic, economic and natural characteristics places considerable stress on the housing stock and urban infrastructure.

By bringing together the many actors who influence our homes and settlements, this Challenge seeks to break the counter-productive cycles of blame which have hampered the building and planning sector, building consumers (whether householders or landlords), central and local government and communities. These cycles of blame are associated with many issues including leaky building syndrome, productivity in the building industry, poor design and low innovation, perceptions of a poorly skilled workforce, dissatisfaction with building work, difficulties with insurance, difficulties coordinating multiple processes administered by different organisations such as the Māori Land Court and local government, preventable building failure under severe conditions and subsequent poor remediation and repair, and contractual failures and payments. The breakdown of trust and loss of faith is manifest in costly litigation, risk averseness and risk shifting, an accumulation of regulation, and a range of costly dispute resolution structures and processes. Ultimately it is evident in a model that is not delivering for New Zealand.

The Challenge will play an important role in providing evidence, tools, new insights and inspiration co-created with the building sector, householders, building owners and communities. It will ensure that these stakeholders take the initiative and improve their own environments in a way not currently possible.

Translating research into action

Ultimately this Challenge is concerned with maximising its impact on a series of defined outcomes. We have set out an integrated Challenge approach that targets its research to deliver these better outcomes, particularly through research co-creation with stakeholders. The Challenge is particularly aware that research in isolation will not be sufficient to deliver system outcomes. The impact of Challenge research on outcomes is only as good as the:

- **Insight** informing the nature and direction of the research (eg: the quality and nature of input from stakeholders in helping shape the reasearch)
- **Agility** of the Challenge to adapt to new information, priorities and performance (eg: the ability of the Challenge to respond and adjust over time through its core structures and systems such as contestable and Quick Response funding, research management systems)
- **Expertise**, quality, specialisations, motivations and responsiveness of the research community (eg:. the new ways of working and collaboration between institutions that have been created by the Challenge Parties and beyond. How this has developed and unlocked different capability and capacity, organisation and incentives)
- **Weighting** and commitment given to translating the research into outcomes (eg the Challenge's commitment not only to conduct excellent research but to also put resource and energy in to effective dissemination, and ensuring utilisation by stakeholders).

To effect change, in addition to establishing a strong Challenge culture and approach in its own right, the Challenge will need to influence, encourage, acknowledge and collaborate with important stakeholders within the "supply chain" which will deliver innovation (change) in homes, towns and cities. This represents a real opportunity to influence the culture, practice and behaviour of stakeholders.

This approach and the model outlined here is necessary to bring about change and drive forward the critical industry transformation that is required. The Challenge is therefore mindful of:

- Its unique ability to contribute to system outcomes (e.g., comparative advantages such as its national profile and the prestige that comes with being part of the wider National Science Challenges)
- How its assets can be used to maximize impact (eg: the influence that its research investment can have both directly and in unlocking other support)
- The need to successfully manage interactions with and leverage the assets of other stakeholders and participants in the process to deliver co-created outcomes (e.g. through alignment and realising gains via joint working and collaboration.)

Important players beyond the Challenge in the homes, towns and cities supply chain include:

- End users of and mechanisms for the adoption of the innovation/research outputs (housing consumers, building and home owners, landowners, builders and construction companies, social and health service providers, local and central government regulators, community housing providers, policy makers)
- Enablers for adoption and education e.g. Industry groups, training providers (BCITO, professional bodies such as NZIA, IPENZ, Ngā Aho)
- Providers of research (e.g., CRI, Universities, CoREs, other National Science Challenges, independent and private providers)
- Private investors in related commercial innovation
- Public funders of relevant innovation (e.g., MBIE, Callaghan Innovation)

The Challenge is built on knowledge that industry transformation is an exercise in partnership, collaboration and co-creation. Accordingly, it requires credible commitments from partners to provide the Challenge with the necessary assurances that they will deliver mission critical elements. This has been a core component of the Challenge's engagement with stakeholders during its development (Section 1.4.7.2). This must and will intensify as the Challenge shifts from securing support and buy-in at the conceptual level to securing support and buy-in within project and programme critical paths (Figure 1).

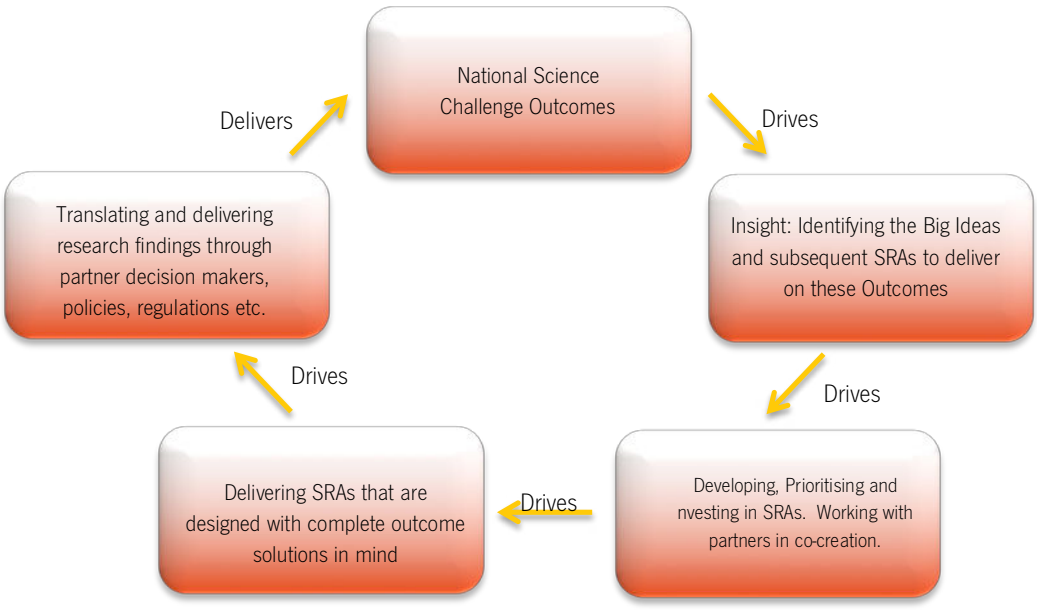

Figure 1 Industry transformation model for the Challenge

1.2 Challenge Goals

1.2.1 Vision (Te Tekoteko)

Ka ora kāinga rua: Built environments that build communities

Homes, neighbourhoods, towns and cities throughout New Zealand that enable people to enrich their lives and reach their social, cultural and economic potential throughout their life stages.

1.2.2 Mission (Te Tahuhu)

Our mission is Manaaki Tangata. Researchers, engaged with industry and community, through innovative research with commitment to co-creation of new knowledge, will transform the systems and organisations that shape the creation and regeneration of our homes, neighbourhoods, towns and cities. The mission of the Building Better Homes, Towns and Cities (BBHTC) National Science Challenge is to help transform dwellings and places where people live into homes and communities that are hospitable, productive, and protective. Critical characteristics are:

- Fit-for-purpose, flexible homes and built communities that can adapt to New Zealand's diverse populations, structural ageing, and the challenges of New Zealand's unique geography and environments, urbanism, and regionality.
- A building, design, planning and regulatory sector that is robust and is consistently able to deliver:
    - Sufficient quantity and quality of new and renovated homes necessary for the health and wellbeing of individuals, families and households.
    - A range of housing solutions that align with the full range of material and physical capacities of households.
    - Neighbourhoods, towns and cities with safe and affordable dwellings that connect people and enable them to take opportunities and participate productively in New Zealand's economic, civic, and cultural life.
- Dwellings, neighbourhoods, towns and cities that promote social and economic wellbeing and New Zealand's international competitiveness through:
    - Vibrant, liveable and affordable cities that reflect New Zealand’s diversity;
    - Transitioning to low-carbon towns and cities;
    - Expanding demand for our innovative design, materials, and building services to support the revitalisation of housing and settlements.

1.2.3 Objectives

Improve the quality and supply of housing and create smart and attractive urban environments through:

- An improved housing stock;
- Meeting future demand for affordable housing;
- Taking up innovation and productivity improvement opportunities;
- Improving current and future urban environments and residents' well-being; and
- Better systems for improved land-use decisions.

1.3 Challenge Framework and Strategy

1.3.1 Tane Whakapiripiri Framework

The Challenge is framed around an evocative metaphor – Tane Whakapiripiri ('the trees of Tane bound together') referring to the wharenui (meeting house) as the gatherer and connector of people. This acknowledges the primary importance of dwellings and the holistic nature of a kāinga (Māori village). It also signals that this research will bring together researchers to achieve the vision of good homes, places and communities in which people can live and work together.

The Tane Whakapiripiri framework (Figure 2) draws on and builds on McFarlane's He Awa[d] Whiria (Braided Rivers) model (Ferguson et al. 2011) and Smith and Hudson's Negotiated Space model (Mila-Schaaf & Hudson, 2009), It acknowledges and values the distinctive perspectives of Western Science and Matāuranga Māori and provides mechanisms and space for the different world views to inform each other and enhance outcomes. The Tane Whakapiripiri framework encourages collaboration and partnership, but also recognises the need for distinction between these world views. The distinction between Mana Whenua[e] and Manuhiri recognises the unique status of Māori as indigenous people to Aotearoa, and iwi, hapū[f] and whānau as holding mana whenua within their rohe[g]. The Tane Whakapiripiri framework also reflects the National Science Challenge principle of purposive collaboration.

By housing the Challenge in the Tane Whakapiripiri framework we will, over the course of the Challenge, build a cohort of researchers who have the skills and capabilities to work within both Matāuranga Māori and Western Science paradigms and to effectively collaborate across disciplines.

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[d] **Awa** – waterways

[e] **Mana whenua** refers to demonstrated authority by local people over land or territory in a particular area. Mana whenua are either local Māori with ancestral ties to a region or an iwi authority of the region by take raupatu – or conquest. In legal terms, mana whenua group means an iwi or hapū that (a) exercises historical and continuing mana whenua in an area or (b) is a mandated iwi organisation under the Māori Fisheries Act 2004; a body that has been the subject of a settlement of Treaty of Waitangi claims; a body that has been confirmed by the Crown as holding a mandate for the purposes of negotiating Treaty of Waitangi claim, and that is currently negotiating with the Crown over the claims.

[f] **Hapu** – sub grouping of the main tribe acknowledged by following a particular ancestor related to the eponymous ancestor of the tribe. Hapu usually emerge when the population and capacity to self sustain a whānau grouping has been reached.

[g] **Rohe** – is district or region of an iwi authority.

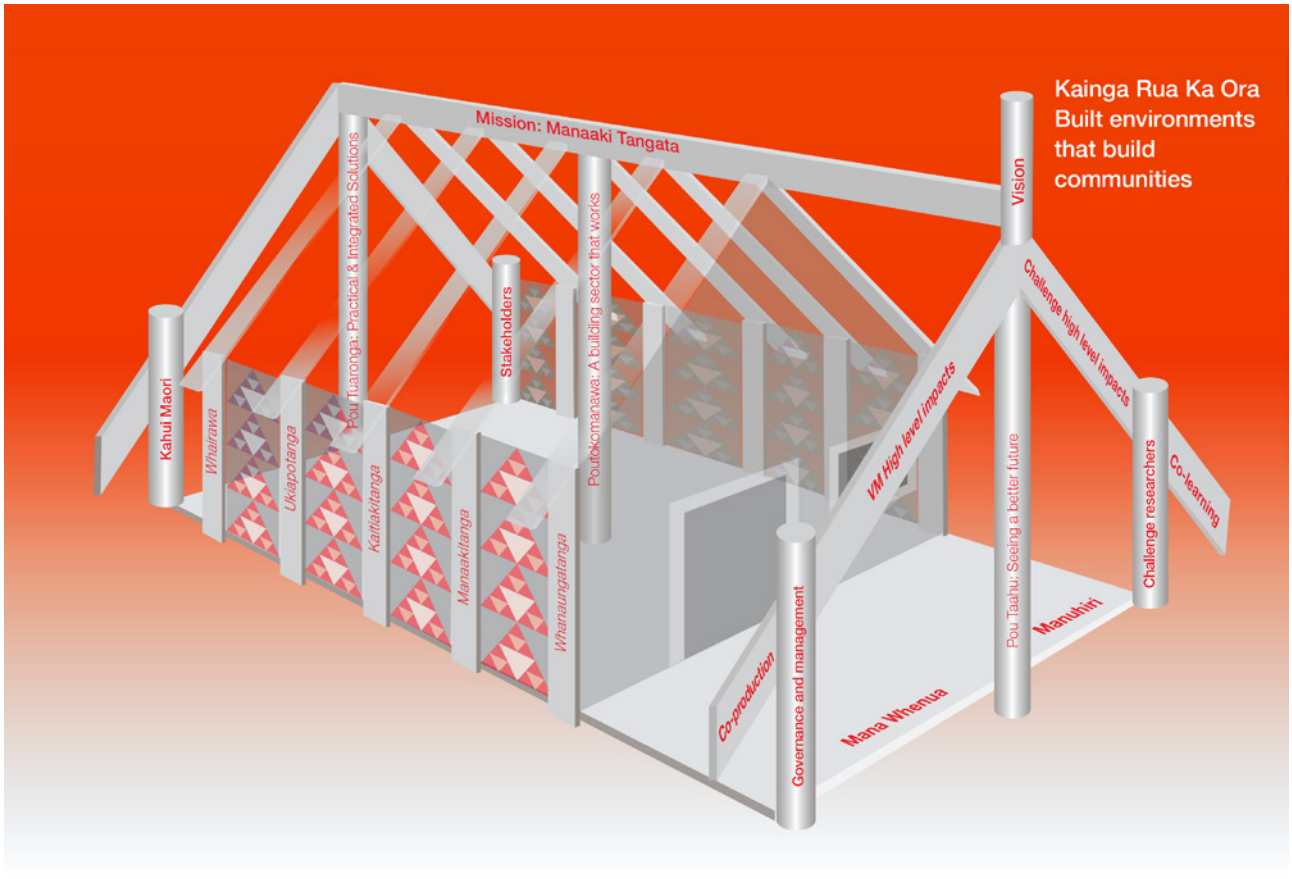


Figure 2 Tane Whakapiripiri framework incorporating Challenge Vision, Mission, Objectives, Outcomes, Pathways a People

The Vision and Mission reflect fundamental aspirations found among all New Zealand's peoples about home and community. Te Tekoteko (the Vision) and Te Tahuhu (the Mission) incorporate the expertise of Māori researchers and reflect the grounding of this research programme in the ethics and responsibilities associated with Manaaki Tangata. They also form key structural components of Tane Whakapiriri.

The uprights forming the structural part of the walls of the wharenui), represent the **Outcomes** (Table 1) which themselves deliver to the vision, mission and objective of the Challenge:

- **Whānaungatanga:** social interaction enabled by the built environment
- **Kaitiakitanga:** built environments connecting people to the natural environment
- **Ukaipotanga:** identities acknowledged and valued through the built environment
- **Wahi manaakitanga:** health and safety promoted through the built environment
- **Whairawa:** equitable access to wealth and resources enabled in the built environment.

The Challenge **Pathways**, listed below, are represented by the three central posts that support the Tane Whakapiripiri – the pou tāhū (front post), the pou tokomanawa (centre post) and the pou tuarongo (back wall post) (Table 1, Figure 2):

- Practical & integrated solutions;
- A building sector that can work for the best;
- Seeing a better future

The four corner pou represent the people who will deliver the Challenge (see Section 1.4 The Team):

- Stakeholders
- Researchers
- Governance and Management
- Kāhui Māori

Tukutuku is a woven Māori artform, which often adorns the inside of wharenui. The metaphor of tukutuku refers to the strength created through relationships. In this Challenge, the tukutuku diagram in Figure 3 shows the interlocking research strands which will be explored within the 'house' depicted by the Tane Whakapiripiri framework. Within this diagram, the central Vision of the Challenge joins the three Pathways which lead to the multiple Objectives and aspects of the Mission of the Challenge.

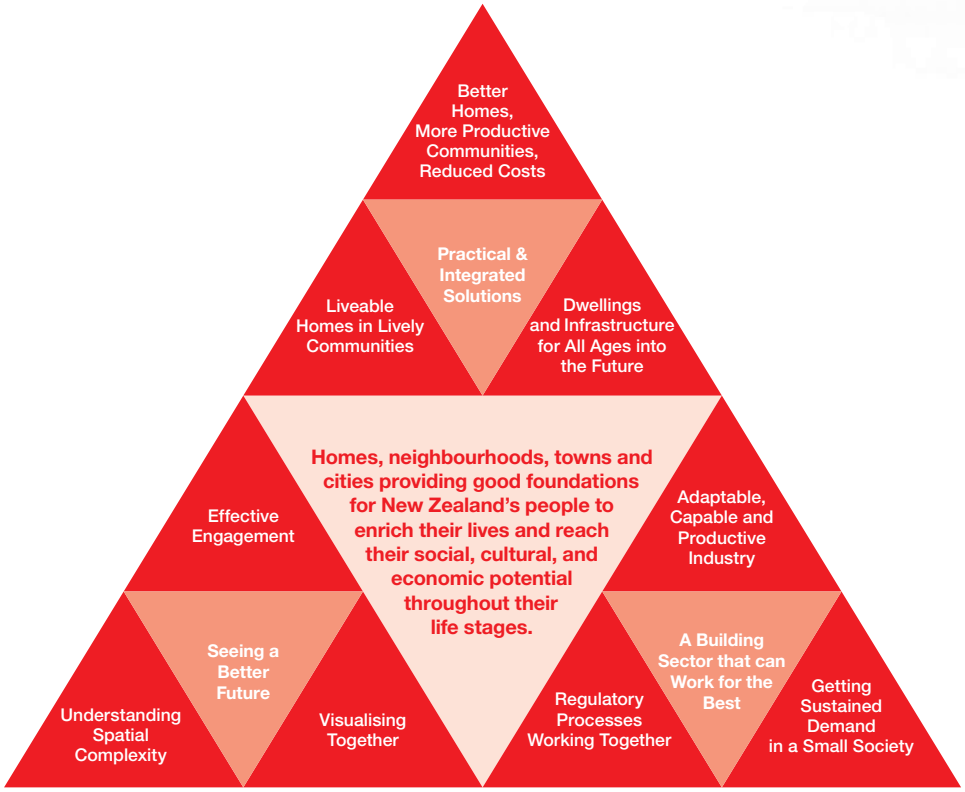


Figure 3 Tukutuku - Challenge Vision, Pathways, Mission and Objectives.

1.3.2 Outcomes

Table 1 lists the links between Outcomes and the Challenge Mission and Objectives. The Outcome framework is covered in more detail in Section 1.7.

Outcome	Description	Link to Challenge Mission & Objectives
Whānaungatanga **Social interaction, enabled by the built environment**	Social support between participants is vital at the whānau[h]/family and community levels. Shared experiences of community members create a sense of collective belonging, obligations, and reciprocal caring. Interaction between those creating and living in the built environment is vital for creating a successful environment and to drive our entire society to collectively create the best built environment.	Improved current and future urban environments and resident's well-being Dwellings, neighbourhoods, towns and cities that connect and enable people and promote social and economic wellbeingAn improved housing stock
Kaitiakitanga **Built environments connecting people to the natural environment**	Humans are interdependent with the natural environment. Iwi and hapū who have traditionally inhabited a location ***(mana whenua)*** play a primary role of **kaitiaki** (guardians of the natural environment). However, to work for the best, all residents of a location need to serve as guardians to ensure sustainability of natural resources and in respect ***of mana whenua***.	Improved housing stock which increasingly use sustainable building practices as the norm. This in turn improves people's wellbeing Vibrant and livable cities enhancing well-being through connection with sustainable natural environments
Ukaipotanga **Identities acknowledged and valued through the built environment**	Place is critical in promoting a sense of identity and belonging amongst individuals and communities connected with those places.	Built environments fit-for-purpose for NZ's diverse populations which meet the physical needs of their inhabitants Neighbourhoods, towns and cities that connect people and enable them to participate productively in NZ's economic, civic & cultural life Better land use decisions which reflect the natural environment in which the built environment resides Vibrant & livable cities that reflect NZ's diversity
Wahi manaakitanga **Health and safety promoted through the built environment**	**Manaaki** is a core value based on the importance of providing hospitality, support, and nurturing for both guests as well as family and community members. **Wahi Manaakitanga** extends the concept of **manaaki** to how we create homes, neighbourhoods, and communities that are healthy and safe places to live.	Homes supporting the health and well-being of their inhabitants Housing solutions that align with the material & physical capacities of households including affordable housing Neighbourhood, towns & cities are safe places to live and work and incorporate safe dwellings

[h] Whānau - family are both immediate siblings off the parents but may also include the extended whānau of the parents siblings or even grandparents siblings. First, Second and third cousin lines are also considered whānau all the way back up the genealogy tree to the eponymous ancestor.

Whairawa **Equitable access to wealth and resources enabled in the built environment**	Accumulation and distribution of wealth within communities not only includes monetary wealth but also resources more broadly, and the processes through which wealth is generated, protected, and used to address the needs of communities.	Neighbourhoods, towns & cities that enable people to participate productively in NZ's economic life and improve resident's well-being Innovative design, materials and building services revitalising housing and settlements Improvement in living standards for New Zealanders

Table 1 Challenge Outcomes and their linkage to the Mission and Objectives

1.3.3 Pathways

The Challenge Pathways all combine to deliver the Outcomes, as outlined in Table 2. The Pathways are all clearly linked to the Mission and Objectives, as outlined in Table 3. The relationships between the Pathways, Vision, Mission and Objectives are also depicted in Figure 3.

Outcome Pathway	Practical and integrated solutions	A building sector that can work for the best	Seeing a better future
	In order to create the better future in which our built environment supports social interaction, identities, health and safety, equitable access to wealth and resources and connects people with their natural environment, we need to:		
Whānaungatanga **Social interaction, enabled by the built environment.** ***Kaitiakitanga*** **Built environments connecting people to the natural environment** ***Ukaipotanga*** **Identities acknowledged and valued through the built environment** ***Wahi manaakitanga*** **Health and safety promoted through the built environment** ***Whairawa*** **Equitable access to wealth and resources enabled in the built environment**	create solutions that work for people thus are co-created with the people who will use them and who will be affected by them and that are integrated with one-another so they create constructive interference results. These solutions must be tested in real life scenarios in order to ensure their utility and drive their uptake.	have a building industry capable of working for the best by being i) suitably skilled, with knowledge of what is considered best by the people who will live in the environment ii) connected with shared understanding between builders and inhabitants and ability to uptake improved ways of achieving the future iii) is innovative - skilled and open to new ideas.	be able to envision that future collectively and in ways that break down barriers across groups e.g. building industry, regulators, neighbourhood through co-creation of solutions and development of tools and methods for collectively visualising what is possible.

Table 2 How the Pathways deliver the Outcomes.

Pathways	Description	Alignment to Challenge Mission & Objectives
Practical and Integrated Solutions	Dwellings and built infrastructure must deliver to the needs of people across life stages, of different capabilities and of different cultures, including Māori. We need fit-for-purpose solutions that can be enacted in New Zealand and by the entities involved in the construction industry. The Challenge will identify a structure to improve regulatory and community decision making through understanding and improving the relationships between the complex set of decision nodes involved and through reducing unexpected outcomes from decision logics involving many actors. The Challenge will deliver integrated methods of collecting, storing and providing geospatial data as the underpinning requirement for planning and visualisation of communities. The Challenge will, in collaboration with inhabitants, deliver proven methods of community interactions which shape neighbourhoods, settlements and cities into the places in which the inhabitants want to live and which will support their needs. It will identify models for successful regeneration of 2nd tier settlements. The Challenge will deliver methods and physical solutions for creation of papakāinga to meet the needs of Māori communities, and to reflect the diversity of cultures in our built environment.	Fit-for-purpose, flexible homes and built communities A range of housing solutions that align with the material & physical capacities of households delivered in an improved housing stock Neighbourhoods, towns & cities with safe and affordable dwellings Improved urban environments and residents' well-being leading to demand for innovative design materials and building services which result in further revitalisation
A building sector that can work for the best	To deliver the housing and infrastructure which will provide strong foundations for New Zealanders we need a building sector that is cooperatively working to create the environment that New Zealanders seek. The current sector struggles as a result of lack of innovative capacity, lack of skilled and motivated personnel on the construction side and a lack of communication between those who create the built environment (holders of land & money, regulators and constructors/materials suppliers) and those who live in the built environment (inhabitants). Our systems that deliver the built environment, involving constructors, regulators, materials suppliers and dwellers, deliver highly costly housing and infrastructure compared to much of the developed world with poor control over timelines and little vision of the desires of the dwellers. Therefore the Challenge will increase the innovative capacity and improve the skill sets of the building industry such that they can and will adopt the optimal materials, methods and systems with which to create the built environment. The Challenge will draw upon Māori knowledge as a source of innovation and inspiration in community development, it will elucidate the differences and similarities between Māori community built environment aspirations and will ensure that the regulatory framework and construction systems are capable of and intent on delivering to the aspirations of Māori. The Challenge will develop new structures for decision making which will reduce costs and increase efficiency of construction. The Challenge will strengthen the communication linkages and pathways between the different actors in the building sector to drive delivery of communities that reflect the social, economic, cultural and environmental desires and requirements of their inhabitants.	A building, design, planning and regulatory sector that is robust and is consistently able to deliver Sufficient quantity and quality of new and renovated homes necessary to the health and wellbeing of individuals, families and households. Dwellings, neighbourhoods, towns and cities that promote social and economic wellbeing and New Zealand's international competitiveness Expanding demand for innovative design materials and building services which result in ongoing innovation and improvements in our built environment

Seeing a better future	To achieve a better future requires, first, its visualisation. Seeing a better future requires both that there is coherence of the vision of the nature of a better future and there are methods through which all the participants in the built environment can collectively envisage that future. The Challenge will strengthen the linkages between the different actors involved in creation of buildings and communities, initially through involving representatives of all the actors in the research activities and later in demonstration projects such that there is a cadre of influencers throughout the built environment actors who will go on to effect change in others. The Challenge will deliver methods for actively visualising the futures in which the inhabitants wish to live, both methods for community interaction and for digital representation and imaging. These will build on accessible new and better organised geospatial data across the range of spatial scales relevant to homes, towns and city planning, operation and performance.	Improved housing stock, current and future urban environments and resident's well-being Better systems for improved land-use decisions. Neighbourhoods, towns and cities that connect people and promote social and economic wellbeing

Table 3 Challenge Pathways and their linkages to the Mission and Objectives

1.3.4 Strategic Research Areas

In the development of the Challenge the researchers and interim management and governance have worked with a wide range of stakeholders (Section 1.4.5) to identify a small number of the Strategic Research Areas (SRAs) in which the Challenge research should initially be focused. These are summarised in Table 4.

Strategic Research Area	Description
Transforming Decision Making for Homes, Towns & Cities	Improving the architecture of decision making in the building sector, recognising the high degrees of complexity of interactions between numerous actors, including the market.
Next Generation Information for Better Outcomes	Creating a framework for data collection and collation to support urban decision making Creating a geospatial toolkit using data to aid urban planning Creating an across Challenge geospatial information-sharing infrastructure
Supporting Success in Regional Settlements	Increasing success of NZ 2nd tier settlements through regeneration based around a new understanding of the systematic forces that affect settlement success Identification as to which settlements & interventions should be focused on
Shaping Places: Future Neighbourhoods	Co-creating better neighbourhoods in the major cities, as a fundamental unit of communities, through understanding place-shaping practices that lead to success
Hei Papakāinga Ora	Co-creating papakāinga which support the wellbeing of diverse Māori communities and the expression of their values in the built environment
Transforming the Building Industry	Developing a healthy, coherent, well-functioning construction sector through upskilling people (creating training programmes), creating new fit-for-purpose products, re-engineering processes for efficiency and creating an innovation environment

Table 4 Strategic Research Areas.

The Strategic Research Areas all deliver through one or more pathways to multiple Outcomes (Table 5 and the Outcome Model in Section 1.7). The Research Plan (Section 2) details the programme of work for each SRA.

Pathway ***Strategic Research Area***	**Practical & integrated solutions**	**A building sector that can work for the best**	**Seeing a better future**
Transforming Decision Making for Homes, Towns & Cities (TDM)	TDM will identify practical ways in which the relations between the complex set of decision nodes related to buildings, and their logics and tools can be improved to encourage processes that build shared decision making and reduce inertia and perverse outcomes.	TDM will provide mechanisms that remove barriers to inaction and promote logics which result in desirable outcomes for all actors. The result will be that the building sector is facilitated to work for the best where presently, even though intentions are good, actors cannot work together effectively because of flawed decision making systems.	The methodological approach, carried out together with end-users, will assist stakeholders to identify what success looks like and will include imagining of new 'plausible ways' to create and shape housing and urban futures
Next Generation Information for Better Outcomes (NGI)	NGI will deliver a geospatial toolkit to enable integrated planning of urban development redevelopment, co-created with stakeholders, maximising economic potential of past and future investments. NGI will deliver guidelines for data collection, collation and integration to underpin improved planning of and thus the actuality of the communities in which we live.	NGI will ensure that maximum information is available equally to all to facilitate co-creation of the built environment	NGI will deliver guidelines, methods and tools for collection, collation and use of geospatial data which will assist all stakeholders to understand spatial complexity and construct a collaborative venture for achieving a better built collaborative
Supporting Success in Regional Settlements (SSRS)	SSRS will deliver an inventory of regeneration solutions for 2nd tier settlements such that planners and communities can identify the most appropriate interventions to drive success in their community. SSRS will deliver a means to evaluate success thus driving iterative improvements.	SSRS will work in tandem with stakeholders to assess approaches most likely to regenerate successful 2nd tier settlements, driving co-creation.	SSRS will utilise real-life case studies which will act as future models for visualising possible communities.
Shaping Places: Future Neighbourhoods (SP)	SP will deliver a toolkit of examples and procedural guidelines for use in neighbourhood (re)generation to promote multi-dimensional community success. SP will deliver methods which ensure that neighbourhoods will participate in their own generation/regeneration activities, promoting success.	SP will deliver methods to bring neighbourhood communities together with regulators and agencies involved in (re)generation to ensure *collective* participation and emphasis in creating the best communities.	SP will deliver methods which will ensure communities will participate collaboratively in their own (re)generation activities.

Hei Papakāinga Ora (HPO)	HPO will deliver novel housing and community design and construction solutions which meet the specific needs of Māori communities, assisting communities to develop fit-for-purpose housing solutions. HPO will deliver housing policy innovations which ensure planning for Māori communities is fit-for-purpose.	HPO will deliver solutions co-created with Māori communities and building industry stakeholders to drive joint commitment towards innovative communities of the future.	HPO will deliver solutions co-created with Māori communities in a process which facilitates their visualising the communities in which they would like to live. HPO will deliver novel housing and community design solutions which can act as inspirations to diverse communities.
Transforming the Building Industry (TBI)	TBI will deliver tested innovation models to drive innovation uptake in the building industry which will improve future built structures. TBI will deliver re-engineered Council processes co-created with Council staff that work efficiently and effectively.	TBI will deliver practical methods and resources for upskilling industry personnel who are fit for the future building industry and inspired to deliver the best.	The "Whole of Life Building" project will provide an example of what is possible in the NZ built environment, assisting and inspiring NZ communities to achieve the same goals.

Table 5 Strategic Research Areas and their delivery to Pathways

1.3.5 Vision Mātauranga

As a Crown-funded research initiative, the Challenge has focused on Māori, as Treaty partners, in its early development. This focus also reflects the cutting-edge nature of Māori research collaborations within the indigenous research world. Mātauranga Māori, and Vision Mātauranga – the imperative to unlock the innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future - are integral to the Challenge.

Māori have a long, rich and innovative culture of design and building, incorporating thoughtful and adaptable settlement design to create truly functional buildings (Wallace & Irwin 1999; Leach et al, 1999). Mātauranga Māori offers expertise in traditional building materials with good thermal performance, and traditional building techniques for 'fast builds'. Through a new generation of architects, designers and engineers, Māori innovation in the building sector continues and is a driving force in 'bicultural architecture'.

Research which improves the design, building and maintenance of settlements in rural areas and the delivery of affordable and functional community housing has particular urgency for Māori communities, as the current burden of poor housing and inappropriate settlement planning falls disproportionately upon these groups. Furthermore, Iwi and hapū, urban Māori organisations, Māori businesses, and Māori tradespeople are active participants in the building industry working in rural, provincial and urban settings. The Māori Economic Development Strategy and Māori Housing Strategy both recognise Māori as increasingly important economic actors with interests in the built environment.

The value of Māori innovation is recognized at all levels of the Challenge structure including governance, management, the Kāhui Māori advisory panel (as detailed in Section 1.4), research leadership and research. The Tane Whakapiripiri framework embeds Mātauranga Māori within all six Strategic Research Areas, and Māori researchers and communities are identified as co-creators within many research projects (see detail in Section 2). Māori are involved specifically in co-creation of new knowledge regarding decision making, geospatial information to underpin community development, 2nd tier community regeneration, place making in urban areas and upskilling of building industry organisations and personnel, particularly in innovation. Māori researchers are driving SRA Hei Papakāinga Ora which will develop new methods of creating housing and communities on Māori land to meet Māori needs, as well as inspiring new methods of community development across all cultures.

1.3.6 Prioritisation and Contestable funding

As detailed in Section 1.4.2, Challenge researchers and interim management completed an extensive programme of stakeholder engagement, resulting in the prioritisation of the initial Challenge research focus and investment of effort through its Strategic Research Areas (SRAs). The SRAs represent the core of the Challenge's research portfolio, in particular through the first phase of Challenge funding (until June 2019). All SRAs will be reviewed in 2019 and priorities will be established then for the next five years of funding.

In addition to the funding prioritised for the SRAs, the Challenge has also set aside provision for contestable funding of research. BRANZ as Challenge Contractor has established processes to carry out such a round (BRANZ has similar processes for investment of the Building Research Levy) which will be modified to suit the needs of the Challenge.

We will use contestable processes to target gaps in research that emerge during the delivery of SRAs and to seed fund new and emerging cross-Challenge opportunities discovered during the delivery of research and ongoing stakeholder engagement. The questions and priorities will therefore be determined by review of Challenge and SRA progress as part of ongoing monitoring of the research portfolio. Research proposals from any contestable round will be subject to assessment and clear decision-making criteria. This will be fully scoped within six months of signing the Challenge Programme Agreement, ready for the first planned contestable round in late 2016/17. It is anticipated that the process will use independent, international and domestic review and include stakeholders/end users as part of an assessment panel. This will include drawing on the expertise of our Independent Science Advisory Panel.

A minimum of 5% of the total 10 year research funding (and up to 25%) will be made available through EOI/RFP/mini-prospectus rounds of two types:

- **Biennial contestable rounds**: The first of these contestable rounds will occur at the end of 2016/17 so that Year 1 of the Challenge can be focused on bedding in the SRA research programmes. A 2 year cycle is seen as the best way of balancing cost to the Challenge and providers.
- **Quick response mechanism**: This will act as a flexible/agile investment to balance the biennial contestable rounds. Opportunities may arise as wholly-funded Challenge investments, to co-invest with other research funders or to meet the information needs established by the Challenge. Opportunities will be identified to/by the SLT through a Quick Response Application process, prior to advancing for the director's consideration.

At this time 8% of the Challenge budget has been put aside for contestable funding through to June 2019. It is expected that this figure will be adjusted upwards as SRAs are refined and to take in to account (normal) programme slippage across the SRAs. The level of contestable funding in the first phase of the Challenge reflects a decision to focus efforts on the 6 SRAs in the first phase, but retain scope to go to market for new or supporting research. The figure for contestable research funding in the second phase is intended to be significantly higher – recognizing the commitment to re-fresh and renewal. This will ensure that the contestable funding ambitions across the life of the Challenge can be realised.

Contestable funded projects will be subject to contracting, monitoring, and reporting arrangements put in place by the Challenge contractor. Sample sub-contracts (including for non-Challenge Parties) have been included in the draft Collaboration Agreement.

1.3.7 Dynamism and refresh

The Challenge is determined to remain agile, adaptable to new circumstances, to take new directions indicated by the findings of its research, and provide opportunities for new researchers as well as new clusters of research effort. The ten year funding horizon for mission-led research demands that the principles of refreshment, re-invigoration, and adaptation are incorporated in the Challenge's operations across governance, management and on-going research planning to avoid becoming self-referential, exclusionary or routine.

Against the stable backdrop of an independent Chair (see Section 3.3) with a three year term (renewable for further 3 year terms) the Challenge will introduce new skills and experience required by subsequent project phases, while maintaining the continuity and retention of critical skills and perspectives through:

- **Planned Renewal of the Board:** The Governance structure has been designed to maintain continuity over the timeframe of the Challenge while also ensuring that the Board can adapt its skill set as the Challenge moves through the establishment phase into supporting intense research delivery, knowledge exchange, and leverage step change and transformation across the

dwelling and urban environment value chains. As noted in the Board Terms of Reference (see Appendix 2 – Collaboration Agreement) Board appointments will be through staggered 3 year terms to balance refresh with continuity.

- **Planned Renewal of the Science Leadership Team:** members of the SLT will be appointed for a term of three years in the first instance. There will be a subsequent rotation, at which time members with skills deemed highly relevant to ensuing phases may be selected for a second term, as approved by the Board. The renewal process will:
    - Allow SLT members the opportunity to demonstrate how their skills might align with the next phase of the Challenge, alongside those of potential new applicants.
    - Ensure that SLT skills – of both new and returning members – are strongly aligned with emerging research directions
    - Allow senior scientists assisting in the management to continue active research practice by rotating out of management
    - Develop new research management capability in a number of individuals.
- **Evaluation and Review:** a evaluation and review will be used to inform Board decision making as well as the Science Leadership Team.
- **Research-Prompted New Ideas Colloquia:** biennial colloquia will bring together researchers working on Challenge funded projects together with researchers who undertake research aligned with the Challenge, in order to review emergent findings and new directions for the Challenge research plan.
- **Challenging the Challenge Colloquia:** will be designed to allow stakeholders to consider the balance of research effort in different research areas. These will take place on a biennial basis.
- **Research Innovation through Contest:** A minimum of 5% of funding over the 10 years will be allocated through contestable process as described above in Section 1.3.5.

1.3.8 Co-funding

The Mission for this Challenge cannot be achieved through the NSC funding envelope alone. Indeed, research aligned to the Challenge (by Challenge Parties and others) and related activities for uptake and application of Challenge research (by end-users) is going to be necessary in realising the Challenge ambitions.

There are relatively small amounts of co-funding mapped to the Challenge at its outset (see detail on co-funding in each of the SRAs described in Section 2). However all SRAs have intent to secure co-funding through their relationships with stakeholders, particularly given the close involvement of stakeholders in all the research activities.

The likely activities for which co-funding will be accessed are the time of stakeholders participating in the research, for learning spaces in which research findings will be tested and demonstrated and for larger demonstration projects close to the conclusion of research activities. This is likely to include parties involved in community and business initiatives consistent with the Challenge Mission (e.g. industry groups involved in housing, building and construction, organizations such as councils involved in urban planning), as well as parties promoting engagement by New Zealanders in such initiatives (e.g. government departments). We expect significant co-funding investment opportunities to arise from the SRAs during the first phase of the Challenge, as the specific opportunities are more visible for potential external co-funders.

We will also work with key stakeholders and international researchers through the Challenge to secure co-funding through research investment mechanisms, including by leveraging the Challenge 'brand' and prestige to access domestic and international funding. We also recognise the significant co-funding that Challenge Parties have provided in the course of development of this proposal.

1.3.9 Related funding and related research

Related funding and research are activities which are complementary to the Challenge but are not directly part of or under the control of the Challenge.

There are two specific sources of funding for related research already identified:

- **Mapped MBIE Contracts:** MBIE has mapped two of its research contracts with New Zealand research organisations into the Challenge Funding. These are WAVE (BRANZ) and Resilient Urban Futures (RUF) (University of Otago). The WAVE programme is a technical programme of work aimed at addressing weathertightness, ventilation and air quality issues. It is

fundamental science that will feed through to the Hei Papakāinga Ora SRA in particular. RUF is focused on the resilience of cities and as such has strong connections through to the **Supporting Success in Regional Settlements, Hei Papakāinga Ora,** and **Shaping Places; Future Neighbourhoods** SRAs. The Challenge Director will engage with the contract-holding research organisations and remain informed regarding their contracted activities (including the end-user relationships) for the remainder of their contract terms. We note the BRANZ contract has now been completed (the MBIE contract finished in September 2015). Although the Challenge has no role in directing or managing these mapped contracts, the Challenge Parties acknowledge that the research capabilities working on the mapped contracts are relevant to the research activities of the Challenge. There are strong existing links. For example, the leader of the RUF programme from Otago University (Prof Howden-Chapman) is also an active member of the BBHTC Challenge. At the end of their contracted terms, it is noted that the funding becomes Challenge funding and will be directed towards activities agreed in the Challenge Programme Agreement.

- **CRI core funding:** Scion has allocated $200,000 of core funding to the Challenge per annum. As such, research expertise in Scion that are identified as contributing and/or complementary to the goals of this Challenge will be aligned to deliver Challenge outcomes (where reasonable and in line with Scion's statement of core purpose). As the revenue and expenses from Core-funded aligned projects will be retained fully within Scion, they have not been reported as line items in the budget, and will be treated as 'in kind' support.

The Challenge will identify further aligned research being undertaken by Challenge Parties. All Parties have agreed to identify any research funded from non-Challenge sources that complements research and related activities funded directly by the Challenge. The Parties acknowledge that the scale of Aligned Research may change over time and that such Aligned Research will remain under the authority of individual Challenge Parties. Challenge Parties will report their Aligned Research contributions to the Challenge Director, for the purposes of reporting progress and achievements from the Challenge as a whole. The Challenge Director will oversee an integrated reporting process to enable this, and circulate the subsequent reports to encourage Challenge Parties to strive to use their Aligned Research to contribute to the Challenge priorities, where possible. The contribution of Challenge Parties to priorities determined by the Governance Group will be included in the regular reporting of Aligned Research contributions to the Challenge.

The Parties will represent the value of such Aligned Research according to their respective financial management systems. The Parties acknowledge that the valuation of Aligned Research may be determined on an annual basis for each financial year in advance or in arrears. Each Party will provide a 'best estimate' of the total value of the research they are aligning to the Challenge (and describe the nature of that research), which will allow an approximate understanding of the scale of funding in each SRA across the Challenge research landscape. There is no requirement for Parties to align any specific level of research activity or funding, and no Party is intended to receive more or less Challenge Funding solely due to the level of Aligned Research attributed to that Party.

1.4 The Team

Members of the Challenge Governance and Management teams are identified in this section. The formal structure of these teams and their responsibilities are described in Sections 3.3 and 3.4.

1.4.1 Governance Group

Throughout the development of the Challenge, and at the time of writing, an interim Governance Group (Appendix 5) is providing governance for the Challenge. The transition to permanent governance arrangements has been initiated with the search for an independent Chair well underway. This is a priority for the Challenge. It is anticipated that an independent Chair of the Challenge Governance Group will be appointed by the end of November 2015. The other four to six members of the Board will be recruited by mid December 2015. The Terms of Reference for the Challenge Governance Group are set out in the Collaboration Agreement (Appendix 2)

1.4.2 Director and Science Leadership Team

1.4.2.1 Director

The Challenge has been led through to this proposal by two interim co-Directors, Ruth Berry and Richard Bedford. Ruth is an experienced research leader with extensive relationships across the science sector. Richard is one of New Zealand's most distinguished academics and is currently the President of the Royal Society.

Given the collaboration and understanding of the Challenge and its stakeholder and research participants that had been developed by these interim Directors, a decision was taken not to seek a permanent appointment during the compressed timetable for proposal re-submission from mid-2015.

At the time of writing the Challenge has gone out to market (New Zealand and internationally) seeking a permanent Director. A copy of the job description for this position is included in Appendix 4. This sets out the characteristics, experience and skills that the Challenge is seeking in this permanent appointment. Given an anticipated recruitment period of 3-4 months it is anticipated that an appointment will be possible in early 2016. This recruitment timetable has also been put in place to enable active participation by the yet-to-be appointed Chair of the Governance Group.

1.4.2.2 Interim Science Leadership Team

Interim Science Leadership and Māori Science Leadership Teams (Table 6) were established when the Challenge was formed to respond to the initial RFP in early 2015. The Māori Science Leadership Team met regularly, led engagement with Māori communities, and actively engaged other Māori researchers to form a wider Roopū Rangahau Māori. During the Challenge Commencement Phase both Science Leadership teams have come together to provide integrated research leadership for the Challenge during the development of this proposal. The Interim Science Leadership Team was deliberately large to encompass the wide range of research worldviews required for the Challenge to "do things differently" and achieve the transformative outcomes expected of a National Science Challenge. During the four months of the Commencement Phase the Interim Science Leadership Team has continued to operate as a cohesive group of "Citizens of the Challenge", and have not championed discipline or organizational interests above Challenge needs.

Challenge Role	Name	Organisation	Skills
Pathway Advisor – Seeing the Future	Prof Simon Kingham	University of Canterbury	Spatial, urban, visualisation technologies
	Dr Malcolm Campbell	University of Canterbury	Health, geography, visualisation technologies
	Prof Suzanne Wilkinson	University of Auckland	Engineering, construction industry

Pathway Advisor – Building Sector that can work for the best	Prof John Tookey	AUT	Engineering, construction industry
Pathway Advisor – Practical & Integrated Solutions	Kay Saville-Smith	CRESA	Housing, neighbourhood engagement, urban communities
	Dr Suzanne Vallance	Lincoln University	Neighbourhood engagement, urban communities
Outcome Advisor - *Whānaungatanga*	Dr Matthew Roskruge	University of Waikato	Economics, Matāuranga Māori
	Anaru Waa	University of Otago	Māori health, evaluation & qualitative research methods
Outcome Advisor – *Kaitiakitanga*	Dr Kepa Morgan	University of Auckland	Engineering solutions for indigenous peoples, Matāuranga Māori
Outcome Advisor – *Ukaipotanga*	Dr Huhana Smith	Te Rangitāwhia Whakatupu Mātauranga Ltd.	Housing, neighbourhood engagement, urban communities, Matāuranga Māori
	Dr Simon Lambert	Lincoln University	Māori development, environmental planning, innovation, Matāuranga Māori
Outcome Advisor – *Wahi Manaakitanga*	Dr Ella Henry	AUT	Sociology, Māori management, business and development
Outcome Advisor – *Wahi rawa*	Derek Kawiti	Victoria University	Architecture, 3D technologies, kaupapa[i] Māori research
Principal Advisor	Prof Philippa Howden-Chapman	University of Otago	Cities, urban environments
	Lynda Armitrano	BRANZ	Built environment
	Dr Arthur Grimes	MOTU	Economics, housing supply, city dynamics
	Prof Errol Haarhoff	University of Auckland	Design, architecture

[i] Kaupapa – kaupapa is often referred to as cause or reason for a meeting, event or conference. It is derived from Ka ū ki te papa – when a waka can make landfall after traversing the oceans, the kaupapa has held focus on getting to land. When considering Kaupapa Māori research, it is a theory and an analysis of the cultural, political and social context of research that involves Māori and the approaches to research with Māori, by Māori and for Māori (Smith, 1996b). There are many excellent descriptions and discussions on kaupapa Māori and related issues (Cram, 2009, Pihama, 1993, Smith, 1995, Smith, 1996a, Smith, 1996c, Smith, 1999, Smith, 1997). Kaupapa Māori begins as a challenge to accepted norms and assumptions about knowledge and the way it is constructed and continues as a search for understanding within a Māori worldview (Bishop, 1996).i

	Prof Iain White	University of Waikato	Urban environment & planning, spatial complexity
	Robin Peace	Massey University	Evaluation
	Prof Karen Witten	Massey University	People, environment and planning
	Prof Marc Aurel Schnabel	Victoria University	Design, architecture
Advisor – Vision Matāuranga	Biddy Livesey	Massey University	Māori engagement, urban management & planning
Advisor	Emer Prof Harvey Perkins	People & Places	Sustainability & urban change, housing
	Doug Gaunt	Scion	Timber engineering
	Dr Vivienne Ivory	Opus	Data governance

Table 6 Interim Science Leadership Team

1.4.2.3 Science Leadership Team

During the development of the Challenge proposal a committed Science Leadership Team (below) has worked effectively to shape the Challenge's Strategic Research Areas. This team has provided key leadership and science capability within the SRAs and across them. They have been instrumental in helping to forge the Challenge's transformative research framework and its ambitions. During the first six months of the Challenge a formal process to secure permanent appointments will be undertaken.

SRA Facilitator	Pathway Facilitator	Name	Organisation	Skills
Transforming Decision Making	Practical & Integrated Solutions	Kay Saville-Smith	CRESA	Housing, neighbourhood engagement, urban communities
		Prof Iain White	University of Waikato	Urban environment & planning, spatial complexity
Next Generation Information for Better Outcomes	Seeing a Better Future	Prof Simon Kingham	University of Canterbury	Spatial, urban, visualization technologies
		Malcolm Campbell	University of Canterbury	Health geography
Supporting Success in Regional Settlements		Emer Prof Harvey Perkins	People and Places	Sustainability and urban change, housing
		Dr Matt Roskruge	University of Waikato	Economics, Matāuranga Māori
		Prof Errol Haarhoff	University of Auckland	Design, architecture

Shaping Places: Future Neighbourhoods		Dr Simon Lambert	Lincoln University	Māori development, environmental planning, innovation, Matāuranga Māori
Hei Papakāinga Ora		Dr Kepa Morgan	University of Auckland	Engineering solutions for indigenous peoples, Matāuranga Māori
		Dr Huhana Smith	Te Rangitāwhia Whakatupu Mātauranga Ltd.	Housing, neighbourhood engagement, urban communities, Matāuranga Māori
Transforming the Building Industry	Building sector that works for the best)	Prof Suzanne Wilkinson	University of Auckland	Engineering, construction industry
		Prof John Tookey	AUT	Construction management, housing affordability
		Lynda Armitrano	BRANZ	Built environment, sustainability

Table 7 Science Leadership Team

1.4.3 Kāhui Māori

During the development of the Challenge proposal, researchers and stakeholders proposed the creation of a Kāhui Māori to support the development and implementation of the Challenge. The Kāhui Māori is an important part of BBHTC's commitment to implementation of Vision Matāuranga and the realisation of its Tane Whakapiripiri framework. The Kāhui Māori has an advisory role which is to work alongside the Challenge leadership to provide strategic advice on implementation of Vision Mātauranga and wider matters including intellectual property issues where relevant to Māori as specified in the Intellectual Property Management Plan. In particular, it will advise the Director, Governance Group and Science Leadership Team on events in Te Ao Māori that may affect the Challenge. The Kāhui Māori may also guide engagement with Māori stakeholders and develop and review processes to consult between the Challenge and Māori interests.

The draft Terms of Reference of the Kāhui Māori, including detail of the basis for securing initial members, is provided in Appendix 7.

1.4.4 Independent Science Advisory Panel

This proposal has been subject to review by international experts as part of its preparation. Three international reviewers have considered and commented back to the Challenge on the proposal in the time frames available. We have invited these reviewers to form part of the Independent Science Advisory Panel for the Challenge (see short bios in Appendix 8). Three additional, complementary members will be recruited before the start of 2016.

Appendix 9 sets out the terms of reference for the Independent Science Advisory Panel.

1.4.5 Challenge Parties

The initial parties in the Challenge are:

- BRANZ Ltd (Contract holder)
- Auckland Council Research Investigation and Monitoring Unit (RIMU)
- Auckland University of Technology
- Centre for Research, Evaluation and Social Assessment,(CRESA)
- Institute of Geological and Nuclear Sciences
- Lincoln University

- Massey University
- Opus Research
- PrefabNZ
- Research Trust of Victoria University of Wellington
- Scion (The New Zealand Forest Research Institute)
- University of Auckland
- University of Canterbury
- University of Otago
- University of Waikato

The parties have agreed to enter into a formal Collaboration Agreement (Appendix 2).

1.4.6 Challenge Management

The Challenge Director and SLT will be supported by a small Challenge management team. This team will comprise a Challenge manager (.6FTE) and Challenge administrator (.2FTE). Recruitment for these positions will begin in January 2016.

1.4.7 Stakeholder Engagement

1.4.7.1 Stakeholder Groups

The Challenge has a wide range of types of stakeholders with whom we will engage. This section describes engagement at the level of the Challenge while engagement at the level of individual Strategic Research Areas is described in Section 2.

We have categorised our stakeholders based on whether they are internal or external to the Challenge and on their level of engagement, in order to plan our interactions with them. More detail as to how we will communicate with each group is provided in the Communications Plan (Appendix 10).

Internal Stakeholders:

- Governance Group
- Kāhui Māori
- Independent Science Advisory Panel
- Science Leadership Team
- MBIE (contract provider)
- BRANZ Board (contract holder)
- Challenge Parties, as specified in the Collaboration Agreement
- Research teams

External Stakeholders

- Researchers currently beyond the Challenge
- Government organisations, industry, community organisations
- Māori organisations

Interested Parties

- Specific Interested Parties
- General public: every citizen, every resident, is an end user of the Challenge outcomes and thus a stakeholder in the research process and programme.

1.4.7.2 Engagement to Date

Development of the Research Plan has been a national, multi-institutional collaborative effort that has included science, Māori communities, industry and central and local government. Strategic thinkers representing all these sectors have been engaged, both through the Challenge development and existing science-based initiatives, to determine the focus and priorities of the Challenge.

The first stage of Challenge development included holding 10 workshops, 3 hui and many inter- and intra-organisational meetings as described below. The outcome of this process is a Challenge community built with respect. Our Challenge community is committed to and excited about the possibilities of new ways of working together and tackling some of New Zealand's intractable issues.

First phase of Stakeholder Engagement late 2014-early 2015

- A Challenge science researcher workshop was held in Auckland as part of the Building a Better New Zealand conference in late 2014. This enabled early engagement with the research community. It leveraged off this national conference to bring parties together, to begin thinking around how to respond to the Science Board's initial recommendations for the BBHTC Challenge.
- A second science researcher workshop of over 50 participants was held following the announcement of the go-ahead for the Challenge, prior to the release of the RFP. This workshop was held over a whole day in Wellington and saw the development of many of the initial ideas and relationships that have come to fruition in this proposal.
- A third mission focused science workshop was held in Wellington once the RFP was issued. This pulled together over 60 key science and research leaders to work over two days on developing further the initial research ideas and shaping the mission and vision of this Challenge.
- Kānohi-ki-te-kānohi hui were held with leading Māori researchers in February 2015, and the resultant Māori Science Leadership Team have shaped not only the distinct Māori research elements of this Challenge, but also the Tane Whakapiripiri framework and the strong Vision Mātauranga that runs through the proposal as a whole.
- As noted by the Science Board in its initial consideration around the Challenge, the Industry Research Strategy, Building a Better New Zealand, has also recently been developed. The Challenge has been able to leverage off this Strategy. It has benefited in particular from the extensive consultation with stakeholders that took place in the development and initial implementation of this Strategy including an extensive Industry Needs Survey of key industry participants with over 1000 responses in February 2014.

Second phase of Stakeholder Engagement mid to late 2015

- Following the feedback from the Science Board, the Directors initiated a series of feedback meetings with key stakeholders and researchers on the findings of the assessment panel and the Science Board.
- Meetings were held with a wide range of stakeholders at the Challenge and SRA level. Key stakeholders engaged included MBIE, LINZ, Treasury, EECA, Ministry for the Environment, Councils, industry organisations, the Chair of the Ageing Well Challenge and the Director of the Resilience Challenge.
- Presentations and workshops on the Challenge also took place with the Construction Strategy Group and the Construction Industry Council in July 2015. These are leading industry stakeholders – the Construction Strategy Group has CEO level membership from New Zealand's leading building and construction businesses, the Construction Industry Council is the peak body for industry organisations in New Zealand.
- The feedback from these key stakeholders and the research community was then shared with the Science Leadership team during the first of its subsequent SLT meetings. The purpose of this was to inform the development of the revised proposal.
- Three hui were held with Māori communities in Auckland, Wellington, and Christchurch in August/September 2015. These 'Māori Housing Partnerships' hui were promoted through the networks of Te Matapihi and Ngā Aho, as well as through the personal and professional relationships held by the researchers and facilitators. Hui were hosted by the Māori Science Leadership Team, facilitated by trustees of Te Matapihi, and conducted in accordance with tikanga Māori as appropriate.

Attendance at hui was relatively high (approximately 20 in Auckland; 40 in Wellington; 20 in Christchurch) and attendees represented a range of interests including: iwi, hapū and whānau; marae; Māori land trusts; social, housing, and health service providers; building and design professionals; development and property professionals; urban Māori organisations; community housing providers; Māori Land Court and The New Māori Trustee; as well as other researchers and research organisations. Hui were hosted and attended by the Māori Science Leadership Team, with co-director Ruth Berry. As suggested by the facilitator for hui in Wellington and Christchurch, Kaye-Maree Dunn, hui were semi-structured and included whakawhānaungatanga, introductions from the researchers, and focused discussion on opportunities for research; the value of research to Māori communities; and what 'partnership' between communities and researchers could look like.

- Comprehensive notes were taken and drafts of these notes were circulated for review by attendees, as well as for the information of the wider Science Leadership Team. In the spirit of collaboration, it is intended that these notes create a resource for all attendees. A list of possible projects generated through hui was sent to the facilitators of each Strategic Research Area, as relevant, to inform the development of their research programme.
- Five meetings of the Science and Māori Leadership teams were held in Auckland (2) and Wellington (3).
- The Māori Science Leadership Team also met regularly by teleconference. Further hui with Māori researchers involved in the Challenge were held in June and October. These hui were led and driven by Māori researchers and included the wider Roopū Rangahau Māori .
- In addition, specific meetings were organised across the SRAs, details of which are provided in the SRAs in Section 2.

Making Choices - Developing the Strategic Research Areas

Throughout the Challenge Engagement processes work was undertaken to identify and develop the initial Challenge research priorities. This led to the development of the 6 Strategic Research Areas (SRAs).

The Interim Science Leadership Team was tasked with working with stakeholders to identify and prioritise the Strategic Research Areas that should be the initial focus for the Challenge. To support this process and to ensure that the whole Challenge community had an opportunity to provide input into the identification of key priority areas a "Big Ideas" process was undertaken:

- Contact with internal stakeholders, external stakeholders and interested parties was initiated through communication channels that had been established in the first stage of the Challenge. These included direct contact through the Science Leadership Team to named organisational leads and points of contact (including in key end user organisations) and through an established Challenge Newsletter which is distributed across research and stakeholder communities.
- Using these channels members of the Challenge Community as a whole were invited to submit "Big Ideas" to inform the SRAs. A simple template was used with clear explanatory notes – the intention being to reach out beyond contributors who were familiar with particular research techniques (Figure 4).
- The Interim Science Leadership Team facilitated this process within their organisations and networks to ensure that ideas were developed collaboratively, workshopped and aggregated before submission.
- 30 Big Ideas were submitted.
- Over a series of subsequent workshops, the Interim Science Leadership distilled the 30 Big Ideas into the six SRA's.
- These were then tested both amongst the Challenge research community, and stakeholders.

It is acknowledged that the potential scope for research that could be undertaken within this National Science Challenge is vast. Given the levels of research funding available for work in the built environment, engagement around the potential of the Challenge has been extensive and from a diverse community of interests. It is recognised that there are a wealth of different areas of interest and potential research that could have been included. Choices have been made in order for the Challenge to focus and direct its resources.

The engagement and SRA processes outlined here underpinned the choices. This meant working with stakeholders and amongst research leaders to make choices about how best the Challenge mission could be advanced. It is recognized that some areas of potential research have not been included at this time. For example, the SRA prioritisation process has seen the Challenge decide not to focus substantive effort on areas such as transportation, infrastructure, building technologies, diversity during its first phase.

We also note that the SRA process was used to look beyond the existing research and policy landscape. A wide range of work is already underway by (in particular) government to address some pressing issues pertinent to this Challenge such as housing affordability. The SRA process was used to test the additionality of the Challenge and push for it to recognise but move beyond these existing initiatives.

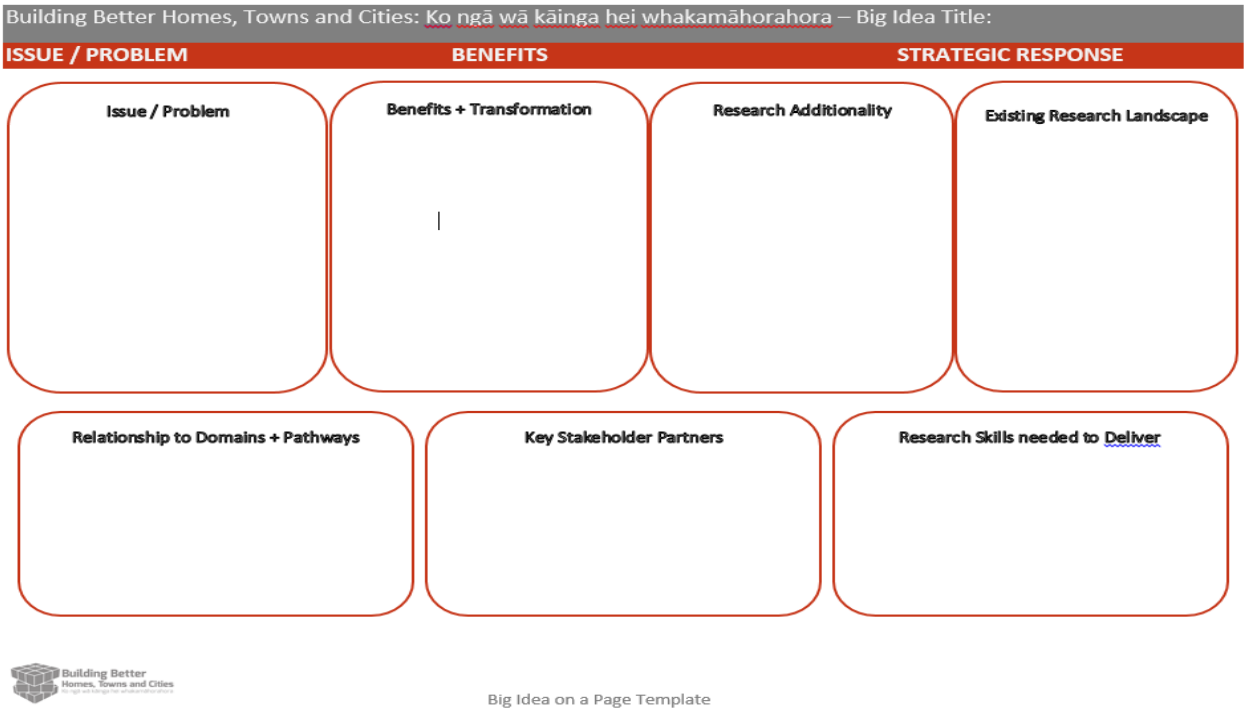


Figure 4 Big ideas template

1.4.7.3 Engagement Mechanisms

Engagement with internal stakeholders has occurred since the idea of a BBHTC Challenge was first feveloped in 2014. Stakeholders will be closely involved in the design and implementation of research in all of the Strategic Research Areas as described in each SRA in Section 2 (Stakeholder Involvement and Pathway to Implementation). They will be carrying out co-creation of the research and implementing the new knowledge, concepts and tools as part of the planned activities.

In addition to direct participation, the Challenge Contractor will apply learnings from leading large, multidisciplinary research initiatives to transfer information across providers. Building on the existing Challenge proposal webpages, we will establish for internal stakeholders:

- **An internal communication platform** to facilitate regular exchange of research results and early-stage data to all Challenge Parties. This will enable updates on investment processes, visits by relevant experts, evaluations and reviews, awards, outreach and engagement.
- **A restricted-access, log-on 'wall'** on which researchers can 'post' material for discussion or peer review before release.

To communicate with external stakeholders and interested parties, as well as internal stakeholders, we will use:

- **Strategic Research Areas specific initiatives** (as described in Section 2, (Stakeholder Involvement and Pathway to Implementation) including wānanga[i], hui, workshops, meetings, learning spaces, charettes, demonstration projects, training sessions
- **Publications and conferences:** Engagement with the research community will involve workshops, meetings and wānanga, the traditional academic pathways for dissemination of knowledge and the generation of debate such as journal publications and conferences. The next Australasian Housing Researchers' Conference is scheduled to be held in New Zealand in 2016, and this presents an opportunity for the Challenge to engage with researchers in New Zealand and Australia, to further collaboration, and to share what we have learnt through the development of this proposal and our initial research programme.
- **Research-prompted New Ideas Colloquia** (as described in Section 1.3.7)
- **Challenge the Challenge Colloquia** (as described in Section 1.3.7)

1.4.7.4 Engagement Ethics

Research with individuals, families and communities about their homes and workplaces raises ethical questions that will be addressed at a project-specific level. Each Challenge project that involves human participants will be expected to obtain ethics approval from the appropriate body at the institution of one of the research leads. While institutional practices differ in this regard, all Challenge projects are expected to adhere to the values of respect for human dignity and cultural values, concern for the welfare of participants and researchers, and justice.

There are also a set of ethical considerations for engaging with Māori organisations and communities. It may be desirable to develop a set of guidelines for engaging with Māori organisations and communities to promote common understanding and to assist researchers to build new relationships. This Challenge aims to build a cohort of researchers who have the skills and capabilities to work within both Mātauranga Māori and Western science paradigms. For the Challenge Commencement Phase we have utilised the existing ethical guidelines Guidelines for engagement with Māori communities/organisations developed by the Resilient Urban Futures project. In the remainder of the Commencement Phase of the Challenge we will develop Challenge Specific Guidance and protocols for engagement with Māori communities and organisations that build on the Guidelines for engagement with Māori communities/organisations.

1.4.8 Building the team

From the outset we have placed a strong emphasis on building a Challenge team that is committed to and has the abilities to deliver on the National Science Challenge principles, particularly coherence and additionality. The team culture has been reinforced through the SRA development process where teams have been multi-disciplinary and multi-organisational with new research relationships emerging through the research development process as can be seen in the spread of organisations shown in Table 8.

[i] Wānanga – to deliberate, to hold higher learning discussions, seminars or forums. In precolonial times the core source of knowledge studied was not only the philosophy but also the scientific observations of the natural environment were discussed for days and months among tohunga or sage experts.

Organisation*	Transforming Decision Making	Next Generation Information	Supporting Success in Regional Settlements	Shaping Places: Future Neighbourhoods	Hei Papakāinga Ora	Transforming the Building Industry
AUT	1			1		4
BRANZ	1					2
CRESA	2					
DWS				1		
Landcult Ltd				1		
LU	1		3	7		
MU	1			2		
MRC Ltd				1		
Motu			2			
PP Ltd			1			
PPR Ltd	1					
Rimu Ltd	1					
Opus		2	1			1
Scion						
Unitec				1		
UA	4		1	5	1	5
UC		5	1	1		
UO	1	2	1	1	2	
UW	2		4	1		
VU	1			2	4	2
WC Ltd			1			
Independent					3	

* DWC= DWS Creative Ltd , LU=Lincoln University, MRC Ltd=Mackie Research & Consultancy Ltd, MU=Massey University, PP Ltd= Peoples & Place Ltd, PPR Ltd=Public Policy & Research Ltd, Rimu Ltd= Rimu Research Ltd, UA=University of Auckland, UC=University of Canterbury, UO=University of Otago, UW=University of Waikato, VU=Victoria University, WC Ltd=Waiora Consulting Ltd

Table 8 Range of organisations collaborating in Strategic Research Areas

The team emphasis has been carried through the process for the development of the SRAs where we have employed a model with pairs of facilitators being responsible for the strategic leadership and development of an SRA and for working with other facilitators and Science Leadership Team members to ensure that the research plan as a whole is coherent and well-rounded.

Both the Science Leadership Team, and the wider team of researchers who have participated in the commencement phase of the Challenge, include researchers with a range of experience, from distinguished senior researchers, mid and early career scientists and post-graduate students.

As we move from commencement to implementation of the Challenge we will continue to value and support the cross-disciplinary team culture. We will be purposefully creating expectations and opportunities for Challenge researchers to come together at an SRA and Challenge level including methods explained above in Section 1.4.7.3.

We note in particular the intention to use the biennial colloquia to explore emerging collaborative approaches such as new technologies. We are aware that new tools for joint research and collaboration will emerge during the life of the Challenge. The colloquia will include dedicated provision to share insight around these, and also self-review the effectiveness of existing Challenge collaboration.

Given the centrality of new forms of collaboration to the Challenge's success in delivering its mission, we also note that the Governance Group will be monitoring the quality and effectiveness of collaboration through the evaluation and performance framework.

1.4.9 Building capability

The Challenge activities will improve research skills and increase capability, providing project opportunities for postgraduate researchers and early-career scientists who are essential to maintaining an invigorated approach within the Challenge research programme. Established researchers will also extend themselves to understand new techniques and manage their integration with existing infrastructure and concepts. By enhancing the scientific expertise across the different sectors of the New Zealand built environment, the Challenge will strengthen science capability and create long-term knowledge partnerships with industry. Specific upskilling of researchers is described in the Strategic Research Areas in Section 2 (Team Upskilling). The Challenge is committed to widening and strengthening the research landscape by ensuring each set of SRA projects includes an imperative to provide professional guidance and support to the next generation of researchers during each stage of their career. In particular we note that this mentoring will offer emerging researchers the opportunity to:

- Contribute in a collaborative research environment;
- Gain exposure to interdisciplinary research, and expand their skills in data collection and coproduction;
- Learn effective dissemination techniques and networking skills; and
- Develop and strengthen their understanding of Kaupapa Māori research.

The Challenge will utilise the established BRANZ and university scholarship programmes as vehicles to focus financial support and mentoring for PhD and MSc candidates at New Zealand universities who are working on projects which align directly with Challenge activities

The Challenge will also:

- Bring researchers together in multi-organisational/disciplinary teams to broaden existing expertise and increase understanding of the built environment;
- Increase capability in technology transfer, science communication and outreach;
- Generate increased understanding by researchers of Te Reo, tikanga and Mātauranga Māori through collaborations between Māori and non-Māori researchers in research with Māori communities, to ensure that the Challenge responds to the needs of Māori; and
- Utilise rotating members of the Science Leadership Team to provide new and emerging researchers with science leadership opportunities and development.

1.5 Vision Mātauranga

1.5.1 Governance

A Board Skills Matrix has been developed by the Interim Governance Group to assess whether nominated persons are suitable candidates for the BBHTC Board. One of the essential skills and areas of expertise required in the Group is around Vision Matauranga/Māori, preferably in the built environment sector.

1.5.2 Advisory Groups

The Kāhui Māori (described in Section 1.4.3) will provide advice to Challenge leadership on implementation of Vision Mātauranga and wider matters relating to Te Ao Māori, guide engagement with Māori stakeholders and support consultation between the Challenge and Māori interests.

1.5.3 Management

Dr Kepa Morgan, Dr Simon Lambert, Dr Matt Roskruge and Dr Huhana Smith are Māori members on the Science Leadership Team (described in Section 1.4.2.3). Their bios are provided in Appendix 6.

The development of the Challenge was supported by a Māori Science Leadership Team, designed to represent the broad range of skills and expertise of the Challenge: Dr Huhana Smith, Dr Simon Lambert, Dr Matthew Roskruge, Anaru Waa, Dr Kepa Morgan, Dr Ella Henry, and Derek Kawiti. This Team have played a key role in guiding the development of the Challenge framework and structure, to the extent that Vision Matāuranga and Te Ao Māori are integral to the Challenge and the Challenge metaphor is the Tane Whakapiripiri framework.

1.5.4 Researchers

There are named Māori researchers contributing time to Strategic Research Areas as in Table 9.

SRA	Principal Investigators	Associate Investigators
Transforming Decision Making		Dr Simon Lambert Dr Fiona Cram Fleur Palmer
Next Generation Information	Dr Lyn Carter	
Supporting Success in Regional Settlements	Dr Matt Roskruge	Te Horipo Karaitiana Dr Simon Lambert Thalia Ullrich
Shaping Places: Future Neighbourhoods	Dr Ella Henry	Dr Simon Lambert Derek Kawiti Dr Rebecca Kiddle Dr Diane Menzies Desna Schollum Jade Kake
Hei Papakāinga Ora	Dr Kepa Morgan	Derek Kawiti

	Dr Huhana Smith Anaru Waa	Jade Kake Dr Robyn Manuel Dr Rebecca Kiddle Kaye-Maree Dunn
Transforming the Building Industry		Dr Regan Potangaroa Derek Kawiti

Table 9 Māori researchers participating in Strategic Research Areas

The Māori Science Leadership Team has also worked with a wider Roopū Rangahau Māori of around 25 Māori researchers, plus non-Māori researchers with significant experience researching with Māori communities. The Roopū Rangahau Māori has contributed to, and continue to contribute the development of the detailed research plan. The Roopū Rangahau Māori (Māori Research Team) includes members from a range of disciplines, levels of experience and organisations and many are the only or one of few in their organizational research teams. The Roopū Rangahau Māori process has been extremely valuable for the Māori researchers and the Challenge as a whole. Therefore we propose to continue to support the Roopū Rangahau Māori process of regular virtual and face-to-face hui. In addition we will implement a tuakana-teina relationship (buddy relationship) scheme for emerging Māori researchers to ensure that they are appropriately supported and assisted to grow into the senior Māori researchers of the future.

1.5.5 Vision Matāuranga

Leading Māori scholars across Aotearoa would attest to the demonstrable "power of the indigenous world view, when bridged to Western science, to create innovative technologies, shape future science directions, and thus promote the recognition, vitalisation and continued evolution of Mātauranga Māori." (University of Waikato, 2011). The Challenge actively promotes Mātauranga Māori as knowledge that is based in the distinct culture and identity of Māori, which also reflects the intergenerational and collective experience of Māori.

As in all things in Te Ao Māori, we must acknowledge those who have strived to advance our knowledge, which has and will continue to shape and lead innovation and development in Aotearoa. From a Mātauranga Māori perspective, karakia must always precede everything we value, in order to preserve and sustain the mauri[k] of an activity, location or element.

Kaitiakitanga of Intellectual Property rights of Mātauranga Māori is the responsibility of Te Roopū Rangahau Māori (as representative of Te iwi Māori) across each SRA. The dissemination of Mātauranga Māori itself also needs to be conveyed in an authentic, culturally appropriate manner. With the guiding principles taken from the Tāne Whakapiripiri model, we utilise an approach to enhance Mana, and strength-based engagement, manaaki tangata, operating from the perspective of caring for the wellbeing of our end users, and whānaungatanga, the interpersonal relationship skills that acknowledge our connectedness to each other and our shared goals.

In the framework of Tāne Whakapiripiri, the vision of Manaaki Tangata forms the ridgepole of the meeting house and Mana Whenua and Manuhiri form the floor of the meeting house.

[k] **Mauri** – Life principle or life force of all living things, originally from the birth of the universe. Mouri ora[k] - the celestial origin of Mauri and Mauri ora being the manifestation of Mouri ora. Mauri can be carried, it can be transferred and it can be destroyed. A core philosophy of Māori is to preserve or enhance mauri for the wellbeing of the entire ecosystem surrounding humanity.

The meeting house itself is a clear example of the way in which the ancient tohunga would locate and place the house to face the rising sun, usually in an elevated site, and to protect the whare[1] from prevailing winds. This approach to Manaaki Tangata is even more relevant, if we are to consider our obligation to future-proofing our houses, towns and cities against climate change and extreme weather pattern shifts across the globe, which is clearly affecting many communities in Aotearoa.

Our understanding of Manaaki Tangata is about helping to prepare for these disasters, as a worst case scenario, to support both low and middle-income families with strengthened, healthy and future-proofed dwellings and communities.

Indigenous Innovation: New Zealand needs its businesses and for-profit enterprises to perform at an optimum level and contribute to economic growth. Māori are actively engaged in a variety of urban and regional regeneration projects that relate to Indigenous innovation, Taiao, Hauora/Oranga and Matāuranga (e.g. Smith, Tinirau, Gillies and Warriner, 2015). This has been reinforced in the stakeholder consultations undertaken by the Māori Science Teams, where iwi have indicated that in their rohe, Rūnanga/Runaka are actively involved in strategic planning for these activities.

Of particular interest are products that may be distinctive in the international marketplace. Several Māori innovations have been identified, including locally sourced and uniquely combined building materials expressed via Māori-centric design principles (see, Morgan, 2005a, 2005b). Expertise exists within the Māori Science Team to guide this component, particularly around indigenous entrepreneurship as a form of emancipation, and physical products and outcomes that are derived from indigenous knowledge (Henry, 2007; Lambert 2013) in Hei Papakāinga Ora.

Indigenous innovation will also be important to Supporting Success in Regional Settlements in that the SRA will rely on the innovations and entrepreneurial insights of our Māori stakeholders in order to identify which connections to examine and to co-produce pathways for success from this knowledge for successful regeneration of 2nd tier settlements.

***Taiao*:** Achieving environmental sustainability through Iwi and Hapū relationships with land and sea. Like all communities, Māori communities aspire to live in sustainable communities dwelling in healthy environments. Therefore research in this Challenge related to sustainable building, in Hei Papakāinga Ora, Supporting Success in Regional Settlements and Transforming the Building Industry.

***Hauora/Oranga*:** Improving Health and Social Wellbeing. Distinctive challenges to Māori health and social wellbeing continue to arise within Māori communities through the often poor level of housing. Synergies between this theme and others within the Challenge as well as the 'Resilience to Natures Challenges' and 'Healthier Lives' NSC's will enable greater advances and a more secure research platform as future cities are home to more people of diverse backgrounds yet must collectively invest and maintain resilient infrastructure and stronger social capital to deal with existing and future hazards and disasters (Lambert, 2014a, 2014b; Lambert, Mark-Shadbolt, Ataria, & Black, 2012).

- **Transforming Decision Making** will assist in reducing the burden of poor housing outcomes through improving the ability of all actors in the building sector to make integrated decisions. This SRA will also identify how mainstream logics, tools and pathway dependencies specifically affect Māori, with a view to improving policy and legal constraints and opportunities on development of Māori land and facilitating development of papakāinga.
- **Next Generation Information:** New and better organised and managed geospatial data will underpin better planned and structured communities which improve the health and wellbeing of those living in them. In addition, the research will explicitly research Māori understandings and values in relation to spatial data, with a view to improving urban environments and investigate how Māori land right preferences can be better catered for in the cadastral system.
- **Supporting Success in NZ Settlements:** knowledge co-production will deliver methods and knowledge for improving success in 2nd tier settlements, including those with considerable Māori populations. Successful populations includes improvements in the health and social wellbeing of those living in them.

[1] **Whare** – generic term for house. Whare is often affixed with a descriptive such as Wharenui – meeting house, whare iti / wharepaku – toilet, whare wānanga – learning house, wharemoe – sleeping house, whare mate – house for the deceased to lay in state (funeral). The term whareuku depicts the prefab clay panel houses.

- **Shaping Places: Future Neighbourhoods:** will contribute by improving social wellbeing in Māori neighbourhoods through co-creating collaborative processes for community engagement in neighbourhood design, including learning spaces in Waimahia Inlet (being developed by the Tamaki Collective and three Community Housing Providers) and in Glen Innes which has a high proportion of Māori and Pacific Islanders.
- **Hei Papakāinga Ora:** will co-create methods of building papakāinga – Māori housing and communities that deliver to the needs of Māori. This will include innovative Māori building techniques and innovative methods of driving development of community housing.
- **Transforming the Building Industry:** will drive innovation in the people, products and processes in the building industry such that our future dwellings will be higher quality, thus improving the health and wellbeing of their inhabitants.

***Mātauranga*:** Exploring indigenous knowledge and research, science and technology.

- **Next Generation Information:** will research Māori understandings and values in relation to geospatial data to provide Māori-specific input to the cadastral system. It will engage with the Māori GIS Association Te Kāhui Manu Hokai (TKMH), assisting in improving Māori participation in and understanding of the geospatial industry. This SRA will also develop notions of **data sovereignty** (Taylor and Kukutai, 2015) with our stakeholders and developing practical expressions of the data sovereignty held by Māori.
- **Supporting Success in Regional Settlements:** will work with stakeholders who are Māori to get their interpretation of the connections which matter to them, the sorts of amenities which are important to their community, and the ways in which connections are expressed.
- **Hei Papakāinga Ora:** will investigate Māori understanding of what contributes to their community wellbeing i.e. links between papakāinga and wellbeing and collate Māori success stories for their papakāinga.

1.5.6 Research Methodology

Kaupapa Māori Research Principles have been articulated to underpin the ontology, epistemology and methodology of this research in the following ways:

- Research that is for with and by Māori: The Māori Science Team have consulted with their own communities (whānau, hapū and iwi), as well as with other Māori stakeholders throughout the development of the research proposals, and ensured that there is a place for Māori community researchers and postgraduate students in the implementation of the research projects;
- Research that validates te reo me ngā tikanga Māori: Each project will identify Māori knowledge that is relevant to that location and community, as well as working with Māori stakeholders, in a manner that is respectful of tikanga Māori. Further, Māori language, identity and knowledge will be incorporated into models and tools that emerge from each project.
- Research that empowers and results in positive outcomes for Māori: Te Aranga Principles will be applied to the research in an on going manner, to ensure the proposed projects are delivering positive outcomes and outputs for and with Māori and their communities, particularly those that are involved in the research; there is rich understanding and knowledge that comes from working in mutually beneficial relationships between the researcher and the researched (whakawhānaungatanga).
- Research that has widely understood and accepted outputs and outcomes, for the benefit of researchers and end users (manaakitanga)

Kaupapa Māori Research will be carried out by Māori researchers within a number of research projects, as detailed in the SRAs (Section 2). A number of projects will also utilise 'Enquiry-by-design' methodology which brings stakeholders together to discuss and develop urban design and planning solutions in a participatory and empowering manner (whakamana). Further projects plan to use research methods grounded in Māori concepts such as huihuinga, hīkoikoi, and wānanga, and identify whakawhānaungatanga as a research outcome.

This research aims to explore indigenous knowledge, and Māori aspirations, to lift and transform the imagination of Māori, to see themselves beyond substandard, rental housing, distant from their turangawaewae because there appear to be no viable or healthy housing alternatives. This goal is expressed as tino rangatiratanga, summing up the capacity to have control over the course of things Māori and, in this case, to advocate for and participate in better planning, design, and decision-making, and to create more sustainable housing, communities, and neighbourhoods. This will occur by way of Māori organising and expressing themselves in the destiny they

aspire to, as a people, uniquely related to, and identified with Aotearoa. As Durie (quoted in Smith 2011) noted, "Fundamentally, tino rangatiratanga is about the realisation of collective Māori aspiration. And despite the many faces of contemporary Māori society and the wide range of views, which exist, there is nonetheless a high level of agreement that the central goal of tino rangatiratanga is for Māori to govern and enjoy their own resources and to participate fully in the life of the country. Māori want to advance, as Māori, and as citizens of the world". Therefore, this Science Challenge will build on existing initiatives and knowledge, to develop, enhance, and disseminate a range of tools and processes that contribute to better homes, towns and cities for Māori and for the wider community.

1.6 Linkages

1.6.1 Fit in the National Research Landscape

The Challenge includes a wide range of researchers and research organisations across New Zealand, as shown in Figure 5, who have an active portfolio of related research and have been major contributors to the New Zealand discourse at a range of scales, from dwellings through to national level and in diverse areas including building science, design, sustainability, Māori development, economics, sociology, geography, and psychology, environmental science, and engineering.

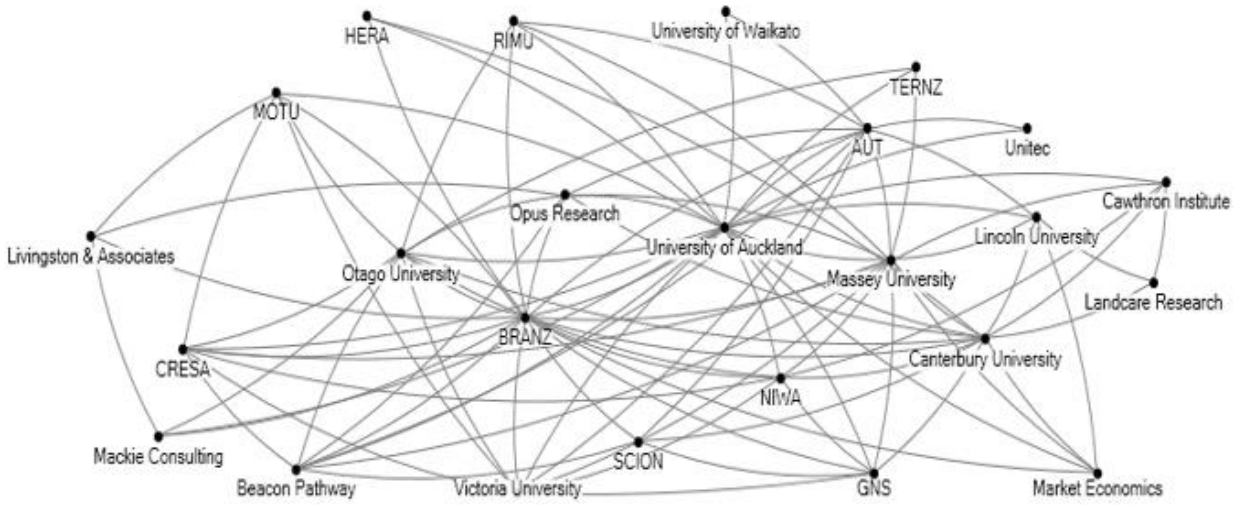


Figure 5 Illustration of nature of Research teams involved in the Challenge

Funding for the research undertaken by these teams, on which the Challenge will build, comes from a variety of sources including MBIE contestable projects, Marsden Fund, Health Research Council grants, university Performance Based Research Fund and internal funding initiatives, the Building Research Levy, central and local government agencies and industry and also from a range of international initiatives.

A number of programmes have produced research on Māori worldviews on housing and settlement design, cultural landscapes, innovative indigenous building materials, and reflecting Māori identity in settlements. These programmes include: work on the Mauri Model – University of Auckland; Tū Whare Ora – Ngā Pae o te Maramatanga/ Landcare Research Manaaki Whenua; the Whareuku project – University of Auckland; Kaitiakitanga in Urban Settlements – Landcare Research Manaaki Whenua; Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū – Taiao Raukawa and Manaaki Te Awanui Trust, with Cawthron and Massey University; and Taone Tupu Ora – Resilient Urban Futures, New Zealand Centre for Sustainable Cities.

Significant work has also been done by Māori researchers and practitioners at the 'interface' of Mātauranga Māori and Western resource management, including Coombes, Johnson, & Howitt (2012, 2013), Kawharu (2002), and Matunga (2000). Work undertaken by researchers and practitioners has resulted in the Te Aranga Māori Cultural Landscape Strategy (2008), which has been further developed into Te Aranga Māori Design Principles (these are specifically considered in the and Te Matapihi – the National Māori Housing Organisation – and the Ngā Aho Network of Māori Design Professionals are also involved in research activities. As part of Resilient Urban Futures, the Tāone Tupu Ora work programme has also developed the Ngā Pou Mauriora framework for urban governance and wellbeing which forms part of the conceptual framework for this Challenge [Waa et al, in press].

Two existing MBIE contestable contracts are mapped to the Challenge funding envelope as also mentioned in Section 1.3.9:

- The University of Otago-led Resilient Urban Futures (RUF) programme links four universities, Motu and NIWA and looks at the city as a complex dynamic system. As well as Tāone Tupu Ora (above) it includes interrelated research strands examining drivers of urban change, processes of community formation, the benefits and costs of compact vs dispersed developments, inter-city infrastructure, how city operation affects air and water quality, modelling the impacts of urban land-use, transport, and understanding active transport.
- The BRANZ-led WAVE (Weathertightness, Air Quality and Ventilation Engineering) programme is jointly funded by the Building Research Levy and MBIE contestable funding. WAVE focuses on developing practical solutions to problems that currently plague New Zealand homes such as leaky buildings and indoor mould. Working closely with domestic and international industry and research partners, it is helping to avoid future issues resulting from changes to materials, designs and construction methods.

There are several other MBIE funded projects including the CRESA project (http://www.cresa.co.nz/) and the TERNZ led (http://www.futurestreets.org.nz/) that are aligned with the Challenge.

$200,000 of existing SCION CRI core funding is aligned to the Challenge. Current research undertaken at SCION includes a focus on sustainable wood and fibre based solutions and includes internal energy and waste technology solutions.

The Health Research Council funded [healthyhousing.org.nz] has strong connections to the Challenge through the Hei Papakāinga Ora SRA. The two programmes will maintain close links as the Challenge progresses. They share a number of key researchers.

The Building Research Levy, administered by BRANZ is a significant source of research investment for the built environment. BRANZ invests in the order of $12,000,000 per annum in building-related research. This research investment is focused on delivering research that has been identified through the joint industry-government research strategy, This strategy was launched in 2013 and the 2014 inaugural conference provided a new milestone in bringing together New Zealand and international researchers from across disciplines. The relationship between this Strategy and the Challenge is provided in Section 1.6.4.

Teams from Auckland, Waikato, Massey and Lincoln Universities, Auckland Council and the AUT have also built up a large body of knowledge on Auckland research related to the Challenge. In the case of the Transforming Cities research team, they have successfully brought together a range of key researchers and stakeholders to focus in a coordinated fashion on Auckland issues and build effective pipelines for research to inform policy. There is insight from this work which has particular relevance to the Transforming Decision Making, Shaping Places and Hei Papakainga Ora SRAs.

1.6.2 Other Challenges and CoRES

Because this Challenge is focused on the environments where people live, work and play, Building Better Homes, Towns and Cities is the nexus where a number of Challenges meet. We have had initial discussions with other Challenges on areas of commonality and potential linkages and this will be an ongoing process as Challenges mature and develop.

In addition to linkages with other specific research programmes (as set out above in Section 1.6.1) weanticipate several areas where we will work with other Challenges:

- **Science Communication** – we will collaborate with the Science Media Centre and other National Science Challenges, (notably Ageing Well and Resilience) to ensure our media and communications strategy includes coordinated media releases, activities, events, resources and sharing of best practice.
- **Societal Outreach and Engagement** – integration of science and society is a common principle and prerequisite of the National Science Challenges. Discussions for such initiatives have been held between the Building Better Homes, Towns, and Cities, Deep South, Resilience to Nature's Challenges, Our Biological Heritage, and Sustainable Seas. As Challenges mature we will also look to connect with the health-based Challenges and Science for Technological Innovation in a similar way. Potential joint initiatives identified to date are:
    - a proposal by key museums to co-fund outreach activities relevant to all the Challenges; shared workshops on common themes;
    - cross-Challenge capacity building (for example cross Challenge meetings have already been held amongst Challenge management and governance on Vision Matāuranga).

We also see a significant opportunity to connect with the MBIE Science in Society initiative: A Nation of Curious Minds – He Whenua Hihiri I te Mahara. The Challenge is particularly interested in the potential of the Participatory Science Platform programme. We see particular opportunity to leverage this programme to support new types of engagement with young people, communities and scientists in collaborative Challenge projects. This Programme is currently being piloted and we will look to engage with the National Coordinator in early 2016 to explore options to utilize this model in the BBHTC Challenge.

We have also identified the need for specific connections at a research project level, to ensure that there is neither duplication of effort or inadvertent gaps. For example part of the Resilience to Natures Challenges has a focus on developing tools and techniques to make buildings and infrastructure resilient, including focusing on resilient cities initiatives. There will be value in collaborating across the two Challenges.

1.6.3 International connections

Improving the quality and supply of housing and create smart and attractive urban environments is a worldwide issue. This is reflected in the large number of countries and international institutions actively researching in these areas. Researchers and organisations involved in the development of this Challenge are well regarded internationally and have a number of very strong connections to and collaborations with key overseas researchers and institutes as described in Section 2 (International Linkages in each of the SRAs). The Challenge will facilitate the development and strengthening of these relationships. This will take the form of two way relationships. In one direction this will be through drawing international research expertise to support the planning and delivery of research (whether through active participation or peer review). In the other direction we will provide the research findings and insights back to the international community (for example through journal papers, presentations at conferences).

Key international relationships at the Challenge level are listed below.

CIB (The International Council for Research and Innovation in Building and Construction): CIB encourages international cooperation and information exchange between governmental research institutes in the building and construction sector. CIB is a worldwide network of over 5000 experts from about 500 member organisations with a research, university, industry or government background, who collectively are active in all aspects of research and innovation for building and construction. Current CIB members from New Zealand include BRANZ, MBIE, University of Auckland and UNITEC. Challenge members engage with CIB on a variety of levels from President, Board membership (BRANZ's CEO is a Board member), leading CIB Working Commissions (Professor Robert Amor is currently leader of W78 Information Technology for Construction) and participating in Task group outputs (book chapters, joint publications, international networks) and activities (annual conferences). CIB hosts the World Building Congress, the next one being in Finland in 2016, with a theme of" Intelligent built environment for life". It is fitting that the Challenge that the next World Building Congress in 2016 is focused on the built environment as an important enabler for the well-being of its citizens, the success of its companies and the competitiveness of whole society, region or country.

Fraunhofer Institute fur Bauphysik (Fraunhofer Institute): Challenge researchers have had an active working relationship with the Fraunhofer institute for building physics since 2003, starting with the Weathertight Buildings (BRAX0302) FRST project which spanned six years. During this time researchers have actively worked with Fraunhofer on a technical level, leveraging off the codebase of their range of computer models (WUFI) allowing New Zealand to make rapid progress in the area. An added benefit to this collaboration has been the incorporation of NZ climate data into the commercial release of WUFI.

IEA (International Energy Agency) – Challenge researchers have been committed contributors over the last 3 years to the IEAEBC Annex 66, an international research project on occupant behaviour 41hanau41za with collaborators from currently 24 countries and 57 organizations including universities, research institutes, design consultant companies, operation managers, and system control companies.

AHURI: A number of Challenge researchers have strong linkages to AHURI (Australian Housing and Urban Research Institute). AHURI delivers high quality research that influences policy development to improve the housing and urban environments of all Australians. AHURI has also developed a substantial body of research into housing issues for Indigenous Australians, which covers culturally-appropriate design, ways to achieve sustainable tenancies and facilitate home ownership, and the nature of mobility and its relationship to homelessness. Of the AHURI constituent research centres, we have closest contacts with the University of University of Western Sydney (Urban Research Centre); University of New South Wales (Faculty of the Built Environment, City Futures); Royal Melbourne

Institute of Technology (School of Global Studies, Social Science and Planning); Curtin University of Technology (Graduate School of Business); and Swinburne University of Technology (Institute for Social Research Centre).

CRCSI (CRC for Spatial Information): The CRCSI conducts user-driven research in spatial information to address issues of national importance to Australia and New Zealand. A key CRCSI programme addresses market failures and supporting critical spatial infrastructure in Australia and New Zealand so that essential government delivery services run more effectively, giving substantial productivity gains in Urban Planning. New Zealand is a member of the CRCSI. Greening the Grey Fields is a NewZealand based CRCSI programme.

Challenge researchers also have strong linkages to the **International Council of Science Union's Urban Health and Well-Being** which is supported by the **Chinese Academy of Science; the Institute of Sustainability** (see below); and the **UN Habitat City Resilience Profiling Programme**.

The Challenge will also benefit from particularly strong links to senior government and industry leaders as well as researchers in the United Kingdom. For example, the Deputy Mayor of London for housing and planning, Richard Blakeway, has established links with the Challenge and recently visited New Zealand to speak at the conference. Similarly Ian Short, the Chief Executive of the Institute of Sustainability recently visited New Zealand with support from MBIE.

Challenge Parties have strong links with **FRIENZ (Facilitating Research and Innovation co-operation between Europe and New Zealand)** a joint initiative between the New Zealand Ministry of Business, Innovation and Employment (MBIE) and the European Commission (EC) through its seventh research Framework Programme (FP7). The FRIENZ project aims to facilitate new and deeper strategic research, science and innovation partnerships between Europe and New Zealand. A September 2015 FRIENZ visit to New Zealand on Resilient Cities was hosted by BRANZ and was used to establish links around BBHTC.

Established links are also in place with many UK universities, the Building Research Establishment (BRE) and professional bodies such as the Chartered Institute of Housing and the National Housing Federation. The University of Auckland has strong linkages with The University of Cambridge, in particular, Professor Susan Smith (co-editor of 'The Blackwell Companion to the Economics of Housing: The Housing Wealth of Nations' and Editor –in-chief of the 'International Encyclopedia of Housing and Home'). Arthur Grimes has cemented links with the University of London School of Advanced Studies where he held a NZ-UK Link Foundation Visiting Professorship in 2013.

Links also exist with the Association of Researchers in Construction Management (ARCOM), The Australasian Universities Building Educators Association (AUBEA); Lean Construction International; together with activities through various Institutions such as IPENZ, CIOB, PMI and RICS.

1.6.4 Fit with New Zealand sector and research strategies

The Challenge will benefit from strong linkages to a wide range of existing strategies and initiatives in New Zealand (Table 10). These will both support the ongoing development and implementation of the Challenge's objectives and mission.

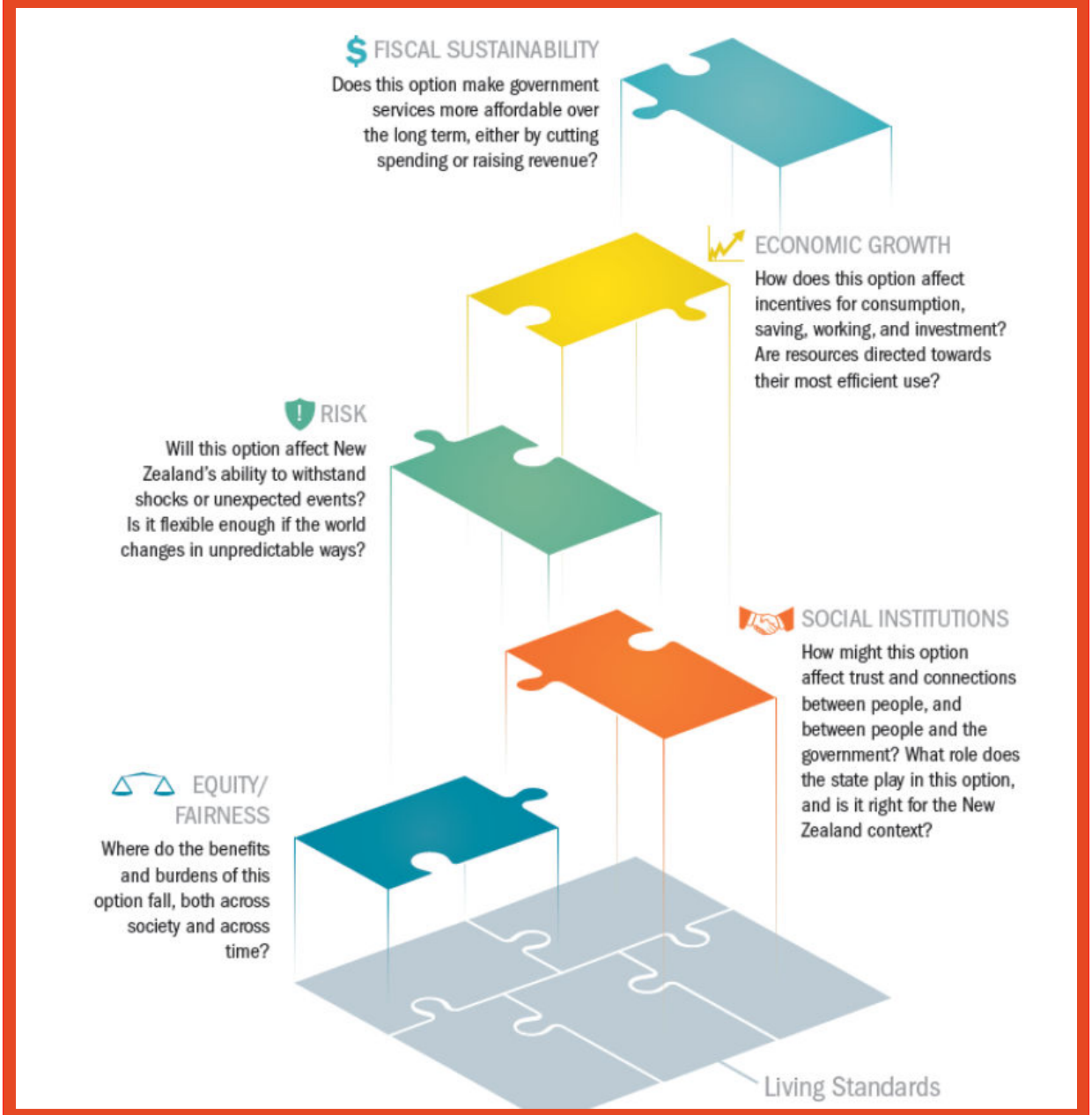
Existing strategy/initiative	Link to BBHTC
Business Growth Agenda (MBIE 2015)	The Business Growth Agenda is a key cross-government stakeholder strategy and plan. Building Infrastructure is one of the six key areas identified in the Business Growth Agenda. The government has set the high level goal that "By 2030, New Zealand's infrastructure is resilient and coordinated and contributes to economic growth and improved quality of life" (MBIE Business Growth Agenda p99). It has identified a number of key priority areas which align with work planned under BBHTC: • Priority area 6: Rebuilding Christchurch • Priority area 9: Increasing competition and efficiency in the housing construction sector • Priority area 10: Reforming the social housing sector to better meet the needs of social housing tenants

	• Priority area 11: Getting a better understanding of future infrastructure challenges and opportunities BBHTC has also utalised the comprehensive datasets and insight provided in the Business Growth Agenda Construction Sector Outlook report from 2014. This provides important baseline information about the scale and nature of activity in the sector, which has informed the development of the Challenge.
Building a Better New Zealand – the Research Strategy for the Building and Construction Industry 2013-2018 (BRANZ et al 2015)	The Industry Research Strategy (IRS) is a complementary strategy that will sit alongside BBHTC. The IRS is co-owned by MBIE, BRANZ and the building and construction industry through the Construction Strategy Group (CSG) and Construction Industry Council (CIC). The BBHTC has engaged with MBIE, BRANZ, CSG and CIC in its development. Given the centrality of the IRS to the existing research landscape it was critical to assess alignment and any potential overlap. The IRS is complementary to BBHTC. BBHTC is focused on a tightly defined transformative research path responding to the government RFP while the IRS is both broader in its coverage but also more immediate/incremental in its outlook. There are strong shared themes in the IRS and BBHTC in terms of around research focus and industry needs. The IRS themes Meeting the Housing Needs of New Zealanders, Maintaining and Improving the Performance of Existing Buildings and Building Better Cities and Communities are particularly related to the all the SRAs in this Challenge. The key dissimilarity between the IRS and BBHTC is that the IRS It is about moving forward based largely on the status quo, rather than seeking the change envisaged in BBHTC. The IRS is focused (predominantly but not outright) on short-medium term research requirements across a broader range of areas, BBHTC on transformation within the parameters for the RFP.
Productivity Commission – Housing Affordability (final) **April 2012**	This report on housing affordability in New Zealand has identified a range of factors the Productivity Commission considers to be impeding availability of affordable housing for New Zealanders. The report provides important evidence and insight that underpins many of the current government initiatives which respond to housing affordability and supply issues. BBHTC has been able to review and draw on the insight provided by this report (and the subsequent government response) in a number of key ways. First, to ensure that it is not duplicating existing effort and second, to help shape and inform its ambitions to move beyond existing work programmes and intentions. Housing affordability is a focus of SRAs Transforming Decision Making and Transforming the Building Industry.
Productivity Commission Review – Using Land for Housing (draft) **August 2015**	This review is still underway at the time of writing the BBHTC proposal. The Government has asked the Productivity Commission to review the local planning and development systems of New Zealand's fastest-growing urban areas and identify leading practices that are effective in making land and development capacity available to meet housing demand. Comparable overseas systems are also being investigated where they provide valuable lessons for New Zealand. The Productivity Commission has released its draft findings and recommendations. The government response (anticipated in late 2015 – early 2016) will also provide a rich source of information to inform the BBHTC SRAs in their early development.
Productivity Commission –	The Productivity Commission's report on regulatory performance in local government, together with summary material and inquiry submissions has been considered by BBHTC in its development. This

Towards Better Local Regulation (final) **May 2013**	is relevant given the role that local government can play in successful towns and cities and the provision of housing. The inquiry is relevant to BBHTC in that its 29 recommendations include considerations which will have implications for urban development, building safety and housing provision. BBHTC shares the Commissions' ambition that these regulatory provisions should perform well and meet local aspirations and needs. We also note that, while the Commission is concerned with regulation across the local government domain, BBHTC is concerned primarily with a narrower sub-set of this (those regulations that apply to building better homes, towns and cities). The direction of thinking in the Commission's report is valuable in informing the outcomes that could be delivered through BBHTC. For example, we note in particular the relevance to SRA Transforming Decision Making.
New Zealand Geospatial Strategy 2007 and Cadastre 2034 (LINZ, LINZ 2007))	The Geospatial Strategy and Cadastre 2034 (developed by LINZ) are key strategies which have strong links to the SRA Next Generation Information. BBHTC has worked closely with LINZ as a key stakeholder in developing this SRA. For example, in developing SRA Next Generation Information, BBHTC has been explicitly looking to plan to ensure that its work and outcomes are aligned to the comprehensive 10 – 20 year cadastral strategy. There are strong connections to the Cadastre 2034 ambition to ensure that, in future, New Zealanders will be able to more easily understand where their rights in land actually are, and Whanau those rights – and any restrictions and responsibilities – in three dimensions.
He Whare Āhuru He Oranga Tāngata – the Māori Housing Strategy **(MBIE 2014)**	He Whare Āhuru He Oranga Tāngata sets out six directions to improve Māori housing over the period 2014 to 2025. It aims to support: • Improving housing for Māori and their whanau • Increasing housing choices for Māori by growing the Māori housing sector. It sets out the opportunities open to Māori and their whanau to improve their housing situation. It also sets out the opportunities for Māori organisations to create more housing choices for Māori. BBHTC has a strong connection to this Strategy through SRA Hei Papakāinga Ora which is seeking transformative methods of improving Māori housing and thus communities.
He kai kei aku ringa – the Māori Economic Development Strategy and Action Plan (2040). **(Māori Economic Development Panel 2012)**	The Māori Economic Development Strategy and Action Plan, He kai kei aku ringa, is designed to boost Māori economic performance and benefit all New Zealanders. It recognises that, for too long, thinking about Māori and the Māori economy has been shaped by a deficit lens. There is an awareness within Te Ao Māori of the importance of economic development which is also reflected in the BBHTC. More and more, Māori are expressing their aspirations in economic terms. With post-settlement iwi emerging as key investors and developers in the built environment it is clear that this has significant implications in the shaping of homes, towns and cities for all New Zealanders (SRAs Shaping Places and Supporting Success in NZ Settlements as well as the strongly Māori-focused Hei Papakāinga Ora). Looking beyond the economic development potential, He kai kei aku ringa also recognises that the unique Māori features and advantage offered by what it terms "brand Māori": • an intergenerational focus on the collective good and longevity; and • the multiple bottom-line approach.

30 Year New Zealand Infrastructure Plan **(National Infrastructure Unit 2015)**	The Thirty Year New Zealand Infrastructure Plan sets out a vision that by 2045 New Zealand's infrastructure will be resilient and coordinated, and contribute to a strong economy and high living standards. Delivering on this vision requires New Zealand to make a step-change in its approach to infrastructure planning, delivery, management and use. It identifies a need to better understand the levels of service we want to deliver, more mature asset management practices and use of data, and more effective decision-making that considers non-asset solutions. The 2015 Plan includes a comprehensive suite of actions that will be undertaken to deliver on the new approach and drive the two outcomes sought from the Plan – the better use of existing infrastructure and the better allocation of new investment. There are a number of key challenges identified in the NIP which can be supported by BBHTC and which have been included in our thinking. For example, the NIP notes that NZ has a number of aging infrastructure networks that will need renewing. This is a simple consequence of when they were built; they are nearing the end of their life. For example, the schooling estate has an average age of 42 years and parts of our water network are now over 100 years old. Meeting the cost of infrastructure renewal and maintenance is even more challenging in areas with smaller rating and economic bases. BBHTC will be able to help address this through the SRA – Next Generation Information which will assist through visualisation and improved planning of infrastructure. The NIP is also concerned with the changing face of NZ. By 2045 it expects another 1.2 million people to live in New Zealand. However, this increase will not be evenly spread across our country: 92% of this growth will be across just five regions, and over 60% is likely to be in just one region: Auckland expected to grow by 716k people). Several regions are expected to shrink over this period. This growing and shifting economy will create infrastructure pinch-points. The continued growth of New Zealand's economy will be more concentrated predominantly in Auckland, creating infrastructure pressures in housing, urban infrastructure, the three waters and roads. BBHTC will be able to help address this via Next Generation Information.
Social Policy Evaluation and Research Unit (Superu) Families and Whānau Status report 2015	This Report presents, for the first time, New Zealand family and whanau wellbeing indicators using family and whanau frameworks developed for this purpose and provides baseline information (from 2012-13) against which progress will be measured. There are a number of the Family Wellbeing Indicators which have direct relevance to BBHTC and which the work of BBHTC will help support: Theme – Economic security and housing 2. Less deprived neighbourhoods – percentage of families living the least deprived (decile 1-5) neighbourhoods 4. Affordable housing – percentage of families where housing costs are less than 25% of equivalised family disposable income 5. No housing problems – percentage of people who do not have any major problems with their house or flat Theme – Safety and environment 3. Feel safe at night in neighbourhood – percentage of people who feel safe or very safe walking alone at night in their own neighbourhood

	5. No neighbourhood problems – percentage of people who report no major neighbourhood problems In the development of BBHTC the Family Wellbeing Indicators have been used to help shape the focus of the SRAs (Particularly Transforming Decision Making and Shaping Places).
Treasury Higher Living Standards Framework 2012	The Higher Living Standards Framework focuses on the most important things for lifting living standards in New Zealand. The Living Standards Hub will provide a vehicle by which BBHTC researchers can share their policy-relevant research and analysis; connect with other researchers and policy analysts; and discuss their work and ideas on living standards.



National Pipeline Report on building and construction July (MBIE 2015)	The (third) National Construction Pipeline Report provides a forward view of national construction demand for the six years ending 31 December 2020. It was commissioned by the Ministry of Business, Innovation and Employment (MBIE) and jointly prepared by Pacifecon (NZ) Ltd and BRANZ. The report is based on a compilation of economic forecasts of building and construction. It includes graphs and commentary on forecast and actual building and construction work. The pipeline report has been used by BBHTC to help understand and quantify the scale of work that is anticipated to be carried out during the first phase of BBHTC. Forecasts show the nature and timing of future building and construction work, by type and region, through to December 2020. These forecasts are complemented by information on known non-residential building and construction intentions from January 2015 to December 2020 and actual building and construction data from January 2013 to December 2014. This information has been used by BBHTC to provide baseline information about current scale and trends in the industry.
National Science Challenge (2015) Resilience of Natures Challenges	Throughout the development of BBHTC the co-directors have been working closely with the Director of RNC. There is a strong understanding of potential for joint working around resilience in the built environment, a key theme in RNC. This was reinforced at a joint MBIE, EQC and BRANZ organised National Built Environment Leaders Forum, held in September 2015. The Forum attracted over 200 key business, community and government leaders from New Zealand and internationally. It is also noted that there are many shared researchers between the 2 Challenges. There is potential for the development of a future shared SRA between RNC and BBHTC on resilience and buildings (subject to resourcing).
National Science Challenge (2015) Ageing Well	Initial discussions have taken place about Challenge connections between the Chair of AW and the Chair of the BBHTC IGG. In particular both Challenge's recognise the importance of addressing the changing housing needs of an ageing population (Ageing Well Challenge Project A. Independence and housing tenure) . Given the choices that have had to be made in the development of both Challenges, it is recognised that this area has not been fully/comprehensively addressed in the research focuses of both AW and BBHTC at this time. Discussions between the Challenges have highlighted a desire to work in this space jointly, utilising the respective Challenges' expertise and leadership to make in-roads, even if this is outside of respective funded Challenge Programme Agreements. This could, for example, take the shape of a joint Challenge initiative which seeks to leverage their expertise and forge a stand-alone SRA in this space (subject to resourcing).

Table 10 Relationship of Challenge with national strategies

1.7 Challenge Outcome Development and Structure

The Challenge Outcomes, in brief are:

- **Whānaungatanga** Social interaction, enabled by the built environment
- **Kaitiakitanga** Built environments connecting people to the natural environment
- **Ukaipotanga** Identities acknowledged and valued through the built environment
- **Wahi manaakitanga** Health and safety promoted through the built environment
- **Whairawa** Equitable access to wealth and resources enabled in the built environment

The process for development, consideration and reconsideration of these Outcomes is as important as the Outcome statements themselves. The research that will be undertaken in response to NSC11 exists in the complex spaces between people, the built environment and the systems that are developed to manage quality of processes and products and flows of information, decision making and response. The systems have overlapping scales, differentiated settings and different value orientations. As a Challenge, we place a strong emphasis on evaluative reasoning as an underpinning strategy to support outcome delivery. Evaluative reasoning requires researchers and practitioners involved in this Challenge to:

- Clarify outcomes and questions
- Establish clear criteria through which the value or quality of interventions and processes can be identified
- Provide defined standards (or metrics or indicators – such as the Mauri model) against which quality can be measured
- Ensure that arguments about the value of our contributions are well warranted.

Based on an evaluative approach, the delivery of the Challenge will therefore be determined across all high level aspects of the Challenge i.e. the value, merit and worth of:

1. The research findings and processes of both individual projects and combined across the breadth and lifetime of a Challenge delivering to Challenge Outcomes
2. Research in terms of it reflecting Mātauranga Māori leadership, engagement and thus delivering to the Challenge outcomes
3. The collaborative, interdisciplinary research processes in the NSC11 approach in delivering Challenge Outcomes

The understanding of the scope and intent of the evaluative framework has and will be provided and communicated through visual outcomes modelling (VOM) and visual monitoring and evaluation planning (VMEP). Structured visual displays provide a systematic way to articulate the aggregate, collective purposes of the Challenge and display the themes and research questions within the Challenge in relation to each other.

We have utilised visual modelling to drive the identification of Challenge Outcomes. Visual modelling relies on the principle that "visual-spatial displays augment cognition" (Hegarty 2011, p.450) in a number of different ways. The ways that are useful in this framework context are that they

- provide a concise external summary of things to be considered;
- organise information spatially by bringing like things into proximity to facilitate the "search and integration of disparate sources of information" (ibid); c) help us use "vision to think" (ibid p. 451) and to consider emergent patterns that might not otherwise be apparent; and finally,
- where the visual display is interactive (as it is in this case) it reduces the need to sift through and decide about which complex interrelations are significant as they are made more transparent and accessible through the visual map.

This outcomes modelling methodology facilitates how we represent and understand the complex processes that underpin the research and activities the Challenge undertakes. The models have been prepared by independent consultant, Paul Duignan in consultation with members of the SLT and MSLT and uses proprietary software (http://doview.com) to generate interactive, iterative visual outcomes models and evaluation and planning displays. The initial development work on these is discussed in the next sections. A high level summary of the model is shown in Figure 6.

In the initial planning processes the visual outcomes model identifies how the conceptual constructs, Outcomes, Pathways, and Strategic Research Areas are aligned with the Tane Whakapiripiri Framework (Figure 2). The more detailed visual monitoring and evaluation plans identify how and when Outcomes, and the delivery from the SRA and projects can be described. Visual linkages within and between SRA and individual projects and how they map to the overall Challenge framework and outcomes are demonstrated in the outcomes model (Figure 6). Change potential comes through the participants understanding how and at which points projects are interconnected and build on each other, what needs to be communicated to who, and when processes and outputs become time-critical.

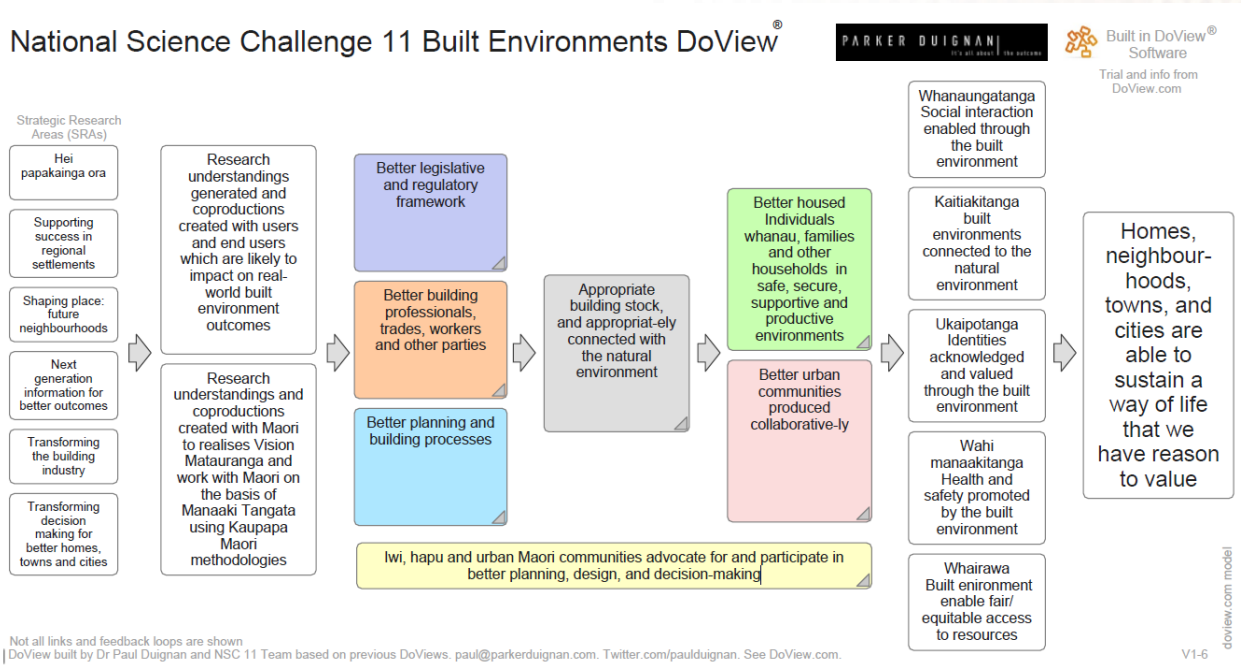


Figure 6 Summary outcomes model

The visual models provide an overarching strategic framework for the Challenge, clarify the contribution of each Strategic Research Area to common outcomes, and identify how indicators will be used for evaluating progress. Such a framework enables us to report with confidence on how research responds to the Challenge and 'makes a difference' across the lifecycle of the project.

1.8 Critical Aspects of Challenge Development to June 2016

The Challenge team has had a compressed timeline in which to create the collaborative programme of work described in this document. We recognise that there are specific aspects of the Challenge on which we will have to undertake some intensive activity over the next 6 months. These are listed below together with reference to the specific area of the Plan in which the activity is described.

	Actions	Timing	Section
Governance	Independent Chair appointed replacing Chair of Interim Governance Group Richard Capie	Oct - Nov 2015	1.4.1 Governance Group 3.3 Governance Arrangements
	4 to 6 Board members appointed additional to Chair	Oct - Dec 2015	
Kāhui Māori	6 members of Kāhui Māori appointed	Oct-Dec 2015	1.4.3 Kāhui Māori
Independent Science Advisory Panel	3 members of Independent Science Advisory Panel appointed in addition to Prof William Clark, Prof Philip McCann, Dr Tim Williams	Oct - Dec 2015	1.4.4 Independent Science Advisory Panel
Director	Director appointed replace interim Co-Directors Ruth Berry and Prof Richard Bedford. Process underway with job description created.	Oct 2015-Jan 2016	1.4.2.1 Director Appendix 4 Director Job Description
Manager and administrative support	Challenge Manager (0.6FTE) and Challenge Administrator (0.2FTE) appointed	Jan-Mar 2016	1.4.6 Challenge Management
Strategic Research Area	Work with key stakeholders and end users to fully scope and detail research at the project level Governance Group approval Initiate research activities	Oct-May 2016 June 2016 July 2016	2.2 Staging of SRAs, 2.8 Hei Papakāinga Ora
Outcome framework and	Complete Outcome framework at SRA and Outcome levels	Oct - March 2016	1.7 Challenge Outcome Development
Monitoring and evaluation	Develop detailed monitoring and evaluation framework and plan including	Oct - April 2016	3.8 Monitoring of Performance 2. Research Plan

	more comprehensive set of KPIs based on outputs described for each SRA		
Detailed Communications Strategy & Plan	A comprehensive Communications Strategy & Plan will be developed on the basis of the existing framework Governance Group approval	Oct 2015 – June 2016 July 2016	Appendix 10, Communications Plan

2 RESEARCH PLAN

2.1 Portfolio Overview

Six Strategic Research Areas (SRAs) have been selected as the initial focus of the Challenge, based on their delivery to Challenge Mission, Objectives, Pathways and Outcomes and through interaction between Challenge researchers, the interim Science Leadership Team and Challenge stakeholders as described in Section 1.4.2. These Research Areas are summarised in Table 11 and the detail of the research they will undertake described in the following sections. There are strong linkages between several of the SRAs as described in each SRA.

	Principal investigators	Organisation
Transforming Decision Making for Homes, Towns & Cities	Prof Iain White Kay Saville-Smith Prof Larry Murphy	University of Waikato CRESA University of Auckland
Next Generation Information for Better Outcomes	Prof Simon Kingham Dr Rita Dionisio Dr Ioannis Delikostidis Dr Lyn Carter	University of Canterbury University of Canterbury University of Canterbury University of Otago
Supporting Success in Regional Settlements	Dr Suzanne Vallance Dr Arthur Grimes Dr Matt Roskruge	Lincoln University MOTU University of Waikato
Shaping Places: Future Neighbourhoods	Prof Errol Haarhoff Prof Karen Witten Prof Marc Aurel Schnabel Dr Suzanne Vallance Dr Ella Henry	University of Auckland Massey University Victoria University Lincoln University AUT University
Hei Papakāinga Ora	Dr Kepa Morgan Prof Philippa Howden-Chapman Dr Huhana Smith Anaru Waa	University of Auckland University of Otago Independent University of Otago

Transforming the Building Industry	Prof John Tookey Lynda Armitrano Prof Suzanne Wilkinson	AUT BRANZ University of Auckland

Table 11 Strategic Research Areas.

2.2 Staging of Strategic Research Areas

Research will commence on the SRAs from January 2016, on the basis of funding being approved. Research will commence in 2016 on timelines as described in the SRAs below in detail. We note that work is required across SRAs to finalise the scope of projects prior to Science Leadership Team approval.

In the case of Hei Papakāinga Ora this is part of the necessary process for engagement with Māori stakeholders. The importance of building and establishing strong, enduring relationships with Māori is particularly important in the HPO SRA. Accordingly, the staging of this SRA recognises the need to build **whānaungatanga** (reciprocal relationships) first, then develop the **kaupapa** (the genuinely shared purpose/meaning/agenda that binds and focuses everyone involved) and then focus on **putea** (the money/resourcing) that supports the SRA. Relationship building and related selection of research projects will take place through to June 2016 with the intent of research commencing in July 2016.

We will also stage the Transforming the Building Industry SRA. The importance of the Transforming the Building Industry SRA to the Challenge has been acknowledged in the prioritisation processes that were used to identify and then create the SRAs. At the time of submitting the proposal it is, however, recognised that further work is required to strengthen and more fully develop this SRA, in particular to engage with key end-users which is fundamental to selecting and scoping the specific research projects to be undertaken. Innovation assessment will take place Jan-Jun 2016 associated with identification of the onward research projects.

All SRAs have been budgeted and programmed through to June 2019. At this point a review of the Challenge will be undertaken by MBIE before any second phase is contracted. In parallel, the Challenge Governance Group will review the progress of the Challenge research portfolio in delivering the Challenge objectives. At this time, SRAs that will continue in to the second phase will be identified and re-scoped. New SRAs will be defined at this time, in particular in light of findings from the first phase of the Challenge. This will also provide an opportunity for re-fresh, of both research and researchers.

2.3 Infrastructure

In regard to the infrastructure required to undertake the research, the vast majority requires no significant infrastructure beyond the normal requirements for office space and personal computing. The single instance of requirement for specific infrastructure beyond the norm is listed in Next Generation Information.

2.4 SRA 1: Transforming Decision Making for Homes, Towns and Cities

	Name	Org.*	FTE funded by Challenge	Skills of individual
PI	Prof Iain White	UW	0.2	Project management, planning, regulation, policy
	Kay Saville-Smith	CRESA	0.21	Housing, sociology, public policy
	Prof Larry Murphy	UA	0.19	Property, finance, markets
AI	Prof Errol Haarhoff	UA	0.07	Architecture, design, urban growth
	Dr Simon Lambert	LU	0.17	Māori development
	Prof Karen Witten	MU	0.07	Neighbourhoods, capacity building
	Dr Pip Wallace	UW	0.11	Law
	Fleur Palmer	AUT	0.07	Māori housing
	Lynda Amitrano	BRANZ	0.08	Building and construction
	Bev James	PP&R	0.21	Social housing
	Ruth Fraser	CRESA	0.21	Housing and social policy
	Dr Elsie Ho	UoA	0.04	Diversity and settlement
	Emma Ferguson	RIMU	0.09	Housing, Local Government
	Alison Chang-Richards	UA	0.11	Christchurch Lived Experience
	Prof Philippa Howden Chapman	UO	0.02	Housing and health
	Dr Ralph Chapman	VU	0.02	Cities and housing
	Dr Fiona Cram	UA	0.18	Māori issues, psychology
PhD student		UW	1.0	Regulating Agencies: planning and regulation
PhD student		UA	1.0	Resource Holders: finance and markets

*CRESA = Centre for Research Evaluation & Social Assessment, LU=Lincoln University, MU = Massey University, PPR=Public Policy & Research, RIMU=Rimu Research Ltd, UA = University of Auckland, UW = University of Waikato, VU=Victoria University

2.4.1 Outputs

By July 2019:

- Decision makers of all types, i.e. Resource Holders, Critical Actors (supply and demand sides of building) and Regulators, will have a deeper understanding of the complex system within which they operate. They will know how their decisions affect others and, in turn, who constrains their decision making. They will have greater knowledge of how their processes may privilege certain practices and who they need to work with to deliver shared outcomes.
- Local and central government, housing providers and the building industry will have a change platform for achieving improved outcomes through access to a robust and transparent mapping of the path dependencies, logics and tools which inhibit the

adoption of key platforms promoted as delivering better homes, towns and cities, for example Special Housing Zones, mixed use intensified redevelopment, smarter streets, and papakāinga.

- Input to Transforming the Building Industry regarding specific building industry processes for improvement focus.

The impacts of this SRA will flow beyond 2019. Over the longer term this innovative and systemic approach will help those concerned with building better homes, towns and cities understand when, why and by whom decisions are made. It will reveal their criticality, connectedness and wider spatio-temporal impact. It will provide an innovative framework within which institutions may act to inhibit or enable change. It will enable existing logics, power relationships and behavioural norms to be challenged and changed to better reflect the complexity of decision-making and the need for future reflexivity and reversibility. By challenging a series of norms prevalent in building better homes, towns and cities, such as silo-based problems and fixes or long-held processes and practices, it will also facilitate greater impact of research emerging from across the Challenge and beyond its lifetime.

2.4.2 Context

The activities of multiple actors in a range of markets (land, development, finance, mortgage, housing etc.) profoundly influence the development and evolution of built environments. To understand and transform the trajectory of housing and urban processes it is essential to engage with these varied decision makers operating within these complex market settings. As such, our SRA aims to analyse the various logics in the **complex 'architecture of decision-making'** created by the myriad of de jure and de facto actors that in combination are involved in shaping our homes, towns and cities. From this interaction we will create shared understandings with actors and agencies regarding how to shift decision-making to reflect the need to deliver better houses, towns and cities in New Zealand. In addition, by adopting this broader systemic perspective we will create opportunities for intervention to be more effective across related fields.

We are undertaking this task through research embedded in contemporary international debates related to understanding and enabling change (e.g. McCann and Ward, 2011; Simmie 2012; Jasanoff, 2013) in urban environments (Bridge and Watson, 2013, Gleeson, 2015; Ward and McCann, 2011: Peck, 2015) and housing (Roland, 2008: Smith and Searle, 2010; Smith 2015; Lovell and Smith, 2010). A key feature of our research is recognising that the way we know and represent the world is inseparable from the ways in which we choose to live in it (Jasanoff, 2013). Knowledge and solutions are embedded in wider societal contexts rather than being separate artefacts to be generated and applied, as has been the prevailing focus of urban research In New Zealand.

This research builds on, but goes beyond, recent New Zealand research, which tends to focus on the outcomes of decisions, to explore who makes decisions, and why and how does that affect the decisions of others. Traditional urban research has tended to adopt a siloed approach to issues, focusing on specific problems, sectors/industries and outcomes (e.g. BRANZ, 2013; MBIE, 2012, 2013 and 2014: New Zealand Productivity Commission, 2012 and 2014). However, to address the complex interdependencies that shape our persistent housing and urban problems, research needs to engage with systemic, cross-sectoral, processes and practices. Our research focuses on key decision-nodes and brings together actors and agencies, many of whom have been neglected in housing research, from across the wider system relating to the provision of better homes, towns and cities. It follows new approaches being developed overseas both into the architecture of decision-making in housing and build environments but also the dominant decision-making logics and path dependencies affecting different people, organisations and sectors.

Understanding the architecture, logics and path dependencies of cross-sectoral decision-making creates the conditions to facilitate transformation. The institutional structures and networks of actors within markets are central to our analysis (Ball, 2006: Lovell and Smith, 2010). Markets are not just neutral resource allocation mechanisms, but consist of networks of actors that make strategic decisions in response to external pressures (e.g. funding criteria, regulatory conditions). For example, to address issues of 'risks' and 'returns', actors within markets adopt accepted industry heuristics and often resist innovations deemed to be costly (Lovell and Smith, 2010) or that have the potential to destabilise existing market players.

Drawing on recent research that challenges traditional understandings of markets as fixed, we recognise that ***actors and institutions actively 'make markets'*** (Callon, 1998) and in the process can often ***resist policy or technical fixes*** (Connelly et al, 2015). Internationally, these understandings are being applied to decision-making for housing and built environments (Ball, 2006), to reveal the logics and path dependencies affecting different sectors and institutional settings (Adams, 2011; Adams, et al. 2009; Adams et al. 2012; Lovell and Smith, 2010, Rydin et al. 2015), and in coproducing knowledge with stakeholders to better embed change (Jasanoff, 2013). We will draw on insights from these contextual approaches and focus on three types of actor/institution that together facilitate a systemic

perspective: i. Critical resource holders – of land and money, ii. Critical actors – affecting the supply and demand sides of housing, iii. Regulating agencies - related to the wide realm of housing from finance to building to planning to health.

A requirement for transformation with regard to better homes, towns and cities in New Zealand is ***identifying and challenging 'path dependencies'***, which describes the notion that future choices are constrained by previous decisions (see Djelic & Quack, 2007). In path dependence, system elements such as persistence or durability and normality, which are seen as positive aspects, instead serve to 'lock-in' a prevailing trajectory (Page, 2004) or replicate practices (David, 1985). For existing networks, institutional lock-in is an effective way to manage risks and reduce uncertainties for market actors, as risks become calculable (Callon, 1998). Actors including policy-makers, the business sector and communities, may have long-standing decision-making frames, routines and processes through which a prevailing system is reproduced and current trajectories resist change (Adams et al 2009; Lovell and Smith, 2010). Therefore our research will focus on the manner in which actors, institutions and practices combine in specific 'assemblages' that create institutional lock-in in order to identify more effective policy and practice interventions to deal with these processes. Our research is closely aligned with the work in Transforming the Building Industry on improving processes and will provide insights that will contribute to the development of the agile design-led methodology employed in that SRA.

Another area where ***complexity must be considered is in relation to policy***. A traditional approach involves use of simple policy 'fixes' to achieve change; indeed, current urban and housing research in New Zealand tends to be focused on a variety of policy 'solutions' that are designed to partially enable possible transitions towards better homes, towns and cities (Murphy, 2014; 2015). Such research includes tracing the outcomes of specific processes or decisions, such as aspects of the RMA (Motu, 2014), or the impacts of land use decisions (New Zealand Productivity Commission, 2012) in order to evidence policy change. However, homogeneous policy debates or fixes do not map well onto the heterogeneous and interconnected social, political and environmental contexts of New Zealand's homes, towns and cities.

Effective transfer of policy is, again, far more complex than can be achieved by developing simple 'best practice' for 'decision-makers' (Peck, 2003). Innovation is strongly territorial and relational, being the product of locally dependent interests, actors and agencies. The effective mobility and transfer of policy or technical innovation, whether within New Zealand or from overseas, can be dependent on a wide range of issues from the flow of global capital to the local practice of power (Massey, 2011; McCann and Ward 2011; Ward, 2011; Peck, 2011).

Another aspect of ***complexity is the interface between technological innovations and uptake by human beings***. New technologies may be championed for inclusion in new development or higher industry-wide efficiency standards mooted. Experts and policy-makers often assume that consumers will make the 'correct' (rational) choices and that technology will transfer to practice. In reality, this is far from true. Guy and Shove (2000: 10) instead argue that: 'similar technical strategies do and do not make sense for different reasons and at different moments in time, and their adoption depends on the sometimes competing perspectives and priorities of a whole network of organisational actors'. Other recent research similarly highlights the manner in which markets are actively made through the actions and practices of sets of actors and institutions who don't necessarily act logically or take up more effective solutions (Callon, 1998; Çalışkan, & Callon, 2009 and 2010: Lovell and Smith, 2010).

The overall thrust of the contemporary academic literature can be seen as dealing with ***complexity through increasing understanding of the logics*** - the ensemble of ideas, concepts and categories (Hajer, 1995) - that underpin decisions connected to housing, towns and cities. Significantly these logics frame perceptions, construct meanings and in doing so help privilege certain approaches or 'solutions', or resist others. Decisions on housing in New Zealand are taken on the basis of similar, and sometimes competing, logics. For example, housing consumers are increasingly responding to investment logics that prioritise the exchange value of housing and resist building innovations that are viewed as risky (Smith, 2008 and 2015). Understandings the various and changing logics of housing consumers (facilitated by evolving finance markets) and developers (including development feasibility modelling) is fundamental to delivering new policies for the provision of affordable housing (Murphy and Rehm, 2013a; b) or to promote wider transformations in sectoral practices (Christophers, 2014; McAllister et al 2015). Therefore, our SRA is designed to identify the points where markets are 'caught between' established practices and innovation (Rydin et al 2015). Working with key actors located within a number of markets we aim to co-produce new decision making logics that will help establish new market practices.

2.4.3 Research Questions

We will focus on three key interconnected types of participants – Resource Holders (land owners and financial institutions), Critical Actors in building – supply side (those who transform land and money into homes and built environments) and demand side (homeowners), Regulating Agencies to answer:

1) What is the architecture of the participants' decision making and their tools, logics and path dependencies that influence the creation and transformation of homes, towns and cities?
2) How can we better integrate the objectives and logics of different decision-making nodes to reduce perverse incentives, moral hazard and negative externalities?
3) How can we provide practical pathways and solutions for re-tooling and visualising alternative logics that increase the potential for the uptake of transformative, shared outcomes that are aligned to the goals of NSC11?

2.4.4 Research Outline including Projects

To transform the nature of our homes, towns and cities requires key stakeholders to make decisions differently. Decisions need to be better rooted in evidence, more cognisant of the effects on others' choices both now and in the future, and determined using different logics and a wider appreciation of what success looks like – in the 'architecture' of decision-making, the path dependencies and ruling relations between decision-making nodes, the tools and logics used by those actors, and the outcomes that they enable for our homes, towns or cities.

Within the myriad of decisions associated with housing supply and the form of towns and cities, this SRA focuses on three key interconnected participants in decision-making:

i) Critical Resource Holders – Land and money are the two crucial resources; the holders are typically financial institutions (Project 1) and land owners (Project 2). Resource holders have their own tools and logics that can influence markets or shape the production and consumption of housing and urban spaces. These logics and tools can differ significantly according to specific relations with the market.

   In the finance sector, the provision of finance, practices of risk management and prudential guidelines, investment priorities and expectations of returns are constituted and assessed differently for householders accessing home finance through the retail banking sector to the financial streams available to developers, housing providers and public agencies investing in infrastructure. The logics and tools applied by financial institutions differ for development on Māori land.

   The decisions of owners of land are diverse regarding the retention, disposal, resistance to development/redevelopment of land and conditions imposed on developments through mechanisms such as covenants. These are all crucial aspects of both housing supply and urban change and redevelopment. Some significant holders of land are constrained in their choices by planning and statutory frameworks. Land use planning undertaken by councils is most commonly referenced as a constraint. The incentives and choices of Māori landowners are also shaped by a separate statutory framework.

ii) Critical Actors – There are two sets of actors positioned very differently in relation to both resource holders and regulatory agencies: supply-side (Project 3) and demand-side (Project 4).

   Supply-side actors are those who transform land and finance into homes and built environments. They include developers, housing providers (public, private and community), the construction industry and infrastructure providers. Their decisions shape the location, type and function of developments, their size, scale and timing and the functionality, connectedness and affordability of the homes delivered within our towns and cities. Their logics can be varied, hidden and have long-lasting legacies. The housing stocks and infrastructure of our towns and cities are embedded in past decisions that can constrain future choices. These actors tend to attract the attention of regulatory agencies, influenced by construction industry practices and technological and skills-based capabilities. Their logics and tools often reflect both prevailing practice and are incentivised or dis-incentivised by the practices, logics and tools applied by the financial sector as well as access to land. Some actors can also become resource holders themselves through practices such as land banking and the imposition of covenants.

   Demand-side actors are householders (owner occupiers and tenants respectively) who exercise an influence on homes and the built environment through their housing choices. It is well-established that the consumer sovereignty of householders is limited. Overseas evidence suggests that home owners are being encouraged to change their logic from use-value to asset-value and tenants struggle manage trade-offs between affordability, connectivity and use-value.

iii) Regulating Agencies (Project 5) – these include the formal, de jure agencies that act to manage the supply of land, manage financial risk, the impacts of development and the performance of dwellings on behalf of society and for the public good. Examples of relevant regulatory mechanisms range from land use planning, building codes, loan to value ratios, public health regulations and tenancy legislation around building performance. These regulatory agencies include the Reserve Bank, Local Government Councils, tenancy services, and District Health Boards. They also include a panoply of industry and professional bodies with statutory obligations to ensure acceptable practices, promote best practice and accredit professionals working in the building and finance industries such as planners, engineers, real estate agents, financial advisers, banking and insurance.

This SRA uses a multi-method approach which allows both tailoring to particular requirements of specific research projects while ensuring inter-project connections through the standardisation of approach. Across all projects set out in the table below, the analytic framework focuses on:

- Establishing the key nodes of decision-making for homes, towns and cities.
- Establishing the path dependencies between decision nodes and the materiality of those dependencies and contingencies in relation to desired outcomes, in particular:
    - Supply of fit-for-purpose housing affordable to those in housing stress
    - Age friendly, walkable and connected neighbourhood, towns and cities
    - Built environments that are adoptable fiscally, economically, environmentally sustainable in the context of changing demographic and economic conditions including settlement contraction or expansion
    - Infrastructure that is adaptable to changing needs.
- Comparing and assessing the alignment of objectives/outcomes sought by specific decision nodes.
- Establishing underpinning logics and tools used by decision nodes and the building of tool inventories.
- Identifying opportunities for re-calibration and re-tooling of existing tools and re-alignment of logics across decision nodes.
- Working with key stakeholders and decision nodes to re-calibrate, re-tool and adapt the decision-making architecture to optimise optimised achievement of shared outcomes, reduced moral hazard and negative spillover effects and externalities.

Projects 1, 2, 3, 4 and 5 are structured around the decision-making nodes of resource-holders, critical actors and regulatory agents. We will scale our level of research activity based on the level of existing research around each node e.g. the resource holder node has been little considered. The projects consider the interactions with the decision nodes in 3 ways:

- Cross-node interactions, in particular node-wide surveys and consensus conferences.
- Targeted focus groups and/or key interviews (and sometimes targeted surveys and documentary reviews) with selected sub-sets within each decision-node.
- Five specialist case or comparative case studies (Project 2) in very different settings:
    - Kawerau - a small, one industry town which has been in decline, has new economic regeneration prospect and is seeking to re-construct itself, but is challenged by issues around ownership of its town centre;
    - Western Bay of Plenty District which has derelict and under-utilised land within its current urban boundaries but is challenged in using them to intensify its settlement patterns;
    - Auckland City which seeks to intensify and redevelop its suburban fabric for mixed use, provide affordable housing groups in housing stress, and whose population increase is driven both by natural increase and migration domestic and international;
    - Christchurch City which seeks to reconstruct its earthquake damaged built environment with fit-for-purpose dwellings in a spatial setting that is connected and affordable for its diverse population and changing local economy.
    - A specialist case study focused on Māori land and the interface with housing provision in rural, provincial and urban environments. This will consider, in co-operation with the Hei Papakāinga Ora SRA, the legislative, corporate and indigenous framing around Māori land and the implications for its development in the context of both Māori economic aspirations and emerging power, and the considerable unmet housing need and high levels of housing stress that burdens Māori populations.

The projects will use five main research techniques:

- Consensus conferences – bringing together practitioners across a decision node to map an agreed version of the decision-making architecture as they see it at three scales – dwelling, neighbourhood and town/city.
- Focus groups
- Surveys
- In-depth interviews
- Review of policy, practice and legislative documents.

Project 6 takes a different, evaluative approach to uncovering the architecture of decision-making and its processes. Lived experience involving multiple decision-nodes will be used to provide learning studies of the architecture 'in action'. These learning studies will focus on; (a) the complexity of lived experience; (b) actual practice rather than stated practice; (c) transferability of learnings. Teams for each learning study optimise research connections in selected developments. All these studies will use a multiple method approach to data collection which will be shaped to the learning study, including surveys, key interviews, focus groups and documentary reviews. While each learning study will show variation, a standard array of core instruments and analytic framework will be developed to ensure that cross-learning study comparative analysis can be undertaken. Each study will report separately with a subsequent process for comparative analysis and reporting.

Project 7 will generate the decision-making architectural map, dependency pathways, logic and tools inventory generated by Projects 1-6 and relevant findings generated across the Challenge as the whole. In addition to creating written draft reports and guidelines for Project 8, this project will carry out:

- Cross-SRA research reporting and facilitated workshops to generate: (a) decision node maps and pathways across multi-layered systems; (b) logic specifications by node; (c) tool inventories; (d) preliminary identification of potential for adaptations for better decision-making.
- Cross Challenge facilitated workshops to review, amplify and enrich the SRA specifications.

Project 8 will drive change. Participatory research methods and the action research framing of the research has been demonstrated as an important contributor to end user and stakeholder reflection and receptivity to change. Project 8 activities will promote transformation and generate an awareness and willingness to adapt as well as vehicles to drive that adaptation forward:

A. **Charrettes** A series of charrettes across and within nodes will have as their major inputs the findings, maps of architecture and path dependencies, tools inventories and adaptation potential guidelines generated from the previous projects. Charrettes will be structured to bring practitioners together to produce implementable solutions and tools. The findings from the projects will be used to determine the number of charrettes and participants but it is envisaged that each decision node would have 2 charrettes. Typically charrettes will involve three structured interactions: (a) review of the programme findings and consensus development about opportunities for adaptation and change, including initial consideration of any prototype tools or processes; (b) a solutions building workshop testing prototype tools and solutions; (c) Review of refined prototypes, tools and solutions.
B. **SRA Summits** will be cross-node and include end users and stakeholders. There will be two sets of summits, the first at the end of the Year 2 which will (a) promote reflexivity around the core ideas of the SRA and how it might impact on outcomes for homes towns and cities; (b) present key findings to date; (c) further promote engagement with stakeholders and end users; and (d) discuss the potential for change. The second set of summits will involve the researchers and the research participants taking a solutions orientation to align new tools, process and solutions with the resolving inertias and potential for changed outcomes.
C. **Nudging for Transformation** Both the charrettes and the summits will be supported by a three-pronged approach to supporting change: (a) tailored reporting and seminars to relevant industry, practitioner and policy across the private, public and community sectors; (b) the provision of findings and tools through linked websites.

2.4.5 Timeline

	15/16	16/17	17/18	18/19
1. Resource Holders – Finance				
Mapping Consensus Conferences	Development Finance- Banks Investors, Developers	Report		Triangulated Analysis & Reporting
Industry Surveys and Focus Groups	Instrument development and Surveying Development Finance, Valuers, Institutional Funds		Report	
Māori and Financial	Development Finance Case Study Successful models	Mortgage finance	Report	
2. Resource Holders – Landowners				
Landowner Land Retention, Development Surveys	Local/Central Govt and Public Housing; Property Investors; Construction	Developers; Community Housing Providers	Report	Triangulated Analysis & Reporting
4 Land Opportunities & Constraint Studies	Bay of Plenty, Kawerau, Auckland and Christchurch			
1 Māori land development & housing			Report	
3. Critical Actors – Supply				
Mapping Consensus Conferences	Housing Providers, Developers, Construction Industry, Infrastructure	Report		
Industry Surveys	Instrument development and Surveying		Report	
Industry Focus Groups	Housing Providers, Developers, Construction Industry, Infrastructure		Report	
Logic and tools inventory			Triangulated Analysis and Reporting	
Path dependencies				
4. Critical Actors – Demand				
Housing Logic Survey	Instrument development	Sampling & survey	Data analysis preliminary findings	Triangulated analysis & Reporting
Diverse Logics Focus Groups	Young people; Older People, Singles, Families. Māori, Pacific, New Settlers		Contracting & Expanding Settlements	
Cross-sectoral Logics	Treasury, Reserve Bank, Health, Social Services, Housing agencies, EECA, ACC, Education, Māori Development		Community services, advocacy & housing;	

			Financial advisers, Real estate agents	
5. Regulating Agencies				
Regulatory Review	Finance, Building, Housing, Planning, Infrastructure, Law		Analysis of cross-sectoral Alignment	
Logics & Tools inventory, Survey and Interviews		Finance, Building, Housing, Planning, Infrastructure		Triangulated analysis & Reporting
Workshops & focus groups	Finance, Building, Housing, Planning, Infrastructure			
Path dependency analysis		Report		
6. Discovering the Architecture by Evaluating Lived Experience for Affordable, Fit for Purpose Housing and Neighbourhoods Project				
Special Housing Zones - Tauranga	Analytic framework and instrumentation	Fieldwork	Prelim Findings	Comparative Analysis and Reporting
SHA Redevelopment and Intensification – Auckland		Fieldwork	Prelim Findings	
CHCH Rebuild Competition Project		Fieldwork	Prelim Findings	
Papakāinga		Fieldwork	Prelim Findings	
Transition Housing - ChCh		Fieldwork	Prelim Findings	
Smarter Streets		Fieldwork	Prelim Findings	
7. Integrated Map and Inventory – Decision-making Architecture, Logics and Tools				
Map of nodes & path dependencies			Reporting	
Nodes & Logics Findings				
Tools Inventory				
8. Adapting Logics and Tools Pathways				
Node Based Charrettes				Charrettes
Nudge Pathways	On-going			
Stakeholder Summits				Summits

2.4.6 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling including personnel involved
PhD Students	Student		Mentoring in collaborative research by supervisor, exposure to interdisciplinary research, skills in data collection and coproduction

2.4.7 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Next generation information for better outcomes (NGI)	Good data is crucial to effective decision-making and will be critical in shaping desired outcomes and justifying intervention. Data availability can be a spur to action while its absence can produce 'non-decisions' where land is undeveloped, or existing practices remain unchallenged. Therefore we will maintain contact with NGI to ensure that the data systems being developed will meet the needs of decision makers.
Supporting success in regional settlements (SS)	
Shaping places: future neighbourhoods (SP)	Initiatives stemming from SP will help transform neighbourhoods to have better walkability, amenities or design. While their research will engage directly with communities to co-produce and deliver outcomes, we will provide a complementary focus on the structures, agencies and actors to reinforce and embed change within the broader decision-making architecture.
Hei Papakāinga ora (HPO)	We will integrate with HPO in order to better link their research on the variety of Māori voices, perspectives and cultural outcomes in the built environment to the regulatory structures within which they must operate and the powerful logics that influence decision-making.
Transforming the building industry (TBI)	TDM will inform TBI's research on the role of innovation in transforming the building industry. TBI will enable technical innovations to be better integrated into practice, by, for example, challenging prevalent decision making logics or understanding the path dependencies that may be in operation within regulating agencies or critical actors.

2.4.8 International Linkages

Organisation	Key International Person(s)	Nature of relationship with THIS SRA
Mistress Girton College Cambridge (UK)	Prof Susan Smith	Professor Smith is an international authority on housing issues. Her recent research has focused on house prices, mortgage markets and the financial instruments associated with them.
Cambridge Centre for Housing & Planning research, University of Cambridge	Prof Michael Oxley (Director)	With over 20 years of experience the centre has a proven track record of providing the evidence and policy analysis (from unrivalled social housing statistics) to influence and support better housing/planning policy and practice. Their specialty areas include: Social housing and low cost home ownership, Section 106 and affordable housing development,

		Understanding local housing markets, the role of home ownership and private renting.
AHURI	Director Ian Winter	The Australian housing and Urban Research Institute (AHURI) has a public good mission to deliver high quality research that influences policy development to improve the housing and urban environments of all Australians. AHURI is purposely structured to support evidence-based policy development. It is a national independent research network with an expert not-for-profit research management company, AHURI Limited, at its centre.
Centre for Urban & Regional Studies, University of Newcastle (Australia)	Prof Pauline McGuirk	This centre engages in research focused on the complex political, economic, social, cultural and environmental processes and relations that are transforming cities and regions. CURS has secured considerable funding for research into housing and urban issues in Australia
Institute of Ageing - Lancaster University	Christine Milligan	Christine Milligan has been focusing on the extent to which ICT can mitigate some of the barriers presented to older people limited service access including barriers presented by built environments and the framing and logics of decisions as well as the efficacy of ICT investment as a pathway to generate inclusive and smarter communities that support older people better.
Built Environment, University of Sydney	Prof. Bruce Judd	Professor Bruce Judd is the Director of the Australian School of Architecture and Design and a member of the City Futures Research Centre at the University of Sydney. He also advises on the Find the Best Fit research programme in New Zealand concerned with downsizing among older people. He works extensively in the area of community building and public housing estate renewal.
University of California Davis	Dr Rob Wiener	The Rural Housing Coalition is concerned with the interaction between affordable housing production, financing development of fit for purpose housing particularly for key workers, retail banking. He leads innovative research-based initiatives including those funded by the California Reserve Bank and other finance and other community agencies to re-engage with vulnerable people to ensure the finance sector, retail banking and housing sector meet their needs.
Age Friendly Banking Programme (Federal Reserve Bank of California)		In order to examine the unique financial needs and increase the financial well-being of low-income older adults, the California Coalition for Rural Housing (CCRH) partnered with the National Community Reinvestment Coalition (NCRC) to conduct an intensive study of over 400 low-income tenants living in subsidized senior housing. Based on these findings and examples from the field, CCRH and NCRC have developed a set of recommendations.
Dept Built Environment, Heriot Watt University	Prof Susan Roaf	Susan Roaf is Professor of Architectural Engineering at and specialises in the adaptation of dwellings, towns and cities and the industry, political and professional changes needed to adapt buildings and cities for climate change and population diversity. She has an international reputation and has contributed to the review of the tools and solutions designed to transform the logics householders , communities and agencies in New Zealand apply to housing resilience in the context of changing biophysical conditions and exposure to adverse natural events.

Centre of Universal Design, Dublin	Dr Ger Craddock	The Centre for Excellence in Universal Design is funded by the Irish government to assist the building and manufacturing industries as well as local authorities to re-think their current investments and re-design the built environments, products and services they deliver to meet the needs of people of all ages and disability status. As an organisation charged with transformation, they have pioneered research and solutions building strategies designed to both re-align the logics of both supply and demand around accessible and functional design.
HMInfo (Housing Modification Information) Specialist Research Review Panel	Catherine Bridge	Coordinated by Catherine Bridge at the University of Sydney, the clearinghouse is dedicated to assisting developers, builders, and architects to re-think the way in which they design, build and modify dwellings by demonstrating solutions and demonstrating how those solutions align with the different cost and amenity objectives and logics across the industry value chain as well as agencies concerned with promoting well-being and accessibility.

2.4.9 Vision Matāuranga

This SRA recognises that Māori are positioned across the three interconnected types of participants - as **resource holders** who control land and finance, as **critical actors** who develop land, and as **regulators** due to the role that Iwi[m] and Hapu[n] play in regulating the use of Māori land. We recognise that Māori are significant landowners, and that they currently have considerable financial resources and an emerging array of financial investment vehicles that can, for example, provide housing and infrastructure as well as financing Māori and non- Māori alike. Four aspects of our research are dedicated specifically to exploring and improving outcomes for Māori from adaptation of the decision-making architecture affecting Māori:

- Mapping the decision-making architecture, logics, tools and dependency pathways activated in the context of papakāinga development in rural, provincial and urban settings across the decision-making nodes, in conversation with Hei Papakāinga Ora.
- Revealing how Māori are exposed to mainstream logics, tools and pathway dependencies while also being constrained by legislative and regulatory provisions around Māori land (noting this is of relevance to the Next Generation Information SRA), its ownership and lease, as well as on the financial and investment operations of iwi, hapū and rūnanga and Māori trusts (considered by Hei Papakāinga Ora).
- Analyse the policy and legal constraints and opportunities on financial investment and the development of Māori land for housing and urban development including the implications for Māori housing providers of the community housing reforms considered by Hei Papakāinga Ora.
- Identify opportunities to better align decision making with the aspirations and resources of Māori young people, families, and households.

[m] **Iwi** – literally meaning derived from Koiwi or bones, describing the closeness of tribal kinship. Iwi is more common defined as the tribe.

[n] **Hapū** – sub grouping of the main tribe acknowledged by following a particular ancestor related to the eponymous ancestor of the tribe. Hapū usually emerge when the population and capacity to self sustain a whānau grouping has been reached.

2.4.10 Stakeholder Involvement and Pathway to Implementation

This SRA will promote public good through better decision-making. Key stakeholders for transformation include: the finance sector, planning agencies, those that commission dwellings across the private, public and community sectors, practitioners working in housing and in built environment, and elected representatives in local, regional and central government.

The programme of research in this SRA has been developed through bilateral conversations as well as consultative workshops with a variety of these stakeholders and potential end-users. This includes those connected with formal institutions and processes, such as local and central government, and other critical actors and agencies, such as community housing fora and the insurance sector. In addition, this SRA reflects conversations with researchers involved in demonstration models and other change initiatives in housing and the built environment as well as Superu, the trading name for the Families Commission, the Government's research and evidence adviser on matters of social wellbeing. Discussions with these groups helped identify the three decision making nodes that are used to shape our inquiry and will be important in developing an effective coproduction research approach. More details are provided in the table below.

Type of Stakeholder	Name of Organisation/Person	Contact to Date
Central Government	EECA	Meeting to discuss priorities for EECA. Strong support for continuing collaboration and support as programmes become established.
	MBIE	Attend BBHTC meeting.
	Treasury	Attend BBHTC meeting.
	Ministry for the Environment	Attendance at cross-sector meeting Auckland indicated strong support for decision-making
Councils	Wellington City Council	Particular interest in infrastructure and amenity decision-making
	Auckland City	Attend BBHTC meeting. Particular interest in decision-making tools across housing, infrastructure and re-development including SHA
	Tauranga City	Canvassed in downsizing workshops then subsequent discussions with elected members and officials. Particular commitment to addressing inner city landholding and investment decisions
	Bay of Plenty	Canvassed in downsizing workshops then subsequent discussions with elected members and officials. Particular commitment to addressing inner city landholding and investment decisions as well as infrastructure and amenity decisions
	Kawerau	Canvassed in downsizing workshops then subsequent discussions with officials and KEA. Particular interest in redevelopment to regenerate town centre and develop age-friendly environments. Concerned to understand inertias especially around resource holders.
	Smart Growth	Canvassed in downsizing workshops then subsequent discussions with officials and community organisations and representatives. Those in clude Tauranga Chamber of Commerse and PATAG. Particular commitment to addressing age friendly development, inner city landholding and investment decisions as well as infrastructure and amenity decisions
Regional Fora	Christchurch Housing Forum	This is a cross-sectoral forum involving tenants protection, councils, private landlords, HNZ, community housing providers, developers and social servfices. Initial conversations, raised at Forum during invited key not presentation on CHCH transitional housing, and subsequent forum engagament.
	Older People's Forum Marlborough	On-going communication. Particualr concern at targeting need in housing provision.
	PATAG	Population Ageing technical Advisory Group, Bay of Plenty is a cross agency Council and District Heath Board initiative seeking to ensure that appropriate housing and

		neighbourhood development is adaptable to changing need and the needs of all generations.
Community Organisations	LifeMark	Ongoing engagement around lifetime design and inertias in the building sector
	Habitat for Humanity Auckland	Ongoing engagement
	CHA	Community Housing Aotearoa ongong enagagement particularly concerned with decision-making around finance and access to land
	CHCH Youth Housing Project	Engagement around youth transitional housing. Particualrly concerned with access to land and the tools used to release land and developer selection for redevelopment of public land.
	CCS	Concerned with decisions around neighbourhood and developing affordable fit for purpose housing.
Māori		NSC Hui
Property Managers	Property Investors Association Rotorua	Ongoing - Particular concerns around rates of return, finance and land access
	Property Investors Association Tauranga	Ongoing - Particular concerns around rates of return, finance and land access
	Property Investors Association Marlborough	Ongoing - Particular concerns around rates of return, finance and land access
	Quinovic Tauranga	Particular concerns about changing profile of demand and industry ability to deliver.
	CHA	Community Housing Aotearoa ongong enagagement particularly concerned with decision-making around finance and access to land
	CHCH Youth Housing Project	Engagement around youth transitional housing. Particualrly concerned with access to land and the tools used to release land and developer selection for redevelopment of public land.
	CCS	Concerned with decisions around neighbourhood and developing affordable fit for purpose housing.

We will work closely with end users in our three participant types to understand the limits and potential for transformative change. For example, agencies such as Auckland Council, the New Zealand Planning Institute (NZPI) and Local Government New Zealand (LGNZ) will link to the regulating agencies analysis, while banks and insurers will contribute with the resource holder elements, and infrastructure providers and developers will assist in researching the opportunities and constraints inherent in delivering alternative outcomes.

The implementation pathway will be embedded in the research design. End user engagement is at the core of our methodological approach, as stakeholder workshops and meetings incorporating key decision agents will be held throughout the duration of the Challenge, emerging from the year 1 mapping exercise. These groups will initially be rooted in the three participant areas to allow an in depth approach and continuity so the research team can build trust throughout the SRA. Learning studies in Project 2 will also help uncover logics and path dependencies and illuminate the ways in which decisions are influenced. Project 8 will drive change in the industry, developing charettes to bring practitioners together to produce implementable solutions and tools, running summits to create cross-node engagement and present information, and nudging the industry through tailored provision of information.

Wider dissemination will include academic peer-reviewed journals, guest editorials of special editions, press engagement, and public position papers that summarise the findings aimed at practical and citizen audiences.

2.5 SRA 2: Next Generation Information for Better Outcomes

	Name	Org.*	Annual FTE funded by Challenge	Skills of individual
PI	Prof Simon Kingham	UC	0.3	Project management, social applications of geospatial science, urban development
	Dr Rita Dionisio	UC	0.2	Urban architecture, spatial data infrastructure
	Dr Ioannis Delikostidis	UC	0.2	Sensors, GIS, visualization, data usability.
	Dr Lyn Carter	UO	0.2	Māori identity, development and knowledge in temporal and spatial contexts
AI	Dr Malcolm Campbell	UC	0.1	Geospatial science, smart cities
	Dr Femke Reitsma	UC	0.1	Crowdsourcing, GIS
	Chris Bowie	Opus	0.3	Secondary data collection and management
	Dr Vivienne Ivory	Opus	0.2	Data governance
	Dr Dave Goodwin	UO	0.1	Māori land use, cadastral reform
Postdoc researcher		UC	1.0	
Programmer/developer		TBC	1.0	
PhD student		UO	1.0	
PhD student		UC	1.0	

* UC= University of Canterbury, UO=University of Otago

2.5.1 Outputs

By July 2019 we will deliver:

Project 1: Data availability, needs and quality

- A clear understanding of the nature, availability and value of geospatial information for key local (re)development stakeholders to making better evidence-based decisions about NZ's homes, towns and cities
- A framework for better geospatial information collation and collection ensuring consistency across custodians, including identifying who the 'key' custodians of data should be (e.g. Land Information New Zealand (LINZ)).
- A mechanism for reducing the inconsistency, uncertainty and risk for investors associated with poor geospatial data

Project 2: Development of a geospatial toolkit to aid better urban decision making

- The development and application of a user-driven urban spatial planning tool
- Assessment of the value of the user-driven urban spatial planning tool to help deliver better homes, towns and cities, through ongoing testing by, and regular dialogue with, the end users at the council and at key end users and stakeholders and quantifying use.

Project 3: Ecology of community: Māori understandings and values in relation to spatial data

- The identification of Matāuranga Māori/Iwi knowledge frameworks for traditional land-ownership processes including key changes over time and impact on tradition-based land tenureship.
- A database extracted from ecological principles of environment, kinship, economic sustainability and cultural practices that could feed into the current cadastral system for an "off the shelf" culturally relevant option, catering for Māori preferences in urban planning and built environments

Project 4: The value of crowd-sourced/sensor sourced data in urban planning

- Implementation and demonstration of new, usable methods for crowdsourcing and sensor data utilisation in NZ (Case study: Christchurch)
- Implementation and demonstration of new methods for analysis, visualization and interaction with crowdsourced and sensor-derived information, adapted to both urban planners and citizens' requirements

Project 5: Challenge geospatial Information Infrastructure & Learning spaces

- Coordinated geospatial information management across all the Research Streams of NSC 11

2.5.2 Context

The growth and development of new sources of bigger and better digital information has been exponential in recent years. New forms of information and data are being collected and being made available from multiple, varied sources. This 'next generation information' has the potential to inform all sorts of government and other stakeholder decisions and result in better outcomes. Yet, relatively little of the potentially huge value of this is currently being used.

The value to the economy of digital information, especially geospatial data, or location information, is increasingly being demonstrated. A 2009 report estimated that the use and re-use of spatial information in particular added $1.2B (0.6% of GDP) in productivity-related benefits to the New Zealand economy (ACIL Tasman, 2009). ACIL specifically refer to "**Planning and building "smarter" cities and transport systems that will not only cut down fuel costs, but could also avoid accidents (e.g., in-built sensors for urban vehicles), reduce emissions, enable changes in travel behaviour, make for a better living space, and so on, will add much more in terms of value***"* (ACIL, 2009, 4). LINZ has estimated that, over the next decade, New Zealand could benefit from a tenfold increase in the value generated by location information (LINZ, 2014). In addition Treasury's National Infrastructure Unit has recently released the document 'The Thirty Year New Zealand Infrastructure Plan 2015' which highlights the need for high quality data to better inform decision making (National Infrastructure Unit, 2015). Christchurch City Council's use of the prototype Envision and ESP tools (developed as part of the **Greening the Greyfields** project) to validate decisions about urban infill areas is an example of the potential value of this type of information.

The Ministry for the Environment identifies a lack of consistency in decisions as a key problem in New Zealand's urban and infrastructure planning system saying "**There is no effective, single mechanism for facilitating engagement, securing agreement among participants and providing information for robust decision-making ..... This leads to inconsistencies in decision-making and, as a consequence, creates uncertainty and increased risk for investors**" (MfE, 2010, 8). MfE identify spatial planning as a key part of the solution. GIS and geospatial data have been used to help with spatial planning decisions (Awasthi, Chauhan & Goyal, 2011; Boroushaki & Malczewski, 2010; Coutinho-Rodrigues, Simão & Henggeler Antunes, 2011; Pfeffer et al, 2013; Schetke, Haase and Kötter, 2012) and participatory spatial knowledge management is a growing new way to elicit information and inform policy. However there are potential limitations, such as accountability, empowerment, and control and use of knowledge, which need to be understood (Pfeffer et al, 2013) to ensure these technologies are used most appropriately, which we intend to address in this SRA.

The value of open access to publicly-funded data is widely heralded; open access to data in appropriate formats can provide policy-makers with data needed to address multiple urban problems (Arzberger et al., 2004). In its role managing building and property information, the Government is currently working with local government on opening and integrating building and property data. However, there is much that can be done to complement and support that work, particularly in the areas of

- privately held building and property data - there is little/no information infrastructure for such data
- visualisation tools that assist with civic engagement and in improving processes.

Geospatial visualisation technologies, serious games and interactive geodesign tools also have the potential to be used for developers and planners to produce better homes, towns and cities and to promote community engagement and public participation in urban planning processes (Dionisio et al, 2015; Eikelboom & Janssen, 2015; Glackin, 2013; Lee, 2012; Pelzer et al, 2014; Wu et al, 2010). A number of geospatial tools have been developed in contexts similar to NZ e.g. Polytrim (Canada) to integrate datasets and functions (Danahy and Hoinkes 2003), iCity (Canada) to combine large geospatial datasets (Stevens, Dragicevic, and Rothley 2007), Synthicity (California) enhances urban analysis and visualisation (Department of City and Regional Planning, Synthicity 2015), Safecity (Poland) for infrastructural and hazard risk management (Kulawiak and Lubniewski 2014), Envision and Envision Scenario Planner were developed in Australia and have been extended to Christchurch. None however includes high quality information about infrastructure alongside demographic and land use information, and includes the ability to forecast likely impacts. We propose that being able to include all these features will allow us to develop a high quality urban planning development tool to allow evidence based and informed decisions.

Geospatial data and associated methods have been used to assess the impact of built environment on health and wellbeing (Durand et al, 2011). This includes a body of research in New Zealand looking at the impact of such things as greenspace (Nutsford, Pearson & Kingham, 2013; Richardson et al, 2010), fast food outlets (Pearce et al, 2007) and other environmental features (Jenkins et al, 2015; Pearson et al, 2014) and with the research regularly using GIS methods (Pearce, Witten & Bartie, 2006). This type of research becomes more reliable as data quality improves and the research inform personal home location decisions and strategic planning decisions.

Two relatively new sources of data are crowdsourcing and sensor sourced data. Crowdsourcing is a potential way to gather geospatial data (Heipke, 2010) and has been used in the public health arena (Brabham et al, 2014). Crowdsourced data has potential to be used both in urban planning (Adams, 2013) and in encouraging public participation in the planning process (Borges et al, 2015) although there are warnings about how the information should be used (Barbier et al, 2012). Examples of crowdsourced, citizen-centered projects for improving awareness, safety and well-being in cities include: “crowd-mapping” efforts in Kenya (exposing *Kenyan* election killings through Usahidi Platform); in Japan (revealing radioactivity levels after Fukushima nuclear disaster through Safecast Platform); “OpenSense” project (an online real-time air pollution information system) and “da_sense”, collection and visualising map-based information about noise, pollution and traffic. There is increasing use of sensors in the urban environment with huge potential for them to inform urban decision making, although a number of challenges have been identified associated with gathering and collating data from the network of sensors that could be embedded in urban infrastructure (Oliveira et al, 2015). Therefore one of our projects will tackle improved methods of collecting, collating and validating crowdsourced and sensor sourced data, aiming to identify the value of such information and mechanisms for using it to its full potential.

2.5.3 Opportunity

There are a number of barriers to the development and provision of better homes, and promotion of towns and cities:

- Councils are constrained by the quality of data that informs their decision making. It is difficult to plan for greater intensification in an area if the council does not know what the downstream impacts are, e.g. if there is enough latent underground infrastructure capacity to support intensification or what the impacts on air quality might be, and what future trends they must take account of. The disconnection between planning, infrastructure and financial instruments hampers the ability to make evidence-based decisions.
- Communities, including Māori communities, are not engaged in the planning process. They are often reluctant to embrace intensification because of the lack of good exemplars and appropriately aligned communication channels. This prevents communities from making informed decisions about their future as they cannot imagine viable alternatives, leaving them with perceptions anchored in the stereotypes of units surrounded by concrete car parks or down long drives, or ghettos and slums.
- Many developers are risk adverse; they know what they can do to guarantee revenue and this can make them unwilling to risk trying to produce innovative development examples. While suggested alternatives may be ‘better’ socially, developers’ focus may remain on maintaining their short term profit levels.
- There is often unknown and/or mismatched information and one outcome is that if someone wants to purchase a home or section they have to consult multiple agencies to get the necessary information. This is not advantageous to promoting urban

development, given that is time consuming, costly, and the data is often unreliable and delivered in a form that the users do not understand.

Many of these gaps and corresponding opportunities can be addressed if we have better information with better geospatial data aligned with better systems, infrastructures and protocols around their use, better understanding of data strengths and weaknesses and better information-driven geospatial tools that can be used in the decision-making and community-engagement processes.

Currently LINZ, as part of the rebuild of Christchurch, is leading the development of a spatial data infrastructure project through a series of sub-projects. A number relate specifically to BBHTC namely, 3D Enabled Cities, Property Data Management Framework, Forward Works Viewer, and Utilities Data Access (LINZ a&b, 2015). LINZ is now leading a wider programme of work to integrate and improve building and property data. However the data in these projects is largely government and local government owned, and there is little information about the need for and availability of other sources of data. This can be built on by a well thought through program of research.

The Challenge creates a particular opportunity for end-users to work with researchers from the outset of projects. A key to improved decision making in urban redevelopment is improving communication and tool uptake by end-users. There is rich data available in some areas of NZ, e.g. Wellington infrastructure, which we will use as a learning space within which to create a geospatial toolkit, in collaboration with end users, to enhance urban redevelopment. Our collaborative work with end-users will include upskilling of planners and policy makers in their ability to understand and use geospatial data and tools. We will also ensure that the tools we develop are appropriate for our end users, being easy to use and broadly accessible.

Crowdsourcing as a modern, low-cost, high-volume method for collecting data about different aspects of everyday citizens' life is emerging as a potentially valuable source of insight and intelligence for city planners and developers as they make decisions, including in New Zealand (e.g. Clouston, 2015; Wilson et al, 2014). Crowdsourced data can provide not only a deeper, more direct insight on urban environment conditions, such as air pollution, noise, but can also capture people's preferences on certain urban environmental features and infrastructure, such as cyclists' route preferences. Furthermore, it can be used for stakeholder and public engagement on new ideas, developments and changes within cities and towns. In New Zealand there is still an application gap in using these new data generation technologies to achieve transformational outcomes in the built environment and we will identify methods for best collecting and using crowdsourced data to usefully inform urban decision making. These new data sources have the potential to change how we can access and use data which could potentially lead to dramatic and transformative changes in the accuracy of our decision making and potentially huge savings in data collection costs.

2.5.4 Research Questions

To drive the development of better homes, towns and cities through improved use of geospatial data:

A. What data are needed and available; who owns the data and how, and by whom, is it being used; what are the access and intellectual property implications of privately owned data?
B. In areas of limited information and resources, which data is essential to collect/collate?
C. How can the essential new data be collected, standardised and managed to make it interoperable with other building and property data so that it is useful for end users?
D. What are Māori understandings of spatial data and how do they value such data.
E. How can sensor and crowd-sourced data be used to help usefully inform urban decision making?
F. How can data be used such that:
    a. Organisations and people learn from each other's experiences?
    b. Appropriate, fit for purpose geospatial planning tools are developed?
    c. There is increasing knowledge available about where we live?
    d. Value is delivered to policy makers, planners, communities & New Zealand?

These questions are not being addressed by other existing research in New Zealand. The results have the potential to be transformative by increasing our efficient and effective use of information to make better evidence-based urban planning decisions. The old adage, '**rubbish in, rubbish out'**, can be accurately applied to planning decisions, '**rubbish information into the decisions, bad outcomes out**'. These questions will also have value to the other SRAs as shown below and are questions that by virtue of New

Zealand's size, of interest globally. By being able to address these questions in a small geographically isolated country of 4 million people, lessons will be learned for and transferred to the wider global community.

SRA Question	A	B	C	D	E	Fa	Fb	Fc	Fd
Transforming decision making	X	X			X	X	X		
Supporting success in regional settlements								X	
Shaping places: future neighbourhoods								X	X
Hei Papakāinga ora				X					
Transforming the building industry			X						

2.5.5 Research Outline including Projects

The Next Generation Information for Better Outcomes stream consists of the following five interlinked projects.

Project 1. Data availability, needs and quality

A key barrier to making good decisions about housing need, location and type is lack of appropriate and accurate spatial data. Therefore this project will identify the key spatial information needed to make best urban planning decisions and ultimately lead to the development of a comprehensive spatial urban planning decision tool. This will integrate a multitude of features, such as infrastructure capacity and management, demographic and development projections and plans, natural hazards, residential redevelopment potential, along with the capacity to model the impact of different development types. The inclusion of all these features has not been previously attempted in a single integrated decision making toolkit, making this transformative.

To be able to create and/or collate the appropriate data, we will first identify what the key datasets are, who owns them, how fit-for-purpose they, and what new data needs to be collected. This will include examining data from private sources such as some of the key infrastructure providers, insurance companies, health data etc. It will also assess the costs and benefits of collating and/or creating and/or purchasing necessary information. Next we will look beyond currently available data to identify additional data required.

This project is new but will build on work LINZ started in the development of the Canterbury Spatial Data Infrastructure (SDI) Programme. This goes beyond the Canterbury SDI in that it seeks to identify the other key datasets that are needed to inform good decision making.

This project will:

- Undertake interviews and dialogue with key policy makers in NZs larger urban areas to identify information requirements.
- Undertake interviews and dialogue with key organisations to identify available 'private' information, assess the feasibility of this being made more 'available', identify constraints to doing so (such as intellectual property and commercial sensitivity), and suggest mitigation mechanisms to allow more use of such information and protect the various interests of different data custodians.
- Work with key information custodians (such as LINZ, Statistics New Zealand and local governments) to collate and compile available information, and transform it into a consistent data infrastructure
- Develop a consistent data infrastructure protocol/framework for future data collection.
- Identify the data/information analysis methods and models currently used in urban decision-making.
- Identify the 'essential' data/information for those areas that have limited information, expertise and resources (e.g. smaller urban areas).
- Support the integration, and where necessary the development and dissemination, of community engagement tools such as geovisualisation and serious games.

Project 2. Development of a geospatial toolkit to aid better urban decision making

We will develop a geospatial toolkit to enable planners and infrastructure stakeholders to plan, and assess the impact of, urban development and redevelopment within existing infrastructure constraints, and run strategic redevelopment scenarios that will determine the infrastructural requirements of each scenario. The nature of the tools which will be components of the toolkit will be identified as part of the research, in consultation with the end users to ensure they were needed and useful. They could include:

1) Tool for identification of potential intensification areas

2) Tool for assessing impact of development

3) Community engagement tools

Participating stakeholders will supply data and collaborate in the definition of specifications for development of the toolkit. We will build on the work in Project 1 and extend work currently being undertaken by researchers at the University of Canterbury, together with Australia's Curtin and Swinburne Universities, in the Greening the Greyfields and apply our findings in Wellington as a case study area which has rich data not yet used.

It is anticipated the model will be extended to Auckland in Years 6-10 to maximise the economic potential of past (and future) infrastructural investments. We will also discuss with the '**Supporting success in regional settlements'** SRA potential to develop a smaller scale toolkit in one of their second tier settlement learning spaces.

We will examine a wide range of infrastructure:

- Electricity;
- Water supply and sewage;
- Storm-water run off;
- Gas;
- Telecommunications;
- Access to open spaces, and car parks;
- Community resources;
- Public transport and road traffic.

The project will comprise five stages:

i. Engagement and consultation: Workshops and consultation meetings with participating stakeholders including Wellington City Council, LINZ, MBIE, Treasury, Wellington Regional Council to decide and agree the tool specifications. This will include discussion of expectations regarding the geospatial software requirements, inputs and outputs, functionalities, and user interface.

ii. Tool Development: Creation of the new geospatial software toolkit meeting the specifications defined in stage one. This will be developed with ongoing input and feedback from the end users. It will likely be a web based multi-criteria modelling tool coupled with a scenario impact assessment tool, although this will clearly be developed in consultation with the end users to ensure it is multi user friendly while being able to answer the required questions for evidence-based decision making; to maximise its implementation potential.

iii. Tool Implementation: Delivery and testing of the new geospatial toolkit with Wellington Council and other key stakeholders, including the use and assessment of community engagement tools (e.g. geovisualisation, serious games). This will include a series of one-on-one conversation as well as workshops.

iv. Tool assessment and sensitivity testing: Testing how well the model works and its value as a user-driven urban spatial planning tool in helping deliver better homes, towns and cities, as well as sensitivity testing the individual components of the tool, and assessing the applicability of the toolkit in other cities in New Zealand. This will enable the identification of the key essential information to maximise the power of the outcomes of the toolkit.

v. Development of a strategy for ensuring uptake of the tool by participating stakeholders, recognising that new software tools require careful socialising in the workplace before they are readily adopted by stakeholders for regular use in their work.

Project 3 Ecology of community: Māori understandings and values in relation to spatial data

This project will consider:

- How Māori values, practices and beliefs helpfully inform technical and organisational aspects of the wider New Zealand planning debate for improved decisions in urban environments?
- How Māori land-use preferences and other issues might be better catered for by the current cadastral system, and thereby contribute to achieving better decisions leading to a better quality and supply of housing?

Some of the principles of Māori land tenure and values, beliefs and mātauranga-a-Iwi/Māori have been lost or diluted in the formal Western tenure model while continuing to function within Māori community practices. Mātauranga Māori frameworks are based on experiential learning and practices that inform present and future development for Māori communities. This information derived through Mātauranga Māori frameworks will help inform culturally, environmentally, economically and socially balanced planning decision making processes that demonstrate the innovative potential of Māori knowledge, resources and people.

This project will first identify case study examples of successful Māori community housing initiatives that operate through a framework built on wider Māori/Iwi knowledge frameworks embodying core principles of Māori land tenure. It will also, through semi-structured interviews, a literature survey, and collaboration with Hei Papakāinga Ora SRA, identify and codify examples of customary tenure principles that could have a bearing on the nature and types of information used in urban planning and design decisions. These might include such things as: individual rights being subordinated to group rights; specific, familiar places where individuals can return and be themselves as an aspect of well-being; work/mahi contributing to a sense of belonging and self worth; and land not being negotiable wealth (the latter could, for example, emerge through options for affordable entry points to house ownership such as Community Land Trusts and/or Community Loan Funds). By examining specific case studies such as the Ngati Whatua ki Kaipara housing initiative, a model for sustainable intergenerational health and well-being will be developed that utilise novel methods for urban and semi-urban development based on the data produced from ecological principles of environment, kinship (whakapapa[°]), cultural practices and economic sustainability.

The second aspect of ecology of community is to cater better for certain Māori land-right preferences in the cadastral system with a view to achieving better urban planning decisions. This research will focus on general land owned by Māori and on Māori freehold land near urban centres. For the latter, ad hoc agreements have at times been needed with regional councils (e.g. Rāpaki near Christchurch negotiated an agreement about papakāinga housing) or else combinations of existing instruments have had to be applied in what Judge Ambler has termed “hybrid partitions”, because existing legislation lacks “off the shelf” options catering for Māori preferences. In addition, although the Māori Freehold Land Registration Project has brought most Māori Freehold Land onto the register, a high proportion of survey plans are computed rather than surveyed, meaning that anomalous accuracies and survey costs can impede uniform development. The inclusion of Māori preferences into official policy will help create sustainable and culturally relevant landscapes in urban/semi-urban communities. Incorporating the total ecology of Māori communities will enhance the overall land-use and contribute to safe and healthy communities.

This project will:

- Identify case study examples of successful Māori community housing initiatives that operate through a framework built on wider Māori/Iwi knowledge frameworks embodying core principles of Māori land tenure.
- Through semi-structured interviews. a literature survey, and collaboration with the *Hei Papakāinga Ora* SRA, identify and codify examples of customary tenure principles that could have a bearing on the nature and types of information used in urban planning and design decisions. These might include such things as: individual rights being subordinated to group rights; specific,

[°] **Whakapapa** – literally, to be grounded to a specific land or area. Whakapapa or genealogy is what connects us to our past, and grounds us to our present.

familiar places where individuals can return and be themselves as an aspect of well-being; work/mahi contributing to a sense of belonging and self worth; and land not being negotiable wealth (the latter could, for example, emerge through options for affordable entry points to house ownership such as Community Land Trusts and/or Community Loan Funds).

- By examining specific case studies such as the Ngati Whatua ki Kaipara housing initiative, a model for sustainable intergenerational health and well-being will be developed that utilise novel methods for urban and semi-urban development based on the data produced from ecological principles of environment, kinship (whakapapa), cultural practices and economic sustainability.

Project 4. The value of crowd-sourced/sensor sourced data in urban planning

This project will assess the value of crowdsourced and sensor data as information to inform and feed into the urban planning decision making processes. It will result in not only better planning outcomes, but in better social engagement in decision making. It will develop guidelines for the use of these forms of next generation information in achieving better quality urban outcomes.

This project will follow a User-Centred Design:

i. Surveying citizen groups and planners working with local government to identify data properties about currently unavailable and/or new (and usable) information that could be crowdsourced. Areas of focus will be use of crowdsourced information to enabling more effective maintenance of, improvement in and accessibility to urban public services and infrastructure (e.g. road, bus, and bicycle route network), sustainability of cities in terms of the environment (e.g. air pollution), crime, traffic congestion, energy use, urban sprawl, and balance between built and natural environment, and participatory democracy on important planning decisions that may impact liveability of cities and well-being of citizens.

ii. Developing new methods for collecting/collating crowdsourced and sensor data, using prevalent sources (e.g. smartphone sensors) or customized devices that can be used to help inform the urban planning processes.

iii. Developing prototypes of interfaces for interaction with crowdsourcing and sensor-derived information for different users in different contexts of use (e.g. providing hot spot maps of urban housing area issues, such as extreme noise/pollution/traffic, used by urban planners to inform decisions).

iv. Testing the usability of the developed prototypes against general SDI requirements and needs

v. Formulating guidelines for creation of a common lexicon for the management of crowdsourced and sensor data in urban planning decision making processes.

The project will focus on Christchurch, but comparison will be made with other main cities (e.g. Auckland, Wellington) and the potential for its use in those cities.

Project 5. Challenge geospatial Information Infrastructure & Learning spaces

This Research Stream includes a cross-cutting role across the other five SRAs, collating geospatial data that those streams use and designing an information infrastructure for this data. This role will utilise appropriate opportunities to undertake Learning Space research in local areas requiring geospatial data. The activities to be undertaken will be developed in pro-active discussion with other SRAs from the outset of the Challenge. In particular, there are cross-SRA learning space opportunities in, Transforming Decision Making, Supporting Success in Regional Settlements and Shaping Places: Future Neighbourhoods.

2.5.6 Timeline

All Projects will initially run for three years.

2016	2017	2018
Project 1. Data availability, needs and quality		
Interviews & dialogue with key policy makers to identify information requirements.		
Interviews and dialogue with key private organisations re: 'private' information		
Collation and compilation of available information, and transformation into a consistent data infrastructure		
Identification of data/information analysis methods and models currently used in urban decision-making		
	Identification of the 'essential' data/information for those areas that have limited information, expertise and resources	
	Integration, and where necessary the development, of community engagement tools	
		Development of consistent data infrastructure protocol/framework for future data collection
Project 2. Development of geospatial tools to aid better urban decision making		
Initial workshops and consultation meetings with participating stakeholders to identify toolkit needs		
Initial creation of the new geospatial software toolkit meeting the defined specifications, including ongoing stakeholder engagement and dialogue		
	Delivery and testing of the prototype geospatial toolkit	
	Assessment and incorporation of community engagement tools	
	Sensitivity testing of components of toolkit	
	Toolkit assessment with end users	
		Finalisation of geospatial toolkit
Project 3. Ecology of community: Māori understandings and values in relation to spatial data		
Overview of Matāuranga Māori traditional frameworks to identify & extract key land tenure principles & changes over time that impact on tradition-based practices		

Identify case studies of Māori community housing initiatives demonstrating knowledge frameworks		
Dialogue with Iwi partners, residents and key policy makers to identify customary tenure principles with a bearing on planning and design		
Codify customary tenure principles with a bearing on planning and design		
	Develop Matāuranga Māori knowledge framework/manual of key principles and processes to guide and inform planning and design; consultation with Iwi partners and stakeholders and revise as necessary	
Identify case studies of general land in urban areas and Māori freehold land near urban centres where extra-ordinary agreements have been negotiated with local authorities and/or combinations or unusual applications of existing instruments resorted to that indicate Māori preferences		
Dialogue with Iwi partners, residents and key policy makers to identify motivations for workarounds and preferences not accommodated by "off-the-shelf" legislation	Develop draft legislation that would cater for Māori preferences	
	Validate draft legislation by dialogue with Iwi partners	Validate draft legislation by dialogue with Iwi partners
Project 4. The value of crowd-sourced/sensor sourced data in urban planning		
Interview principal citizen groups and local government urban planners to identify properties of currently unavailable information with the potential to be crowdsourced		
Develop new methods for collecting/collating crowdsourced and sensor data, using prevalent sources (e.g. smartphone sensors) and/or customized devices that can be used to help inform the urban planning processes		
Investigate the integrity, accuracy and repeatability of the collected data / improve methods based on the outcomes		
	Develop prototypes of interfaces for interaction with crowdsourcing and sensor data-derived information for potential uses and users within the context of urban planning and decision processes	
		Test the usability of the developed prototypes against general SDI requirements and needs

	Formulate guidelines for the management and integration of crowdsourced and sensor data to urban planning decision making processes	
Project 5. Challenge Information Infrastructure & Local Case Studies		
Identification of key cross-stream 'information' research opportunities		
	Geospatial information research in other SRAs based on identification of key opportunities	

2.5.7 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling including personnel involved
Ioannis Delikostidis	Mid		Will be mentored in leading a project by Malcolm Campbell
Rita Dionisio	Early		Will be mentored in project development by Simon Kingham
Postdoctoral Fellow	Early		Upskilling in working at the intersection of research and policy development with government departments
PhD students	Student		Training in research

2.5.8 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Transforming Decision Making for Homes Towns & Cities (TDM)	Evidence-based decisions, the focus of TDM, require high quality information such as the geospatial information that NGI will deliver. We will maintain open dialogue with TDM to ensure that the tools we deliver are appropriate to the needs identified by their stakeholders
Supporting success in regional settlements (SS)	Both SP and NGI will include projects specifically focusing on Auckland and Christchurch; NGI will be collating geospatial data for use in both SRAs
Shaping places: future neighbourhoods (SP)	SS has a strong regional development focus in second tier settlements which provides an opportunity for this SRA to develop a geospatial planning toolkit appropriate to these settlements.
Hei Papakāinga ora (HPO)	We will maintain open dialogue with HPO to ensure that their and our work on Māori understandings and values in relation to spatial data are complementary
Transforming the building industry (TBI)	We will maintain open dialogue with TBI to ensure that their and our work on processes impacting on the building industry, in relation to spatial data, are complementary

2.5.9 International Linkages

Organisation	Key International Person(s)	Nature of relationship with THIS SRA
Curtin University (Australia)	Prof Peter Newman	Peter Newman is PI on the Greening the Greyfields project and also Science Director of the Built Environment theme of the Cooperative Centre for Spatial Information (CRCSI)
Swinburne University (Australia)	Prof Peter Newton and Dr Stephen Glackin	Peter Newton and Stephen Glackin are key researchers on the Greening the Greyfields project.
Cooperative Research Centre for Spatial Information (CRCSI) (Australia)	Phil Delaney	Phil Delaney is the program manager for the Built Environment theme of the Cooperative Centre for Spatial Information (CRCSI)

2.5.10 Vision Matāuranga

This SRA will contribute to:

- **Hauora/Oranga:** better planned and structured communities will improve the health and social wellbeing of those living in the communities. This SRA will provide data and tools to assist in planning better communities and involving those living in the communities in the planning and visualisation processes, ensuring that the communities achieved can reflect the needs of those living in them.
- **Matāuranga:** Project 3 will explicitly research Māori understandings and values in relation to spatial data, with a view to improving urban environments, particularly for Māori. In addition it will investigate Māori land right preferences to improve how they are catered for by the cadastral system and thereby contribute to a greater supply and better quality of housing for communities on Māori land.

This Research Stream will engage with the Māori GIS Association Te Kāhui Manu Hokai (TKMH). TKMH is an association of Māori GIS users in Aotearoa/New Zealand whose aims are to promote the use of geospatial information systems (GIS) and associated information technologies for the benefit and advancement of iwi Māori in Aotearoa/NZ, and to advocate for and improve Māori participation in the geospatial industry at all levels. TKMH is guided by kaupapa Māori principles and values including rangatiratanga (self-determination), whānaungatanga (kinship & relationship building), manaakitanga (hospitality), kotahitanga (unity), aroha (empathy) and kaitiakitanga (guardianship).

Project 3, Ecology of community: Māori understandings and values in relation to spatial data, will be led by Lyn Carter (University of Otago) who is an experienced Māori researcher. We anticipate the associated PhD scholarship will be offered to a Māori student.

2.5.11 Stakeholder Involvement and Pathway to Implementation

Type of Stakeholder	Name of Organisation/Person	Contact to Date
Councils	Auckland City Council	Ongoing conversations about NSC 11
	Wellington City Council	Involved in a workshop about NSC11 and ongoing conversations
	Christchurch City Council	Involved in the related Greening the Greyfields project and conversations about NSC 11
Central Govt	LINZ	Have been involved in a workshop about NSC11 and ongoing conversations
	MBIE	
	Treasury	

The key end users in this project are policy makers including spatial planners and infrastructure managers at TLAs, as well as strategic policy makers at MBIE, Treasury MfE and LINZ. By working directly with these and other key stakeholders from the outset of this research, the project will be transformative by maximising the likelihood of policy implementation and being operationalised. End users will be involved in the development of the tools and the development of guidelines throughout the process. In addition to one-on-one meetings, there will be a series of workshops and training sessions to ensure stakeholders and end users are full engaged in the development of the outputs and that the outputs genuinely meet their needs and requirements.

We have discussed this SRA with the TLAs in Auckland, Wellington and Christchurch. This includes the work of the Cooperative Research Centre or Spatial Information (CRCSI) funded **Greening the Greyfields** research project with Christchurch City Council on the development and implementation of a new set of geospatial planning tools and will be used and tested in engagement with stakeholders. LINZ's Integrated Property Service programme people were consulted.

In the learning spaces of other SRAs we will engage with the relevant councils and examine their data use, availability and needs thus providing a small (in terms of population) council view in the research.

The Resilience to Nature's Challenges is identifying platforms for integrating hazards-related data, with crossover with urban data. They will also be developing ability to measure improvements in ability address resilience to natural hazards over the course of the programme. Therefore researchers from this SRA will work with Resilience to Nature's Challenges researchers to ensure we share information and progress to avoid research duplication.

By working with, and developing the toolkit directly with, end users, we have a direct pathway to implementation. The toolkit will be tested and used as part of the project by the very people who will be the ultimate end users:

i. Initial engagement and consultation with stakeholders (participants, and end users);
ii. Development of a toolkit that meets the specifications determined by stakeholders);
iii. Implementation of the research outcomes, assessing the toolkits usability among stakeholders;
iv. Toolkit assessment and sensitivity testing.
v. Use of toolkit by the organisations directly involved in the research.
vi. The toolkit will be developed in a way that makes it as transferrable as possible to new places, including a simple data entry interface. This will maximize the chances of it being use in further organisations beyond those involved in the initial research.
vii. Training materials will be prepared and made available to all potential users.

viii. The participants in the learning spaces will act as early adopters and sector leaders, assisting in spreading knowledge regarding the availability and utility of the geospatial toolkit.

ix. We will hold workshops and training sessions at appropriate fora e.g. Local Govt NZ conferences.

2.5.12 Co-funding

Nature of Activity being Co-funded	Source of Co-Funding (Organisation name, Fund type, Cash/in-kind)	Secured/Applied For/Potential
Geospatial tool development	TLAs (seeking both in-kind and cash)	Potential
Geospatial tool development	Cooperative Research Centre for Spatial Information (cash through program 4.5 Built Environment)	Potential

2.5.13 Infrastructure Requirements

Item	Location/Ownership	Use
High spec computer	University of Canterbury	For toolkit software development, visualization

2.6 SRA 3: Supporting Success in Regional Settlements

	Name	Org.*	Annual FTE funded by Challenge	Skills of individual
PI	**Dr Arthur Grimes**	Motu	0.33	Economic geography, econometrics, economics of wellbeing, macroeconomics
	Dr Mike Mackay	LU	0.33	Urban and rural geography, urban and community studies, tourism and leisure studies.
	Dr Matt Roskruge	UW	0.33	Economics, demography, Māori economic development, applied econometrics.
AI	**Dr Malcolm Campbell**	UC	0.2	Geography of health, geo-spatial data systems, economic geography, urban geography, smart cities, quantitative methods.
	Dr Vivienne Ivory	UO & Opus	0.05	Urban and community studies.
	Te Horipo Karaitiana	UW	0.2	Governance, Māori economic development, stakeholder engagement.
	Dr Simon Lambert	LU	0.2	Kaupapa Māori research, Planning, Development, innovation.
	Prof Deborah Levy	UA	0.2	Property studies, place branding and marketing.
	Dr Dave Maré	Motu	0.2	Economic geography, econometrics, labour economics.
	Prof Laurence Murphy	UA	0.1	Urban geography and property finance.
	Prof Harvey Perkins	PP Ltd & UA	0.2	Geography, urban and rural transformation, regeneration.
	Prof Jacques Poot	UW	0.2	Migration, regional science, econometrics, population economics, building economics.
	Dr Jared Thomas	Opus	0.15	Social psychology, behavioural science.
	Thalia Ullrich	WC Ltd	0.2	Stakeholder engagement, research translation, governance, Māori economic development.
	Dr Suzanne Vallance	LU	0.2	Planning, urban regeneration and rejuvenation, community studies.
	Prof Iain White	UW	0.1	Spatial planning, international perspectives, planning policy and practice, knowledge co-production.

PhD students	UA, LU, UW	4.0	2 students: Quantitative focus (Economic Geography, Quantitative Sociology) 2 students Qualitative focus (Planning, Urban regeneration). At least one from each will have Kaupapa Māori research experience.

*LU= Lincoln University, Motu= Motu Economic & Public Policy Research, PP=Peoples & Place Ltd, UA= University of Auckland, UC=University of Canterbury, UW=University of Waikato, WC Waiora Consulting Ltd.

2.6.1 Outputs

By July 2019 we will:

- Describe the system of connections within and between New Zealand settlements quantitatively and qualitatively.
- Determine measures of success for settlements.
- Describe how the system of connections can be utilised to create successful outcomes.
- Identify regeneration interventions at different scales that will increase settlement success.
- Enable stakeholders to operationalise regeneration interventions appropriately and effectively.
- Initiate the establishment of a national community of practice to share information about the development of successful settlement regeneration and advance the development of those approaches.

2.6.2 Context

The SRA arises out of national and international public and policy concern about considerable variability in the success of towns, cities and regions (hereafter abbreviated to 'settlements') (National Business Review, 2014; Tallon, 2013). Settlement success in these terms is multi-dimensional: a successful settlement is prosperous (across a range of dimensions), liveable (for a diverse population), healthy (for all), and environmentally, socially and economically sustainable. This concern about settlement success is linked to the view that the potential of individuals and families/whānau cannot be fully realised if they are living in places that are under-performing economically and are under-developed socially, culturally, environmentally and in relation to infrastructure.

In Aotearoa New Zealand the settlements experiencing the widest range of success fall into the 'second-tier' with populations ranging between 10,000 and 65,000 residents (Eaqub & Stephenson, 2014; Johnson, 2015; Maré, 2005). These second-tier settlements typically have populations holding fewer formal credentials, are less productive per worker than larger urban areas and offer lower wages. They tend to have more specialised economic bases and fewer start-up firms. They also offer fewer urban amenities or other benefits of agglomeration (Rosenthal and Strange, 2003; Anderson, Burgess and Lane, 2007; McCann, 2013; Camagni and Capello, 2015; Dijkstra, Garcilazo, and McCann, 2013; Henderson, 1997).

While some second-tier settlements stagnate or contract, others are thriving, attracting internal and external migrants and firms from major cities. The settlements differ considerably in industrial structure, population characteristics and performance. Some of them are located near larger settlements with their major transport links, but most have a more peripheral location. Many have significant Māori communities including traditional marae and other cultural institutions of great importance to Māori cultural identity. Some second-tier settlements have recently been described by economic commentators as 'zombie towns' (National Business Review 2014), an unhelpful description which hides the potential of people and place.

The international research about the challenges faced by second-tier settlements, and attempts to ameliorate them, is reported in an extensive and predominantly European literature encompassing geography, economics, planning, urban politics, development studies and urban sustainability (Carpenter, 2006; Couch et al., 2008; Davies, 2002; Miles and Paddison, 2005; Parés, Bonet-Martí and Martí-Costa, 2012.). This topic is significantly under-explored in the context of the Aotearoa New Zealand experience and there is great potential to use the international scientific literature to inform local analysis and design pathways for improved outcomes in New

Zealand while contributing to the international debate. This SRA will combine international literature with a focus on a selection of regional settlements that are experiencing different levels of success.

In an effort to define settlement success, urban and regional spatial planners have taken a holistic approach (Albrechts, Healey and Kunzman, 2003; Auckland Council, 2012; Davey, 2014). Moving well beyond a land-use management perspective they have defined success in terms of functional integrated effectiveness in a number of spheres, including: population, the needs and aspirations of particular cultural/ethnic groups; recreation, arts and culture, historic heritage, the urban and regional economy; the bio-physical environment, responses to climate change, the rural and agriculturally productive parts of urban areas; the built urban environment, housing; physical and social infrastructure and transport and communication (Rutledge et al. 2008).

In Europe, settlement regeneration approaches have been and are being used to achieve elements of the functional integration desired by spatial planners. These approaches attempt to harness local resources effectively; connect networks of government, private and third sector actors locally, nationally and globally, and use those resources and connections to produce local sustainable economic, social and environmental outcomes. This approach has demanded that planners and those interested in regeneration take the role of intermediaries and market agents (Adams and Tiesdell, 2010). They have used codified and tacit knowledge (Perkins, Throns and Newton, 2008) to facilitate and enable regeneration outcomes. The main foci of regeneration efforts have been on settlements that in some way require urgent policy attention.

The European Union has supported urban regeneration as a key policy initiative and, in recent years, has funded pertinent research (Carpenter 2006; Parés, Bonet-Martí and Martí-Costa 2012) and published practice guidelines. Both the scholarly and applied urban regeneration literature offers insights that are of great value for this SRA. UK urban regeneration literature, for example, emphasises the processes of globalisation and de-industrialisation that occurred from the 1980s and reports outcomes of over 20 years of urban and regional economic, property, social and cultural regeneration experimentation, some of which has been very successful (Davies, 2001; Healy, 1992; Jones and Evans, 2008; Roberts and Sykes, 2000; Tallon, 2013).

The starting point for urban regeneration practitioners, whether amateur or professional, is to recognise that settlements are in a constant state of flux, affected by multiple internal and external forces that determine whether they grow, stand still or decline. These forces are linked to: demographic change, globalising processes, austerity measures, established and novel patterns of production and consumption, natural or man-made disasters, shifting socio-spatial configurations of inequality and exclusion, increasing social and cultural diversity, new forms of public-private investment and governance, experiments with the development of urban space, environmental management and social/cultural service provision (Couch et al., 2008; Tallon, 2013; Vallance, Dupuis and Thorns, 2013; Vallance, 2013; Peck, 2012).

Importantly, a critical literature has developed pointing out that a naïve approach to property-related regeneration has the capacity simply to increase property values and lower housing affordability, thus excluding the very people who are supposed to be the beneficiaries of development policies and programmes (eg Grimes and Liang, 2010; Grimes and Young, 2013; Porter and Shaw, 2009). Similarly, economic, social and cultural regeneration activity organised by 'formal' and relatively well-resourced public and/or private agencies, can overwhelm or undermine 'informal' interventions by community members if not approached with sufficient sensitivity (Deslandes 2013; Iveson 2013; Munzner and Shaw 2015).

A review of Aotearoa New Zealand's regional news media and Internet sources[P] indicates that there are many extant examples in the country of attempts at such regeneration (but see also Cloke and Perkins, 1998; Mackay, Perkins and Espiner, 2009: 9-13; Perkins and Thorns, 2000). These include:

- **Economic development:** building on under-exploited local resources and skills sets, supporting business incubators, place branding and marketing, new buildings and tourism events to attract new visitors, developing regional Māori economic development strategies (e.g. He Mauri Ohooho)

[P] For recent examples see Baker (2015); Bradley-Smith (2015); Bruce (2009); Bruce (2015); Howie (2009), Jamieson (2015); Malone (2015); Saggers (2015); Wolfe (2015).

- **Community development and planning:** creating new urban and regional spaces and institutional/governance arrangements e.g., to mitigate climate change, advance an 'envirotown agenda', defending existing resources from threats of closure or diminution.
- **Property development:** rehabilitating former industrial/commercial spaces or public facilities for re-use, constructing new public and private facilities/spaces for interaction e.g. cycle-ways, farmers' markets, offices, factories, stadia, convention centres, providing new technologies and infrastructure to advance connectivity.
- **Historical, cultural and environmental heritage conservation**

Often, a number of these interventions are in operation at the same time (see for example, Mackay, Perkins and Taylor, 2014; Perkins, Mackay and Espiner, 2015). They are not always coordinated effectively and there is only limited national connection between regeneration practitioners and therefore little scope for learning from each other.

Local and central government are increasingly placing an emphasis in policy agendas on regional regeneration (MBIE, 2014) and settlement regeneration as a tool for its achievement (Department of Internal Affairs, 2008). There is a very great need to support these activities with strong sciences in this programme which will utilise a community of researcher working on various aspects of urban/rural change in Aotearoa New Zealand's globalising environment (eg Perkins, Mackay and Espiner, 2015; Perkins and Thorns, 2012; Schöllmann, Perkins and Moore, 2000) and other existing relevant research which focuses on:

- Regional prosperity determinants including agglomeration and infrastructure[q]
- Determinants of healthy homes, neighbourhoods and cities (especially building on aspects of the Resilient Urban Futures [RUF] programme)
- Impacts of amenities and economic factors on house prices, rents and the availability of housing (Grimes et al., 2013)
- Social and cultural connections (Roskruge et al. 2013)
- Determinants of city sustainability (RUF programme)
- Resilience and sustainability through collaboration (Vallance, Dupuis and Thorns, Marsden Fast Start)
- Models of cities as a system (Grimes et al., 2014)
- Regional demography (NIDEA; Cameron and Poot 2011; Grimes and Tarrant 2013)
- Internal and external migration drivers[r]
- Regional labour market adjustment
- Tourism, amenity and urban and rural development (Perkins, Mackay and Espiner, 2015; Mackay, Perkins and Taylor, 2014)

This SRA will be integrated with new methodological approaches to the study of the space- and cultural-economy (for example, Bathelt, 2006; Jones, 2013; Allan et al., 2013), and both tactical (Lydon, 2011) and adaptive urbanism (Vallance et al., 2015). There are also international conferences in process focused directly on these issues (see for example, Regional Urbanism in the Era of Globalisation.)[s]

In combination, and applied for the first time to Aotearoa New Zealand's second-tier settlements, our research will support and advance settlement regeneration by creating a much more sophisticated understanding of the connections and flows between settlements, and using, a researcher-stakeholder co-production methodology to evaluate and strengthen regeneration practice.

2.6.3 Opportunity

There have been concerns about the success of second tier New Zealand settlements for some time. The regional economic development approaches of the 1970s and early 1980s are now seen as inadequate. Novel approaches are required. However, the field lacks strong analysis grounded in primary research and stakeholder engagement and this will be required if policy solutions and appropriate action is to be initiated. This demands a trans-disciplinary and multi-scalar methodological approach in order to connect the

[q] Cochrane et al. (2010); Fabling et al. (2013); Glaeser and Maré (2001); Grimes and Liang (2010); Grimes & Young (2011); Grimes et al (2012); Grimes and Young (2013); Grimes (2014); Grimes et al (2014); Maré (2004); Maré and Graham (2009); Maré and Fabling (2011); Maré and Graham (2013); Roskruge et al. (2012).

[r] Cochrane and Poot (2008); Maré and Timmins (2003); Maré et al. (2007); Maré et al. (2009); Maré et al. (2011); Maré and Coleman (2011); Morrison et al. (2006).

[s] http://www.hud.ac.uk/schools/artdesignandarchitecture/research/conferences/regional-urbanism/

key stakeholders and jointly explore the development of optimal pathways, networks and interventions for settlement success. Iwi in rural settlements have a vested interest in regional economic and social development interventions that contribute to the attractiveness and success of the settlements within their rohe (boundaries). A key issue for the regeneration of smaller settlements is improving connections across the Māori economic ecosystem. It is for this reason that we have committed to a co-production research approach, with stakeholders and practitioners in second-tier settlements participating in the shaping and undertaking of the **whenu** (research strands) and the research questions.

The SRA is thus an opportunity to meet the Challenge Objectives of (i) **creating smart and attractive urban environments by taking up innovation and productivity improvement opportunities***;* and (ii) **improving current and future urban environments and residents' well-being***.* In order to meet the Challenge Objectives the SRA will create a holistic understanding of settlement and community interconnections, the contribution of these connections to regional success, and use this understanding to design and implement innovative and novel pathways to encourage success.

The research design is an interwoven mixed methods approach, where the research programmes are complementary and interdependent. Critical areas where this research goes beyond business as usual include:

- Developing a model of the system of settlements in Aotearoa New Zealand using the rich range of New Zealand microdata, including the newly released New Zealand Integrated Data Infrastructure and Longitudinal Census data, to draw conclusions about how connecting across scales can improve economic, social and environmental success of the country's settlements and the country as a whole.
- Concurrently, with co-production of knowledge as a goal, engaging closely with settlement regeneration stakeholders in, and associated with, second-tier settlements, and working with these stakeholders to build a qualitative understanding of what connections within and between their settlements mean for their success.
- Using findings from each approach to inform and guide the other, so that the system of connections can be described both as a statistical relationship and contextualized in qualitative understanding.
- Investigating critically the range of locally based but globally connected interventions designed to regenerate settlements at a variety of scales.
- Identifying what approaches to regeneration work well and jointly, combining the skills of researchers and stakeholders, develop tactics to advance them.
- Adapting methodologies to help Māori communities within these settlements improve their wellbeing by undertaking research with a unique Māori interpretative lens.
- Establishing a variety of fora to bring together and connect settlement regeneration practitioners and researchers engaged with settlements at a range of scales from across the country to create a community of practice to share information about the development of successful urban regeneration and advance those approaches in order to improve urban environments and residents' well-being in all parts of Aotearoa New Zealand.

Co-production of knowledge is central, and we will work closely with stakeholders and practitioners to achieve success in these critical areas, and to ensure that our research is relevant and transformative for the second-tier settlements of Aotearoa New Zealand.

2.6.4 Research Questions

- What are the systemic drivers of success and lack of success of New Zealand's second-tier settlements?
    - Across different scales of place (home, neighbourhood, settlement, region)
    - Affected by different networks of connections within and outside the area
    - Across multiple dimensions of success
- How can Māori connections across scales be enhanced to facilitate successful economic outcomes and enhance wellbeing?
    - within the Māori economic ecosystem
    - between settlements of different scale
    - internationally, particularly the Asia-Pacific region via Māori-led cultural diplomacy

- What forces and interventions enable some places to materially out-perform or under-perform compared to expected performance based on the identified systematic forces?
    - i.e. what works
    - And, just as importantly, what hasn't worked
    - Why has this occurred
    - And is it replicable in other places and/or at other scales?
- If successful interventions are replicable in other places at various scales, who may take on the intervention roles?
    - i.e. who are the settlement urban and regional regeneration stakeholders
    - What are their objectives
    - At what scale(s) should the interventions occur
    - And should they be coordinated across relevant networks of places?
- What information sharing mechanisms could be used to connect settlement regeneration practitioners and researchers from across the country to create a community of practice to share information about the development of successful urban regeneration and advance those approaches?

2.6.5 Research Outline including Projects

The overall research goal is to identify the systemic forces that affect second-tier settlement success in Aotearoa New Zealand. This multi-scalar programme will comprise three fully interwoven *whenu* (strands), each comprising multiple Projects. Each *whenu* will inform the others, and have the co-production of knowledge as a methodological underpinning.

Whenu tuatahi: Connections (the first strand), operates at multiple settlement scales and will rely mainly on quantitative analysis. The analysis will explore a range of indicators to gauge success: amenity value and wellbeing (Project 1), business connectedness (Project 2), and adjustment between towns, cities (Project 3). **Whenu tuarua: Mauri Tu, Mauri Ora** (the second strand), will contribute to the co-production of knowledge of specific relevance to Māori communities by taking a kaupapa Māori approach to adapt the work of **whenu tuatahi** (Project 4), and **whenu tuatoru** (Project 5). The **whenu tuatoru: Regenerating for success** (the third strand), is built around research co-produced with settlement regeneration stakeholders and will be significantly but not exclusively qualitative. As part of our co-production approach, selection of settlements for this **whenu tuatoru** will occur in consultation with stakeholders and the members of **Supporting Success *in* Regional Settlements** and the broader Challenge team. There are four projects in **whenu tuatoru**: Regeneration in practice (Project 6); The elements of successful regeneration (Project 7); Advancing regeneration interventions (Project 8); and Creating transformative connections, conversations and actions (Project 9).

When combined, the research **whenu** and their projects will: (i) create completely new understandings of the forces that stakeholders can "work with" in enhancing outcomes at differing scales and across different nodes of the settlement network; and (ii) identify exceptions where settlements have performed materially differently to what may be expected given the systematic forces. Exceptions may be positive ("successful settlements") or negative ("unsuccessful settlements"). By in-depth analysis of stand-out intervention successes (and intervention failures) in settlements that we would otherwise expect to have performed differently, we will more readily be able to ascertain which interventions may succeed at which scale for differing types of settlement.

Overall, the research programme provides – for the first time – a systematic method for determining the settlements and interventions on which we should focus. This will allow decision-makers at multiple levels to focus their interventions on what is likely to succeed at different scales, given different forces and different network connections involved.

Programme whenu and associated research Projects

Whenu tuatahi: Connections

The analysis will first draw on descriptive and statistical techniques applied to historic and recent NZ data. Researchers will be guided by discussion with practitioners and stakeholders and make significant use of Statistics New Zealand's unit record data on firms, employees, households and houses. This will allow us to ascertain the key patterns that have driven the success of NZ settlements both in recent times and over longer historical timeframes. Connections will uncover the impact on communities of forces such as internal and international migration, ageing, transportation, agglomeration, the internet, past and looming impacts of climate change and innovation policies which will have pervasive – but differing – effects at different scales and in different locations with different networks.

This whenu comprises three staged projects, Project 3 bringing together and extending Projects 1 and 2. Research in this whenu will elucidate connections between all settlement scales in Aotearoa New Zealand (including the largest, Auckland) and particularly the interactions between larger and second-tier settlements. The focus on amenity values, the connectedness of local businesses and inter-related adjustment within and between towns and cities as they affect settlement success has been chosen to be consistent with emerging debates in the space economy (Bathelt, 2006; Jones, 2013) and urban and regional economics literature (Scott, 2012; Boschma, 2005; Dijkstra, Garcilazo and McCann, 2013; V. Henderson and Thisse, 2004; Glaeser et al., 2015). The knowledge produced will both be guided by researchers in other whenu and provide guidance for the knowledge generated within them.

Project 1: Impacts of Amenities at Varying Spatial Scales:

How valued are amenities within settlements?

Hedonic price (and valuation) models will be used to estimate the impact of existing amenities – at different locations and at different scales – on prices. Two separate studies are envisaged:

i. An examination amenity values for settlements across the whole of NZ. This will be an important building block for identifying areas that have particularly high or low amenity values, thereby feeding into the choice of specific areas to examine in the other *whenu*.
ii. We will complement the studies in the second stream of research by deriving amenity values in a second-tier settlement that either has particularly high or particularly low overall amenity values in order to quantitatively assess the reasons driving these particular amenity values. The choice of settlement will be made in conjunction with co-researchers in the SRA and with settlement stakeholders.

Project 2: The contribution of connected local businesses:

What effects do connections across spatial scale have on local prosperity, through the impact that they have on the performance of local businesses?

The strength of effects will be estimated using statistical methods, applied to rich NZ microdata on firms and workers (core data sources are the Statistics NZ Integrated Data Infrastructure, Longitudinal Business Database and Census of Population and Dwellings). The project will have three main foci, each relating to a particular type of business connection, each of which can be detected using existing data:

- **Business-to-business connections**: towns and cities may be connected through the presence of multi-location firms, and business ownership links.
- **Connections through worker flows**: flows of workers, especially skilled workers, between firms in different locations serve to link towns and cities.
- **Value-chain connections**: towns and cities may be interdependent due to flows of inputs and outputs. Well-performing suppliers or customers in nearby locations may improve local prosperity. Value-chain connections include connections with innovation hubs (e.g. universities and business incubators that may or may not be in the same settlement).

For each of these three areas, we will document the difference in performance between strongly and weakly connected firms and locations, and also test for causal relationships, through event studies and, where possible, independent variation over time. We will consider a range of firm performance measures, including productivity, innovation, attracting investment, and employment growth.

Project 3: Inter-related adjustment within and between towns and cities:

How do communities adjust when amenities or firm conditions relevant to a place change; what effects do these adjustments have on local outcomes; and what can be done to optimise the adjustment process so as to improve outcomes?

This project will include a combination of theoretical and empirical approaches to clarify the nature and strength of inter-related adjustment across towns and cities. The dynamics of amenity impacts across locations and time will be examined using an intertemporal model of location choice (Maré and Coleman 2011). We will elucidate the mechanisms by which local firm and population composition responds to changing local prospects. This is particularly relevant for identifying the longer-term impact of locally focused interventions to improve towns and cities. Event-study approaches will be used, employing the rich available micro-data, to investigate the longer term impacts of changing amenities (including infrastructure) and other forms of local economic and residential development. The studies will focus on changes in the composition of people and firms in directly affected areas as well as in surrounding and more distant areas. Related approaches have been used in New Zealand to learn about the impact of motorway extensions and of the Christchurch earthquake (Fabling, Grimes and Timar 2014; Grimes and Liang 2010).

Whenu tuarua: Mauri Tu, Mauri Ora – Successful Māori economic ecosystems

The research will engage directly with individuals; private, public and third-sector agencies; and rūnanga/runaka responsible for the initiation and management of settlement regeneration interventions and interventions. Developing on the knowledge gained from the other **whenu**, a combination of qualitative and quantitative geo-spatial data gathering and analytical techniques will be utilised to critically investigate the range, scale and connectivity of locally based regeneration interventions and evaluate existing regeneration approaches. We will use this knowledge to co-produce strategies which will advance the approaches found to be most successful and further advance the capacity of Māori.

This **whenu** embodies kaupapa Māori by adopting an academic/practitioner partnership approach to the leadership of the project. Dr Matt Roskruge will lead Mauri Tū, Thalia Uhlrich will lead Mauri Oho. The inclusion of Te Horipo Karaitiana as a community research partner is key to realizing integrated knowledge translation within this **whenu**. He is actively involved in the Regional Growth Strategy process for Toi Moana and, as ex-CEO of the Federation of Māori Authorities, has well developed connections with stakeholders in the Māori economy, essential for the success of our co-production methodology.

Project 4: Mauri Tū - Right skills for the right resources:

What connections are required to improve regional Māori economic development?

Understanding the dynamics of population, institutions and resources in localised Māori communities is central to developing strategies to maximize the potential for Māori and the settlements in which they reside. This project is adapted from the quantitative methodology and goals of **whenu tuatahi**. **Whenu tuarua** adds to this method by focusing the inquiry towards a specific Māori need, with the research undertaken and interpreted using a Māori interpretive lens; the research will be co-created with the stakeholders. This research focuses on two geographically distinct ecosystems in the Upper North Island (Bay of Plenty->Waikato->Auckland; Northland->Whangarei->Auckland) and its purpose is to identify the stock and flow of skills (nested in people) between localised Māori economies situated within a broader regional ecosystem.

Project 5: Mauri Oho - Right connections with the right institutions:

How can Māori connections across scales be enhanced to achieve successful economic outcomes?

The Regional Growth Study (RGS) process is a cross-government/community collaboration supporting regional growth and transformation. Engaging RGS actors (Toi Moana – He Mauri Ohooho Māori Advisory Group, RGS Governance Group; Tai Tokerau - Te Tai Tokerau Iwi Chief Executives Consortium, Northland Inc, various Iwi Asset Holding companies) in dialogue and new conversation around the data analysed and visualised in Project 1 will provide a space to identify and enhance key connections across the Māori economic ecosystem. We will adapt qualitative methods from **whenu tuatoru** for use in a Māori context by applying kaupapa Māori principles and a Māori interpretive lens. The purpose is to support transformative actions by identifying strategies to create economic opportunities for Māori institutions in support of community regeneration efforts.

Whenu tuatoru: Regenerating for success

The research will engage directly with individuals and rūnanga/runaka to develop tactics to advance the approaches found to be most successful and establish fora to bring together and connect urban regeneration practitioners and researchers from across the country to create a self-sufficient community of practice.

The research will engage directly with settlement regeneration stakeholders to evaluate and advance successful approaches. This *whenu* comprises 4 staged projects each building on the other and the projects in **whenu** 1 and 2. This **whenu** comprises research fieldwork in two South Island settlements juxtaposed against the North Island settlements chosen for analysis in **whenu tuarua**. The settlements will be selected from a range of likely second-tier settlement learning spaces (Invercargill, Queenstown, Oamaru, Timaru, Ashburton, Blenheim, Nelson) using the intervention success/failure model to choose the most appropriate and in which stakeholders are willing to engage. This initial scoping will create a much stronger understanding of regeneration interventions and the local and extra-local stakeholders associated with them. We will then be in a position to evaluate these interventions and support settlement stakeholders in their endeavours. This will include using what we have learned to establish a variety of fora that bring together and connect urban regeneration stakeholders and researchers engaged with settlements at a range of scales from across the country. This will contribute to the creation of a community of practice able to share information about the development of successful urban regeneration and advance those approaches in order to improve urban environments and residents' well-being in all parts of NZ.

Project 6: Regeneration in practice:

What is the local experience and global connectedness of regeneration interventions in second-tier settlements?

We will adopt an innovative actor-oriented methodology involving elements of partnership, collaboration and dialogue in the co-production of knowledge (Enengel et al., 2012; Maclean and Cullen, 2009). This approach holds the potential of producing knowledge that will be useful and relevant to stakeholders in the development of their regeneration interventions. It has the capacity to connect urban regeneration practitioners and researchers and develop new conversations and the beginnings of a community of practice. Data will be gathered using interviews, at hui/meetings, structured workshops, stakeholder-led interpretative fieldtrips and careful analysis of official and informal documentation and web-resources. This method and the types of data it will elicit will enable us create an inventory and typology of the second-tier settlement regeneration interventions.

Project 7: The elements of successful regeneration:

What factors are key to the success of local regeneration strategies?

Researchers in **whenu tuatahi** and **tuarua**, in combination with stakeholders, will examine the contexts, mechanisms and the configuration of settlement regeneration outcomes. This will allow us to refine explanations of regeneration intervention effectiveness (Pawson and Manzano-Santaella, 2012). This theoretical work, and the understanding of the causal relationships involved in regeneration arising from it, will be used as a basis for a systematic mixed (quantitative and qualitative) methods evaluation of the regeneration approaches encountered in the settlement learning spaces (Pawson and Tilley, 1997). . The focus will be on both **how** interventions work and **measures** of their collective outcomes.

Project 8: Advancing regeneration interventions:

What tactics will ensure that future regeneration interventions will deliver successful outcomes?

A range of techniques will be used including scenarios of possible interventions to understand realistic trade-offs between aspirations and what is practically possible given skills and resources. Virtual simulation testing and geo-spatial visualization (linked with SRA Next Generation Information) about changes to the local environment as a result of specific interventions will be used (Lamb & Walton 2011; Guimarãe, Maaß and Gertz 2014; Ivory, Burton and Dravitzki 2014). This will help participants think beyond business as usual. We will take people through an experience where they can consider possible adaptations and compromises and determine whether they would still have a good quality of life under novel circumstances. Results from experiments will be shared with stakeholders to discuss consequences, identify potential investment priorities. The experimental approach provides the opportunity for stakeholders and communities to engage in difficult conversations in a 'safe' way, providing robust, local evidence of an appetite for change, and allow a range of voices to be heard.

Project 9: Creating transformative connections, conversations and action:

What fora are most appropriate for the development of a self-sufficient community of settlement regeneration practice?

Sustaining regeneration practice and research beyond the end of the Challenge is essential. Therefore we will establish local, regional and national fora exchange of ideas about what works and what doesn't. Such fora will be a useful pathway to increase capacity and skills and build a sustainable and self-sufficient community of practice, which will include experienced and emerging practitioners and researchers.

2.6.6 Timeline

2016	2017	2018
WHENU TUATAHI: *CONNECTIONS*		
Project 1. Impacts of Amenities at Varying Spatial Scales		
Identify, in consultation with whenu tuarua and tuatoru researchers, relevant amenities.		
Examination of amenity values across New Zealand.		
	In depth analysis of amenities in one or more selected second-tier settlement(s) to support research activities in projects 4-9.	
Project 2. The contribution of connected local businesses		
	Analysis of business connections within and between regions, including examination of workforce flows, including both labour and skills, between settlements, and examination of value chains and innovation hubs.	
Project 3. Inter-related adjustment within and between towns and cities		
	Building on findings of projects 1 and 2 plus whenu tuatoru and tuarua, identify theoretical mechanisms for adjustments in response to change, develop models and test theoretical mechanisms.	
WHENU TUARUA: *MAURI TU, MAURI ORA*		
Project 4. Mauri Tu - Right skills for the right resources		
Work with Māori stakeholders to identify opportunities to inform and gain information from whenu tuatahi.		
	Adapt knowledge from whenu tuatahi with stakeholders for use in planning and project 5. Address knowledge gaps through research activities with stakeholder.	

Project 5. Mauri Ora - Right connections with the right institutions		
Cross-cutting engagement with stakeholders from a variety of positions to build an understanding Māori economic ecology.		
Identification of transformative activities which are potential or underway, and develop strategies to support these with data and evidence.		
	Active participation in regeneration activities in partnership with Māori ventures and communities drawing on information from other projects.	
WHENU TUATORU: *REGENERATION FOR SUCCESS*		
Project 6. Regeneration in practice		
Engage with a broad suite of stakeholders nationally to create an inventory and typology of the second-tier settlement regeneration initiatives. Select the two case study learning spaces.		
Project 7. The elements of successful regeneration		
Development of regeneration evaluation criteria for use in the two learning spaces by searching for and refining explanations of initiative effectiveness. Wide consultation with research team and stakeholders.		
Project 8. Advancing regeneration initiatives		
	Building on knowledge developed in all of the earlier projects, model the impact of changes resulting from regeneration activities in the two learning spaces.	
		Communicate of findings to stakeholders, planning to effect change.
Project 9. Creating transformative connections, conversations and action		
Identify and develop communities of interest in regeneration activities, and facilitate these into networks. Networks can be prioritised using information developed in other projects. Establish fora to exchange ideas and disseminate knowledge.		

2.6.7 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling including personnel involved
Dr Matthew Roskruge	Mid	European & Māori	Mentoring in Kaupapa Māori research by Simon Lambert and Māori governance and community engagement, by Thalia Ullrich and Te Horipo Karaitainga
Dr Suzanne Vallance	Mid		Involvement in large-scale, nation-wide, longitudinal research project. Synthesis between projects.
Dr Malcolm Campbell	Early		Mentoring in leadership by Harvey Perkins. Mentoring in Kaupapa Māori research by Simon Lambert and Matt Roskruge.
4 PhD students	Student		Research training, experience in co-production research techniques and working in transdisciplinary teams.
Research Assistants	Early Career		Research training prior to PhD Study

2.6.8 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Transforming Decision Making for Homes Towns & Cities (TDM)	TDM is linked to our SRA through the knowledge generated in understanding the system (Whenu tuatahi and tuarua) and in using this understanding to effect change (whenu tuarua and tuatoru, the second and third strands).
Next generation information for better outcomes (NGI)	NGI is linked to our SRA through the knowledge generated in understanding the system (Whenu tuatahi and tuarua) and in using this understanding to effect change (whenu tuarua and tuatoru, the second and third strands). We will likely both draw on and contribute to Next Generation Information in our research
Shaping places: future neighbourhoods (SP)	The focus on second-tier settlements this SRA complements the research into large-city complexity undertaken in SP.
Hei Papakāinga ora (HPO)	HPO links with this SRA primarily through the interrelationship between whenu tuarua (The second strand), with both projects using a Māori interpretive lens to use information in new ways and help advance priorities for Māori.
Transforming the building industry (TBI)	Links with TBI have yet to be formalised but there is potential for sharing information on challenges facing the building industry in the second tier settlements, especially around provision of labour with the required skills

2.6.9 International Linkages

Organisation	Key International Person(s)	Nature of relationship with THIS SRA
Regional Science Association International	Professor Andres Rodriguez-Pose, LSE	RSAI is the global umbrella organization for research on regional impacts of national or global processes of economic and social change. The organisation has about 4500 members, many of whom are in research fields highly relevant to this SRA, particularly in the case of the quantitative whenu .
Regional Studies Association	Prof Andrew Beer, University of Adelaide	RSA provides a global forum for city and regional research, development, and policy. There is some overlap with RSAI but this organisation has a greater focus on practitioner-oriented and qualitative research thus will support our stakeholder and community engagement. www.regionalstudies.org
Co-operative Research Centre for Spatial Information (CRCSI)	Dr Peter Woodgate, CEO, CRCSI.	CRCSI is an international research and development centre which conducts user-driven research in spatial information that address issues of national importance.
Local Economy Policy Unit, United Kingdom	Director, Andrew Jones, Joint UK Editor, Local Economy Prof David Walburn, European Editor, Local Economy	The Local Economy Policy Unit (Lepu) provides one of the means by which London South Bank University can achieve its aim of contributing to the development and regeneration of the London region. Lepu also connects with research, practice and policy in economic development from around the world. Lepu has participated in the OECD Local Economic and Employment Development Programme (LEED), has links with the European Association of Development Agencies (EURADA) and also has strong networks across North America, South frica, Australia and New Zealand. http://www1.lsbu.ac.uk/lepu/
Northumbria University	Dr Lee Pugalis,	Chair of the Research Group for Economic Development, Innovation and Entrepreneurship (REDIE) andJoint UK Editor Local Economy Which is an interdisciplinary forum for critical review of policy developments in local economic development and urban regeneration. It seeks not only to publish analysis and critique but also to disseminate innovative practice. http://lec.sagepub.com/
University of the West of England	Dr Andrew Tallon	Editor of the international Journal of Urban Regeneration and Renewal www.henrystewartpublications.com/jurr Author of Urban Regeneration in the UK published in April 2013 www.routledge.com/books/details/9780415685030/
University of Melbourne, Urban Geographies	Dr Kate Shaw	Australian Research Council, Future Fellow in Urban Geography and Planning

		https://katesshaw.wordpress.com/publications/
Aberystwyth university	Professor Michael Woods	Leader of the Global-Rural Research project. 'The Global Countryside: Rural Change and Development in Globalization (GLOBAL-RURAL)' is a major research project funded by the European Research Council. The study aims to advance our understanding of the workings and impact of globalization in rural regions through the development and application of new conceptual and methodological approaches. https://globalruralproject.wordpress.com/the-research-team/
Royal Institute of Technology (KTH), Sweden	Professor Hans Westlund	Professor in Regional Planning at KTH (Kungliga Tekniska Högskolan) Stockholm, Sweden; Professor in Entrepreneurship, Jönköping International Business School (JIBS) Sweden and Professor at the Institute for Developmental and Strategic Analysis (IRSA) Ljubljana, Slovenia.
Spatial Economics Research Centre (SERC), LSE	Prof Steven Gibbons, Also Prof Paul Cheshire, Dr Max Nathan	Director, SERC; Professor of Economic Geography http://www.spatialeconomics.ac.uk/
Harvard University	Prof Ed Glaeser	Professor of Economics; Member of Motu International Panel of Advisors http://scholar.harvard.edu/glaeser/home
University of Glasgow	Prof Duncan McLennan	Professor in Public Policy; former Director of Centre for Housing Research, University of St Andrews http://www.gla.ac.uk/schools/socialpolitical/staff/duncanmaclennan/

2.6.10 Vision Matāuranga

Māori are actively engaged in a variety of urban and regional regeneration projects that relate to Indigenous innovation, Taiao, Hauora/Oranga and Matāuranga (E.g. Smith, Tinirau, Gillies and Warriner (2015)). In development of this SRA, we have met extensively with Māori stakeholders through hui organised by the Māori leadership teams and in meetings with Iwi representatives. In these hui it has been indicated that many rohe and rūnaka are actively involved in strategic planning for regeneration activities. In addition, many stakeholders have expressed concern about a lack of information regarding how iwi resources can be utilized to maximise benefits for iwi and Māori generally. One of the themes which has been communicated to us is that Māori concepts of scale connect from the individual to the rest of the planet through cultural institutions – iwi, hapū and whānau – not all of which are flourishing but are relevant to development interventions.

This SRA aims to make a particular contribution to the gap in knowledge, identified in stakeholder engagement hui (meetings), between what is a well-developed understanding of the resources available to Māori and local regeneration or development strategies, and the wider systemic forces which challenge the potential of these resources in terms of productivity, sustainability or their contribution to wellbeing. Examples of these systemic forces include the loss of whānau to large urban centres, the infrastructure requirements to draw visitors, the networks required to develop markets for goods or access to health and education institutions to develop capacity and capability.

Indigenous innovation is captured in our SRA through the reliance on the innovations and entrepreneurial insights of our Māori stakeholders in order to identify which connections to examine (Whenu tuatahi, tuarua) and to co-produce pathways for success from this knowledge (Whenu tuarua, tuatoru).

The theme of **Hauora/Oranga** is reflected in this research through knowledge co-production which is focused on stakeholder needs, knowledge and activities rather than a researcher only approach. We adopt an understanding of wellbeing conceptualised specifically for iwi/hapū/whānau at a broader level (e.g. Kukutai, Sporle and Roskruge, 2015; Kukutai and Taylor, 2012), and will consider connections and pathways from the three whenu which contribute to aspects of wellbeing. The research will assist in delivering better communities, in which Māori can achieve their potential and increase their wellbeing.

The theme of **Taiao** is supported primarily by Whenu tuarua, which will use information being developed in the other whenu to assist Māori to achieve further success from the resources available to them. In consultation with Iwi, we will explore the importance of sustainability and development of environmental resources with our stakeholders, and reflect this in our research across the three whenu.

Mātauranga Māori is required to guide this research project and to create meaningful knowledge. At the beginning of each of the three whenu, Māori knowledge and understanding will be sought and incorporated into each of the whenu. Whenu tuatahi, *Connections* will work with stakeholders who are Māori to get their interpretation of the connections which matter to them, the sorts of amenities which are important to their community, and the ways in which connections are expressed. This SRA will also be particularly impacted by the developing notion of **data sovereignty** (Taylor and Kukutai, 2015). We will address data sovereignty with our stakeholders during the project, developing the data and knowledge in collaboration and to develop practical expressions of the data sovereignty held by Māori.

The modus operandi for this SRA is through relationships, including with inanimate and non-human beings. This means that while spatial location is important, we also need to acknowledge the importance of cultural institutions. The importance of cultural institutions and connections is central to achieving a successful Vision Mātauranga in this SRA.

2.6.11 Stakeholder Involvement and Pathway to Implementation

Type of Stakeholder	Name of Organisation/Person	Contact to Date
Iwi	Te Rūnanga o Ngāi Tahu, Diane Turner, Principal Advisor, Recovery, Office of the Chief Executive	One hui at the offices of the Iwi and attendance of Ms Turner at the NSC11 organised hui at the University of Canterbury, 29 September, 2015.
Local Government	Christchurch City Council. Selwyn District Council Ashburton District Council Waikamariri District Council Auckland Council Western Bay of Plenty District Council Kawerau District Council Tauranga City Council Bay of Plenty Regional Council Opotiki District Council Rotorua District Council Taupo District Council	South Island councils consulted on 22nd Sept as part of Lincoln University's Planning Advisory Board meeting. North Island councils particularly relevant to Whenu tuarua. Chris Parker (Chief Economist- Auckland Council) contacted by Motu North Island councils are all major stakeholders in Mauri Tu, Mauri Ora. South Island councils in the nominated settlements are all potentially major stakeholders.

	Whakatane District Council Northland Regional Council Far North District Council Kaipara District Council Whangarei District Council Waikato Regional Council Hamilton City Council Hauraki District Council Matamata-Piako District Council Otorohanga District Council South Waikato District Council Taupo District Council Thames-Coromandel District Council Waikato District Council Waipa District Council Waitomo District Council Invercargill City Council Waitaki District Council Queenstown-Lakes District Council Timaru District Council Ashburton District Council Malborough District Council Nelson City Council	
Central Government	Ministry of Business, Innovation and Employment; Ministry for the Environment; Department of Internal Affairs; Te Puni Kōkiri; The Department of Conservation; Ministry of Primary Industries	None to date
Health providers	District Health Boards, Ministry of Health	None to date

NGO	With social, economic and environmental development foci including Historic Places Trust, Tourism NZ	Prof Paul Dalziel (President, Lincoln University) Susan Houston (President)
ANZRSAI	Prof Paul Dalziel, President (Lincoln University)	Richard Aitken (Chairman)

Stakeholder engagement lies at the heart of **Whenu tuarua** and **Whenu tuatoru**:

- *Whenu tuarua* will engage with Māori communities in the Upper North Island and the cross-government/community Regional Growth Study.
- *Whenu tuatoru* will comprise fieldwork in South Island settlements, working directly with these communities to identify elements of successful regeneration and ensuring that future interventions deliver successful outcomes. These learning spaces will provide experience from which communities can learn and models for other communities. Finally we will establish fora in which communities will continue to exchange ideas and skills and build a community of practice in regeneration.

Because there are many potential stakeholders in each settlement with an interest and capacity to contribute as participants we will cast a wide net in the first instance when seeking participants; as fieldwork proceeds there will be an inevitable narrowing of active stakeholder participants. The net will include:

- **Individuals**, e.g., community and settlement citizens accessed through hui, town forums and allied stakeholder engagement: politicians; mayors; Māori/rūnanga leaders; community activists; school principals; business leaders; community representatives; social development, recreation, sport and cultural institutions; social and business entrepreneurs; property owners; property developers; financiers; philanthropists; designers; planners; environmental advocates; and those employed professionally as consultants/advisers or part/full-time managers of regeneration agencies and allied organisations.
- **Private, public and third-sector agencies**, e.g., local government; economic development agencies; social and community development agencies and groups; educational organisations; service clubs; co-operatives; recreation, sport and cultural organisations; local promotion and event management groups; historic heritage conservation groups; natural heritage conservation groups; firms across the spectrum of local economic activity; philanthropic trusts; regional and community trusts; licensing trusts.
- **Rūnanga/runaka** and their programmes focused on advancing the interests of their people through a range of cultural, social, and economic development programmes.

2.6.12 Co-funding

Nature of Activity being Co-funded	Source of Co-Funding (Organisation name, Fund type, Cash/in-kind)	Secured/Applied For/Potential
Learning space research	Local Councils, Development agencies, Community organisations, NGOS	Potential
ICT (amenity) data for Whenu Tuatahi	Large corporate (confidential)	Applied for (likely to be granted)
Unit record housing data for Whenu Tuatahi	Large real estate organisation (confidential)	Secured (subject to project by project approval)

2.7 SRA4: Shaping Places: Future Neighbourhoods

	Name	Org.*	Annual FTE funded by Challenge	Skills of individual
PI	Prof Errol Haarhoff (Overall SRA coordination)	UA	0.25	Urban design, housing, Urban growth management, neighbourhood design, architecture, urban planning.
	Prof Karen Witten (Waimahia Learning Space)	MU	0.2	Urban geography, public health, psychology , neighbourhood and wellbeing
	Prof Marc Aurel Schnabel Enquiry by Design)	VU	0.2	Architecture, architectural technology, Building information modelling, virtual reality, digital media, urban design
	Dr Suzanne Vallance (Inner ChCh learning Space)	LU	0.2	Urban studies, planning, collaborative governance, DIY urbanism, disaster recovery and rejuvenation, qualitative and quantitative research
	Dr Ella Henry (Glen Innes Learning Space)	AUT	0.2	Sociology, Māori management, business and development
AI	Prof Iain White	UW	0.1	Climate, environmental change and impacts, sustainability, environmental resources and planning
	Prof Philippa Howden - Chapman	UO	0.05	Public health, housing and health, energy policies
	Dr Lee Beattie	UA	0.1	Urban planning, urban growth management, urban design, plan evaluation.
	Emma Fergusson (PhD candidate)	MU	0.2	Urban planning, social research
	Dr Andreas Wesener	LU	0.1	Urban design, urban regeneration and sustainability.
	Tricia Austin	UA	0.15	Planning, affordable housing, sustainability, disabled access, CPTED, resilient urban futures.
	Dr Rebecca Kiddle	VU	0.2	Urban design, Māori identity in placemaking, built-environment decision making, cross-cultural ideas.
	Dr Simon Lambert	LU	0.2	Māori environmental planning and development; Indigenous disaster risk reduction; innovation diffusion
	Derek Kawati	VU	0.2	Architecture, parametric design, generative digital modelling, indigenous traditional knowledge.
	TBA Economist	UA	0.1	Property and development economics, investment.

	Dr Hamish Mackie	MRC Ltd	0.05	Ergonomics, transport planning, human factors
	Dr Roy Montgomery	LU	0.05	Urban Planning, public space
	Dr Diane Menzies	Landcult Ltd	0.05	Landscape architecture,
	John McDonagh	LU	0.05	Real estate, sustainable and strategic property management
	Desna Schollum	DWS & Ngo Aho	0.2	Community engagement, art & design.
	Assoc Prof David Conradson	UC	0.1	Geography, community welfare, disaster recovery and resilience, place attachment, social connectedness.
	Dr Crile Doscher	LU	0.05	Environmental engineering, GIS, hydrology, modelling.
	Researcher TBA	UA	0.15	Sustainable design, zero-energy, retrofitting and reuse, post-occupancy evaluation
MSc Student Jade Kake		Unitec	0.2	Architecture, Te Aranga principles.

*DWS=DWS Creative, LU=Lincoln University, MRC Ltd=Mackie Research & Consultancy Ltd, MU=Massey University, UA=University of Auckland, UC=University of Canterbury, UO=University of Otago, VU=Victoria University

2.7.1 Outputs

By July 2019:

- We will deliver critical evaluation of Waimahia and Inner Christchurch, in terms of 'meso' level stakeholders, decision makers, policies, planning and participatory practices, and processes which promote and enable, or undermine, the co-creation of neighbourhoods that are able to provide for the well-being residents. This evaluation will be cross referenced to 'macro' level decision making processes which are examined at the 'macro' level in the SRA Transforming Decision-Making.
- Action-oriented (qualitative and quantitative) research methods will have been employed to understand how place shaping initiatives can be used 'successfully' at the neighbourhood scale, and tested work through design enquiries and modelling. Criteria for evaluating the 'success' or otherwise of these projects will be established.
- The factors enabling, or undermining, the integration of Māori cultural values in neighbourhood planning, design and development will have been identified.
- A Pātaka will have been developed (conceptual 'store house' or 'toolbox') consisting of strategies, methods and procedural guidelines to facilitate meaningful participation of stakeholders and end users in the building of future neighbourhoods. This includes visualisation and modelling tools which will be developed in conjunction with SRA: Next Generation Information where appropriate.
- A platform for longitudinal investigation of the learning spaces to the end of the Challenge will have been created.

2.7.2 Context

Over 85 per cent of people in New Zealand live in cities, towns or small settlements and we usually take one of these as our 'unit of analysis'. This Strategic Research Area (SRA) is innovative in taking 'neighbourhoods' as a 'unit of analysis' and thus taking action at a '*meso*' level that resonates with people's lived experiences. Neighbourhoods are places where people and families live, where children grow up and go to school, that cater for recreational, cultural and social needs of all ages, and (most importantly) places where communities are formed. Communities and their neighbourhoods are the 'building blocks' of the larger towns and cities of which they are a part. Livable and well-designed neighbourhoods not only benefit the relevant communities, but also contribute towards more successful towns and cities.

Neighbourhoods are not fixed entities, but parts of towns and cities that work as interdependent parts of larger urban systems (Brand, 1995). They vary in scale, activities, density and character, and may involve overlapping cultural, spatial and geographic boundaries and constructs (Manuf & Mohammad, 2011; Anderson, 2006). Precise boundaries and scales are not considered important – what is relevant is the way in which a neighbourhood, however defined, works in an interdependent way. Equally, neighbourhoods are not independent urban entities – their relationships and connections to the larger town and city of which they are a part are crucial.

The quality of local amenities and services, and their accessibility, influence residential opportunities and the 'livability' of a neighbourhood.[t] Our focus is thus housing in the context of its neighbourhood[u] – a focus that recognises that the people, places and structure of neighbourhoods influence the opportunities available to its residents. Spatially, socially and culturally constructed understandings of neighbourhoods are important, and so are the underlying environmental infrastructure, the public space structure, urban blocks, plots and range of housing types, across place-based and space-based ideas of neighbourhoods.

There is sufficient research to show that neighbourhood designs that facilitate safe walkability, and active public transport modes, generally produce better health outcomes for the residents[v] and may reduce transport related CO^2 emissions (Newman and Kenworthy 1989, 1996, 1999; Dodson 2010, Witten, Blakely et al, 2012). This underpins the approaches taken by the Auckland and Christchurch City Councils where more clearly defined 'neighbourhoods' are embedded into urban growth management strategies that direct future growth to designated 'town centres'[w]. Future growth is intended to be intensified around existing or proposed commercial centres within walking distances of public transport (transit-oriented development). The assumption is that neighbourhood residents under conditions of increased density will have a greater opportunity to engage in a more vibrant urban life outside the home than is immediately available in typical low density suburbs. Moreover, incorporating a range of housing typologies close to commercial centres and transport hubs accommodates the needs of households at different life stages, better enabling people to age in place.

These assumptions, however, need careful consideration. There is some evidence to suggest that density is only one variable of 'livable' cities (Vallance, Perkins & Moore, 2005; Vallance et al., 2012) and that 'socio-political' aspects are often underestimated (Quanstel, Moos & Lynch, 2012; Brown, 2007; Du Toit, et al., 2007; Mehta, 2008). There are also critiques that show that densification policies can increase land costs (Jones, Leishman and MacDonald, 2009; Mohamed, 2009) and impact housing supply and affordability (Bunker et al., 2002; Burton, 2001; Randolph, 2006; Troy, 1996) while others question whether the methodologies used to conclude urban consolidation reduce CO^2 emissions (Ewing, et al, 2008; Badoe and Miller, 2000; Frank, Stone and Bachman, 2000; Crane, 1996; Holden and Norland, 2005). Densification policies can also lead to unintended consequences, such as where development creates inequality, gentrifies neighbourhoods, and drives out poorer communities (Jenks, Burton and Williams, 2000; Quastel, Moos & Lynch, 2012). Scheiner and Kasper (2003) and Neuman (2005) warn against conflating **causes** of behaviour with **conditions**. Despite the critiques, the reality is that more people in the largest cities will be living at higher densities in future neighbourhoods. (Haarhoff, Beattie & Dupuis, 2016; Haarhoff, et al., 2012). Ensuring that this reality enhances people's lives and delivers necessary well-being is a key challenge for this SRA.

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[t] Delivering 'liveabilty' is a concept embedded into most recent iterations of urban growth management policies, such as the Auckland Plan (Auckland Council, 2012). This is also explicit in the Melbourne Plan (Department of Planning and Community Development, 2010) in their 'Activity Centre Toolkit'. International research increasingly underscores the role of the neighbourhood in contributing to overall housing satisfaction, inter alia (Baker (2013); Blunt & Dowling, 2006; Bramley (2006), Fincher & Gooder (2007); Haarhoff, et al (2012); Haarhoff, et al (2013); Beattie, L.. & Haarhoff, E. (2014).

[u] Yang (2008) usefully establishes a conceptual framework for assessing housing units, neighbourhoods and communities as a 'nested hierarchy' of domains that together influence housing satisfaction.

[v] Research from the the **NZ Centre for Sustainable Cities;** Ewing et al (2013); Christian, H et al (2013); Campoli, J. (2012). There is also evidence that links community well-being with access to recreational spaces (Stahle, A (2010), Byrne, J and Sipe, N (2010); The 'Liveable neighbourhoods' policy, Government of Western Australia (2007).

[w] Policies for urban intensification have shifted their focus and purpose over time. In the 1980's the focus was preventing urban sprawl to protect the environment and nature. In the 1990's, resource issues led to sustainability being the main concern, leading to an argument for density as a way to reduce car dependency and CO2 emissions. The current iteration of urban growth management policies now aims to achieve enhanced 'liveability' through density. See Haarhoff et al (2012); Ingram, et al (2009).

Places where people live, and where communities form, are 'shaped' by complex processes involving a range of stakeholders: people and their communities, regulators, market forces and land ownership (Schnabel & Karakiewicz, 2007; see also the Transforming decision-making SRA). This process of place-shaping is not necessarily logical or democratic, and has unequal power relationships. For example, current urban policies restricting low density suburban expansion and directing future growth in cities toward existing areas with mixed uses and a range of housing types (apartments, townhouses, etc.), do not necessary align with the persistent preference, particularly among families with children, for detached houses (Clark, 2005; Clark et al., 2002; Howley, 2009; Haarhoff, Beattie & Dupius, 2016). An evaluation of the trade-offs that people make between, say, the financial and time costs of commuting and suburban amenity is required, as is a better understanding of formal and informal governance mechanisms, and the designs and features of more diverse, yet appealing, neighbourhoods. The latter would include an acceptance of the stronger roles iwi and hapū play in reformatting of existing urban areas and development of new urban spaces.

In a recent Auckland study, people were found to be more prepared to accept higher density, and associated attached housing if the housing units are well designed and sufficiently large (Yeoman & Akehurst, 2015). On the other hand, other research findings indicate that people are prepared to trade-off living in suburbia with higher density options, where the neighbourhood provides good social amenity and services (Preval, Chapman & Howden-Chapman, 2010; Davison, 2011; Haarhoff et al, 2012). The opportunity presented by this National Science Challenge is to identify pathways and strategies though innovative research approaches to ensure that future neighbourhoods better meet societal needs through more effective community engagement.[x].

2.7.3 Opportunity

There have been profound international shifts in executing urban planning, away from a focus on regulatory processes to shaping places involving various stakeholders. (Gallent and Wong, 2009; Adams and Tiesdell, 2013). 'Place shaping' promotes the idea that spatial planning and urban design should play a more central role in influencing actors and the flows in community creation, the 'creative use of powers and influence to promote general well-being of a community' (Lyons, 2007, para 2.43). This underscores a growing international literature indicating that the function and processes of place-making are as important as urban form. This SRA will explore the often neglected interstices between architectural and urban design, form and function, substance and process using a *meso* or neighbourhood level of analysis. Also recognised is that urban planning visions and plans, no matter how good, do not guarantee outcomes that are well aligned to the visions and plans of individuals and communities (Haarhoff, 2012, Hull, 1998; Laurian and Shaw, 2008; Larson and Williams, 2009). In the Aotearoa/New Zealand context, Māori cultural landscapes provide a point of difference and pathways for shaping our urban neighbourhoods to 'enhance mana whenua presence, visibility and participation in the design of the physical realm' for the wellbeing of all people. This SRA creates a unique opportunity to critically engage with international place-shaping concepts and practices, and investigate how these might be informed by Māori knowledge and culture in the shaping of neighbourhoods. Moreover, the SRA provides an opportunity to apply Te Aranga Māori Design principles[y], in the research methodologies and the interpretation of findings.

Place-shaping needs to be informed by the impacts of 'drivers of change' on neighbourhoods over the next few decades. These drivers include well known issues such as a shortage of affordable housing in our larger cities, a population that is becoming more diverse, is ageing and has increasing rates of disability. Future proofing our urban neighbourhoods will take account of walkability, mixed use, density, housing typologies, climate change, amenity and services, transport, connections to the wider city, environmental impact, smart infrastructure, smart devices, value capture, and the enhancing public realm. Interpreting how these impacts will shape future neighbourhoods through innovative design options (Schnabel, 2007) is a key research aim in this SRA. This includes a critical assessment of exemplars of innovative neighbourhoods, where some of the drivers for change are being incorporated into their planning, design and delivery methods. Also relevant is how more innovative approaches involving community organisation, special legislation and arrangements (such as the post-earthquake recovery in Christchurch and the Special Housing Areas (SRA) involving the

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[x] See for example the event-based model of real estate development of Barratt, Stewart & Underwood (1978), , also Adams & Tiesdell (2013). Legacy (2012) argues posits that enhanced legitimacy can be achieved through 'deliberative plan-making processes' and the theory of 'enlarged thought' enable people to reflect on, and gain an understanding of, a substantive planning problem.

[y] Te Aranga Principles and the Auckland Design Manual http://www.aucklanddesignmanual.co.nz/design-thinking/maori-design/te_aranga_principles)

partnership between the Auckland Council and Government. Monitoring and evaluating these innovative practices in terms of delivery of anticipated outcomes for residents and stakeholders in this SRA will provide valuable knowledge of wider benefit to future neighbourhoods across the national space. Also of interest, is how planning frameworks relevant to the two cities inform and direct the planning and design of future neighbourhoods.

In contributing to the drive for better homes, towns and cities this SRA aims to:

- Discover new approaches to the comprehensive planning, design and building of neighbourhoods as environments that deliver enhanced community well-being by applying enquiry by design research[z].
- Incorporate drivers of change in the planning, design and delivery of future neighbourhoods that will provide for community well-being and are informed by Māori knowledge and culture and international urban design 'best practice' principles.
- Use examples of 'best practice' approaches to the planning, design and building of new neighbourhoods, to critically evaluate what works, and does not, for communities and other stakeholders concerned. This will provide opportunities to comprehensively evaluate a range of innovative and exemplary place-shaping practices that are, at present, disparate and **ad hoc**.

Establish a Pātaka (conceptual 'store house' or 'toolbox') of best practice examples and procedural guidelines for use by community and stakeholders related to the planning, design and building of neighbourhoods.

2.7.4 Research Questions

The unifying research questions across this SRA are:

- What configuration of stakeholders, decision makers, policies, planning and participatory practices, and processes promote and enable, or undermine, the co-creation of neighbourhoods that are able to provide for the well-being of residents[aa]?
- What factors enable, or undermine, the integration of Māori cultural values in neighbourhood development?
- How can diverse stakeholders collaboratively design a mix of housing typologies, services and amenity access, physical and social infrastructure, and connections beyond the neighbourhood that enable residents of difference ages, life stages ethnicities and abilities/disabilities to live lives they have reason to value?
- What factors support or undermine the sense of belonging to neighbourhoods of residents of difference ages, life stages, ethnicities and abilities/disabilities?
    - How will well-articulated drivers of change, that are anticipated over the next two decades, impact on the shaping of neighbourhoods?
    - What innovative outcomes can be derived from an enquiry by design research, in terms of process and outcome?
    - How can digital media be effectively deployed better to communicate innovative design alternatives for neighbourhoods to communities and other stakeholders?

2.7.5 Research Outline including Projects

The SRA involves two interrelated research projects:

- **Project 1**: **Place-based** assessment and evaluation of the performance of what are considered to be innovative responses to the planning and design of neighbourhoods. The method for achieving a transformative outcome is through longitudinal studies of 'learning spaces'.

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[z] Enquiry by design research is discussed in section 9 below.

[aa] While the focus is on decision-making relevant to the neighbourhood, and at the 'meso' rather than 'macro' level, this is a point of useful collaboration with the SRA 'Transforming Decision-making'. Cross-over PI's are thus included in the two SRA's to facilitate useful exchanges.

- **Project 2**: **Space-based** enquiry by design research of 'drivers for change' anticipated to impact on future neighbourhoods. The method for achieving a transformative outcome is through a process of inquiry by design and through co-production with communities and stakeholders.

The research projects will all contribute to a Pātaka (conceptual 'store house' or 'toolbox') of strategies, methods and procedural guidelines to facilitate meaningful participation of stakeholders and end users in the building of future neighbourhoods. There is scope for additional learning spaces to be proposed for contestable funding at future stages of this Challenge.

Project 1: Place-based Learning Spaces

With a focus on larger New Zealand cities, two place-based 'learning spaces' have been selected, in Auckland (Waimahia Inlet) and in Inner City Christchurch. These two 'learning spaces' provide different and contrasting contexts and challenges:

Attributes	Waimahia	Inner ChCh
Scale	Small	Large
Context	Greenfield	Earthquake Recovery
Urban location	Fringe	Inner city
Main Development Agencies	Iwi collective and community housing providers	Central Government/ Māori organisations/ Te Rūnanga o Ngāi Tahu
Stakeholder consultation support	yes	yes
Planning method	Masterplan	Masterplan
Innovation	SHA; Partnership model between community organisations; shared home ownership models.	Recovery from earthquake; government led.
Issues	Delivering on affordability; connections to the urban network; delivery against Te Aranga principles	Conflict between central and local government; affordability; re-occupying the inner city

Table 1: Attributes of the selected 'learning spaces'.

Project 1.1 *Waimahia Inlet*:

Waimahia Inlet is a new greenfield housing development in south Auckland that will provide 282 homes of varying sizes and types. Although the development was underway prior to the passing of the Auckland Housing Accord, Waimahia Inlet was designated as the first Special Housing Area (SHA). It differs from many other SHAs, however, in terms of the nature, objectives, and approach of the developers. The development is being carried out by a consortium of the Tāmaki Collective (13 iwi with ties to Auckland/Tamaki Makaurau) and three Community Housing Providers (CHP) – the New Zealand Housing Foundation, CORT Community Housing

(Community of Refuge Trust), and Te Tumu Kāinga (a CHP administered by Te Tumu Paeroa, the Māori Trustee).[bb] The development has been enabled by a substantial grant from the Crown and is being carried out on a 16ha block of land purchased from Housing New Zealand under a Treaty of Waitangi settlement provision that gives iwi right of first refusal to purchase land no longer need by the Crown.

Waimahia provides an example of how affordable housing can be delivered using architecturally designed, prefabricated dwellings in a medium density development. In addition to affordable open market sales, rent to buy and shared equity schemes are promoted to help assist people into home ownership, and a proportion of the houses will be retained in full by CHPs. This demonstrates the potential for CHPs to partner with other agencies (eg local government) to contribute to the provision of both social and affordable housing. The range of models for provisional of affordable housing are highly topical in terms of Auckland's housing affordability crisis and the central government's desire to exit social housing.

At present, the establishment phase of the development is being documented as part of the Resilient Urban Futures research programme. This study, to be completed later in 2015, has been carried out through:

1. Analysis of the documents relating to the set-up and governance of TMCHL;
2. Interviews with key informants from the various organisations involved, and with the development's project manager;
3. Interviews with 10-12 incoming residents, with representation from the four tenure types.

This SRA creates an opportunity to not only extend the current research to more fully investigate resident's developing perceptions of the neighbourhood and how it meets their aspirations, but also to evaluate performance of the stakeholders involved in the housing delivery process. By extending the interviews with incoming residents as the development is completed, and by observing the development over the next four years, we will carry out an in-depth longitudinal case study of a mixed tenure, medium density neighbourhood developed using a partnership model to meet the housing needs of lower income households. The key research questions are:

1. How do residents view the community at Waimahia? How much contact do they have with others in the neighbourhood? Are experiences similar for residents of differing ages, life stages, tenure status and ethnicities?
2. How effective have the Residents' Association and community support groups been in fostering community ties?
3. How stable or otherwise is the community? Is there considerable turnover of residents? Does this vary across tenure types? Who is leaving? Who is moving in?
4. How do the development processes and neighbourhood outcomes align (or not) with Te Aranga principles and Māori housing principles established through 'Ki te hau Kāinga'?
5. How effective are TMCHL's attempts to prevent speculation and private rental investment in the development?
6. How are property values changing in the development and what are the effects of these changes on residents and on the balance sheets of CHPs?

The proposed longitudinal study over the next four years will include:

1. Increasing the sample of incoming resident interviews over the next year as the development reaches completion, bringing the total number of study participants to 40 and adding a sample of young people, using semi -structured in situ or "Go along" neighbourhood walking interviews (Carrol et al., 2015).
2. Review of the masterplan and individual housing designs with reference to Te Aranga principles and Māori housing principles established through 'Ki te hau Kāinga', generating expected outcomes (cultural practices, whānau dynamics, sense of place) based on the spatial analysis of the Waimahia Masterplan and individual house designs(year 1) and assessing how changes in Māori residents' perceptions of cultural practices and a sense of place enables or impedes expected outcomes (year 3).
3. Tracking both the ownership and occupancy of dwellings in the development through the establishment of a database (to be negotiated with the Residents' Association) supplemented by Quotable Values (QV) data purchased in year 4;
4. Tracking the change in house values in the development over time;
5. Tracking the impact of the development on the balance sheet of the CHPs involved;

[bb] Tāmaki Makaurau Community Housing Limited (TMCHL) is the name of this consortium.

6. Annual follow-up interviews with residents to track their changing perceptions, experiences and expectations over time, as well as to establish whether they have stayed in the development or moved away;
7. Follow-up interviews with the organisational representatives after two years and again at the conclusion of the study to explore their views on the outcomes of the development, the challenges faced, and future plans.

Analysis of our data will deliver transferable knowledge (to other developments) of effective structures and practices for the co-production of mixed tenure affordable housing with a sense of place; strategies for the co-production of place-based community; wellbeing outcome of variations in public vs private open space provision; impacts of deliberative community co production on residential turnover across tenure types.

Project 1.2: Inner city Christchurch: New Zealand's Largest Urban Regeneration Programme

The context for this project is New Zealand's largest urban redevelopment programme following the September 2010 earthquake in the Canterbury region that affected over 8000 homes in the eastern suburbs and 80 per cent of the central business district of Christchurch. These events also altered the social and cultural landscapes in which people live, work and play. Christchurch now provides a unique learning space for urban redevelopment with a mix of public, private, and community-driven rebuilding and rejuvenation projects across residential, commercial, social and environmental sectors. Many of the redevelopment projects have demanded innovation and a radical departure from business-as-usual urban development and management practice made possible by, for example, the Canterbury Earthquake Recovery Act of 2011[cc]

Much of the inner city's redevelopment is guided by the Central City Development Unit's Central City Recovery Plan involving 20 anchor projects and the Christchurch Housing Accord. The long terms goals of the Housing Accord are to a) restore a well-functioning, private sector-led housing market in Christchurch with sufficient supply at the lower end of the market to ensure adequate access to housing for those with lower incomes; and b) to support the sustainable provision of social housing in Christchurch by increasing the quantity of social housing units and better matching the supply to demand. The inner city neighbourhood anchor projects were initiated to "inspire confidence and give momentum to the inner city rebuild. Each project provides opportunities for individuals and organisations to be part of the city's future"[dd].

Christchurch's inner city neighbourhoods are being transformed and rejuvenated through innovative partnerships, funding mechanisms, institutional reform, and a mix of both 'market-led' and coordinated 'master-planned' residential, commercial, and social aspects of urban life. A great deal of research has been carried out to date on components of Christchurch's inner city redevelopment but much of this has been piecemeal, ad hoc and targeted at particular aspects (e.g. housing, or the contribution of the arts, retail activity) rather than investigating how the various components come together, or whether the broader goals of rejuvenation are being met. Issues that have been raised in earlier research include investor confidence, land supply, suburban drift, lack of residential population, funding, the role of local government (in housing, services and facilities) and amenity.

Specific research questions to be explored over the four years of the project are:

- Are the goals of the Recovery Plan (inspiring confidence, giving momentum to the inner city rebuild, providing opportunities for individuals and organisations to be part of the city's future) and the Housing Accord (restoring a well-functioning, private sector-led housing market with sufficient supply at the lower end of the market; supporting social housing by increasing the quantity of social housing units and better matching the nature of the stock to demand) being achieved?
- What 'mechanisms' or 'tools' (from the Blueprint to institutions, innovative partnerships and new funding streams) have best facilitated inner city rejuvenation in Christchurch (and what are the barriers and challenges)? What criteria can be developed and used to evaluate the success or failure of these tools? What additional procedural guidelines and principles are required to facilitate the success of these tools?

[cc] The CER Act will see the Canterbury Earthquake Recovery Authority disestablished in April 2016, but new legislation (under the proposed Greater Christchurch Regeneration Bill) will formalise the transition of CERA's functions to other government agencies, local councils and Ngāi Tahu. It would also establish a new commercial entity, Regenerate Christchurch, which would be responsible for the regeneration of the city.

[dd] https://ccdu.govt.nz/projects-and-precincts

- What configuration(s) of stakeholders, decision makers, policies, planning and participatory practices and processes have promoted and enabled, or undermined, the co-creation of this inner city neighbourhood so that it is (un)able to provide for the well-being of residents and businesses?
- Te Rūnanga o Ngāi Tahu (TRoNT) have been elevated – as is their right – to formal stakeholder status in the Christchurch rebuild and are a keystone investor in important projects as well as releasing considerable land for residential development. What criteria do iwi authorities rely on for decision-making in urban renewal programmes? Under what circumstances do mana whenua such as TRoNT house and otherwise accommodate ngā maatawaka (i.e., those Māori who do not whakapapa to the territory under development)?

The methodology for the proposed longitudinal study over the next four to ten years will include:

1. Establishment of baseline data around residential occupation, commercial and retail activity, investor confidence, housing affordability, and opportunities to participate through secondary data analysis.

2. Interviews and workshops with stakeholders and end-users (including residents, developers, SMEs, service providers, organisational representatives from, for example, Regenerate Christchurch, TRONT, Nga Maata Waka groups, and the Christchurch City Council) over the first three years to explore their views on the efficacy and appropriateness of various rejuvenation tools and strategies, the challenges they have faced and their successes.

3. Secondary data analysis in 2019 and 2024 to enable longitudinal evaluation of rejuvenation and recovery goals.

4. Further interviews with stakeholders and end-users in 2019 and 2024 to explore their views on the efficacy and appropriateness of various rejuvenation tools and strategies, the challenges they have faced and their successes.

Project 2: Future Neighbourhoods – Enquiry-by Design Research.

Project 2.1: Future Neighbourhoods

This research project considers how the configuration and morphology of infrastructure, streets, public spaces and urban blocks, plots and range of housing types impact on people's lives and well-being. It aims to achieve a better design of the relationships within and between neighbourhoods, the people in them, and relationships with other people and parts of the urban system. The relationships will be considered in the context of international urban design principles (Ministry for the Environment, 2001; 2005; Llewellyn Davies Yeang, 2013) and cultural values such Te Aranga Māori Design Principles (adopted in the Auckland Design Manual by the Auckland Council).[ee] This project will also investigate externalities that include neighbourhood relationships to statutory urban planning regulations and processes (such as the Auckland Plan and the Proposed Auckland Unitary Plan), and policies and plans related to the Christchurch earthquake.

'Enquiry by Design' research emulates the iterative process used to achieve evidence-based design solutions (Department of Planning, 2012; Zeisel, 2006; Dorst, 2001). Problems are tested through design tools, with feedback from stakeholders being integrated into the next iteration. This approach considers that there may be a number of 'best' solutions to any design problem involving complex variables, as opposed to a single best solution (Zeisel, 2006). This method also enables investigated through design research to find optimal solutions for the complex variables. (Prince's Foundation, n.d.; Department of Planning, 2012; Zeisel, 2006; Deicke, n.d.). Combining community engagement in a design enquiry, with digital modelling technology, creates a powerful communicative tool. (Lo & Schnabel, 2015)This enables the cost effective production of alternatives designs and the creation of three-dimension visualisations in the co-production of research. Place-shaping will be informed by the impacts of 'drivers of change' on future neighbourhoods as described in the Opportunity section above.

[ee] Auckland Design Manual http://www.aucklanddesignmanual.co.nz/design-thinking/maori-design/te_aranga_principles)

Methodology:

- Unpacking relevant 'drivers of change' and factors that will impact the design of future neighbourhoods.
- Through enquiry by design research investigating and devising solutions for future neighbourhoods that take account of the drivers of change.
- Development and deployment of instruments that enable the testing and optimisation of complex variables in the design of neighbourhoods, to enhance sustainability, affordability and well-being.
- Development and deployment of visualisation tools suitable for community and stakeholder engagement and consultation on design alternatives for future neighbourhoods.
- Generate visions that reflect on people's aspirations and common goals to build up a sense of belonging

Project 2.2 Glen Innes learning space

Project 2.2 will enable the development of collaborative processes for community engagement in the design of future neighbourhoods through use of a learning space in Glen Innes, East Auckland. The participatory action research will be informed by Te Aranga Māori Design Principles. Glen Innes is a settled community developed over 80 years ago. It has diverse business and industry as well as schools, marae, plenty of open space which is underutilised, an aging housing stock on large lots, longer term residents than in other suburbs and probably the highest proportion of Māori and Pacific Islanders of any Auckland suburb. It has the involvement of a multiple stakeholders - Auckland Council, a local community board, three iwi with overlapping rohe, and the Tamaki Development Company, among other entities, as well as independent local initiators of projects. The development scenario is complex and the various entities are currently not meshing well in part due to the changes they are currently undergoing. There are compelling needs for the diverse groups to work so that community fear and friction is changed to confidence, duplication of effort minimised and valued resources for the greatly increased population and community are achieved.

Methodology

- Unpacking issues in the 'learning space' through co-production with the community
- Validating the Te Aranga principles with the community, the Auckland Council and other stakeholders through in-depth interviews and hui.
- Development and testing of the digital modelling and visualisation tools as a co-production with the community and stakeholders.
- Exploring applicability in other areas
- Enabling the community in co-produced research that builds capacity to own on-going research processes that will inform development of their communities.

The research in the 4 projects will lead to additionality by:

- Providing transferable insights from contrasting learning spaces and enquiry by design research which lead to new and innovative place-shaping tools, practice and processes
- Contributing to the development of a 'toolkit 'of ideas and procedural guidelines that will enable a better fit between place-shaping processes, the problem or opportunity, and the target groups in the short, medium and long term timeframes;
- Enabling the integration of international urban design principles to Māori cultural values e.g. Te Aranga principles;
- Enabling communities to carry out co-produced research that will inform their development.
- Using co-production, digital modelling and visualisation tools to enhance community participation in the design of neighbourhoods through realistic representations of alternative solutions.
- Creating a longitudinal approach (short - 4 yrs, medium - 10 yrs and long term >10 yrs) which systematically evaluates and iteratively improves the performance of the innovative processes over time.
- Communicating built environments that match the aspirations of people who take ownership of their neighbourhoods.

2.7.6 Timeline

	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23
1.1 Waimahia								
Based mapping and development aims evaluation								
Resident interviews								
Track ownership and tenures								
Track changes in house values (QV data)								
Annual follow-up interviews to track changes								
Annual tracking of economic performance of CHP's								
interviews with organisations								
Report interim findings to residents/stakeholders								
Review findings and research plan for stage II.								
1.2 Inner City Christchurch								
Based mapping and development aims evaluation								
Resident interviews (potential)								
Repeat resident interviews (actual + potential)								
Repeat interviews: SME's + service providers								
Interviews with development organisations								
Report interim findings to residents/stakeholders								
Review findings and research plan for stage II.								
2.1 Future Neighbourhoods								
Unpacking Drivers								
Alt neighbourhood design investigations								
Develop & deploy modelling tools								
Community and stakeholder workshops								
Report findings and inform Project 1: stages II								

Review findings and inform stage II projects.								
2.2: Glen Innes								
Unpacking issues in the learning space								
Stakeholder consultation								
Developing models and tools								
Exploring applicability of models in other areas								

2.7.7 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling
Karen Witten	Mid-late	European	Partnering with Māori researchers.
Suzanne Vallance	Mid		Involvement in a large, multi-institutional, longitudinal project, national in scope.
Rebecca Kiddle	Early Career	Māori	Involvement in large scale inter-disciplinary project
Lee Beattie	Early Career		Broadening research skill
Emma Fergusson	Student (PhD)		Broadening research skills (by K Witten)
Jade Kake	Master student	Māori	Broadening research skills (by E Henry)
PhD student 1	Student		Broadening research skills (by PI)
PhD student 2	Student		Broadening research skills (by PI)
PhD student 3	Student		Broadening research skills (by PI)
PhD student 4	Student		Broadening research skills (by PI)

2.7.8 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Transforming Decision Making for Homes Towns & Cities (TDM)	Shaping places focuses on the process of neighbourhood planning in larger urban contexts (including both formal and informal 'governance'), design and construction and how these relate to the larger issues of decision making in TDM.
Next generation information for better outcomes (NGI)	Shaping Places will **benefit** from access to relevant data related to the dynamics of peoples, places and spaces in New Zealand towns and cities delivered by NGI. Shaping Places will also access, where appropriate geospatial visualisation tools being developed by NGI.
Supporting success in regional settlements (SS)	Shaping Places is **complementary** with SS in its focus on smaller New Zealand towns, where SP embraces the complexities of larger cities.

Hei Papakāinga ora (HPO)	Shaping places focuses on the process of neighbourhood planning in larger urban contexts (including both formal and informal 'governance'), design and construction and how these **relate** to He papakāinga ora' as an innovative neighbourhood strongly informed by cultural needs.
Transforming the building industry (TBI)	Shaping Places is **complementary** with TBI as new processes and products in the industry will affect dwellings future neighbourhoods.

2.7.9 International Linkages

Organisation	Key International Person(s)	Nature of relationship with THIS SRA
UN Habitat Partner University Network	Prof Dory Reeves	The University of Auckland is a member of, and committed to the mandate of, the Habitat Partner University Network (HPU) of the United Nations Human Settlements Programme. UN-HABITAT promotes socially and environmentally sustainable towns and cities throughout the world, focusing on the "three pillars of sustainability" - equity, ecology, and economy.
Place-making Leadership Council	Fred Kent (Project for public spaces)	Dr Vallance is a member of the Council. The Placemaking Leadership Council (PLC) is a group of doers and thinkers at the forefront of the Placemaking movement. The Council exists to strengthen Placemaking as an international movement and establish a cross-disciplinary network for placemakers working in many diverse contexts.
University of Melbourne	Professor Billie Giles Corti, Director of the McCaughey VicHealth Centre for Community Wellbeing,	Professor Billie Corti is the Lead Investigator of the NHMRC Centre for Research Excellence in Healthy Livable Communities at the University of Melbourne. Her team's research on indicators of livability using routine data will inform the SRA and her expertise in longitudinal studies (egRESIDE) tracking social and health outcomes associated with residential movement.
SWOV, Netherlands	Dr Divera Twisk	Dr Twisk is an expert in design & evaluation of street infrastructure to enable safer active pedestrian and cyclist travel.
University of Melbourne	I A/P Justyna Karakiewicz , Director of Urban Design	A/P Justyna Karakiewicz , Is the leading research in Urban Design, who uses complex parametric modelling to develop responsive and adaptable urban developments. She is member of the Future Cities Lab.
Institute of Sustainability, London	Ian Short	Has extensive experience in cross sector – government, green business, university, residents -collaborations for sustainable neighbourhood development.
Alto University, Helsinki: A/P	A/P Marketta Kytta, Land Use planning and Urban Studies group	We will extend existing relationships around the use of soft GIS methodology for community engagement.
Australian Housing and Urban Research Institute	Dr Ian Winter	AHURI has a public good mission to deliver high quality research that influences policy development to improve the housing and urban

		environments of all Australians. The UoA Urban Research Network has established formal exchange linkages.
National University of Singapore	A/P Patrick Janssen	Future City Lab, NUS, in collaboration with ETH Zurich Dr Janssen leads City and Building Information Modelling, (CIM /BIM).

2.7.10 Vision Matāuranga

Kaupapa Māori Research principles (Henry, 2012) underpin the ontology, epistemology and methodology of this Strategic Research Area in the following ways:

- **Research that is for with and by Māori:** The Māori Science Team have consulted with their own communities (whānau, hapū and iwi) as well as with other Māori stakeholders throughout the development of the research proposals, and ensured that there is a place for Māori community researchers and postgraduate students in the implementation of the research projects;
- **Research that validates te reo me ngā tikanga Māori:** Each project will identify Māori knowledge that is relevant to that location and community, as well as working with Māori stakeholders, in a manner that is respectful of tikanga Māori. Further, Māori language, identity and knowledge will be incorporated into models and tools that emerge from each project.
- **Research that empower and result in positive outcomes for Māori:** Te Aranga Principles will be applied to the research in an on going manner, to ensure the proposed projects are delivering positive outcomes and outputs for and with Māori and their communities involved in the research.

The primary research methods of Shaping Places draw on Enquiry by Design and Learning Spaces. This approach, underpinned by on-going community engagement in every aspect of the research, from identifying community needs and aspirations to the design of toolkits and solutions for community issues and challenges, resonates from a Kaupapa Māori perspective. Kaupapa Māori research emphasizes the rich understanding and knowledge that comes from working in mutually beneficial relationships between the researcher and the researched (whakawhānaungatanga). Further, Kaupapa Māori Research acknowledges the importance of research, which has widely understood and accepted outputs and outcomes, for the benefit of researchers and end users (manaakitanga). Finally, the enquiry-by-design method brings stakeholders together to discuss and develop urban design and panning solutions in a participatory and empowering manner (whakamana and huihuinga). Thus, the Vision Mātauranga philosophy for this study is underpinned by the values and principles inherent in a Kaupapa Māori research paradigm.

Across all projects, research partners will participate in, and contribute to, an evolving, growing and expanding community practice, Te Hapori Haratau, that enables cross-cultural communication by up skilling non-Māori researchers to work better with Māori communities and up skilling Māori participants to better advocate for their community in urban change.

This SRA will contribute to **Hauora/Oranga** by improving social wellbeing in Māori neighbourhoods. Synergies between this theme and others within the Challenge as well as NSCs 6 and 9 ('Resilience to Natures Challenges' and 'Healthier Lives') will improve the communities in which Māori live, creating communities meeting the needs of the inhabitants.

2.7.11 Stakeholder Involvement and Pathway to Implementation

Type of Stakeholder	Name of Organisation/Person	Contact to Date
Community Housing Provider	Community of Refuge Trust, Peter Jefferies	Meetings to establish relationship with the TMCHL and gain approval for research at Waimahia
Māori	Tamaki Collective, Paul Majurey	As above
Central Government	Sarah Holden, Ministry of Social Development	Stakeholder meeting, Takapuna, Auckland. 23 July 2015
Local Government	Regan Solomon, RIMU _ Auckland Council	Stakeholder meeting, Takapuna, Auckland. 23 July 2015
Community Organisations	Vivian Naylor, CCS Disability Action.	Stakeholder meeting, Takapuna, Auckland. 23 July 2015
	Sue Bagshaw, Korowai Youth Well-being Trust, Christchurch	Stakeholder meeting, Takapuna, Auckland. 23 July 2015
	Judy Blakey, Seniors Advisory Panel, Auckland Council	Stakeholder meeting, Takapuna, Auckland. 23 July 2015
Māori stakeholders	Bernard Te Paa Manager, Pae Urungi Tuhono/ Māori Outcomes Auckland Council	Meetings Aug 26, Sep 2 2015
	Lucy Tukua Kaiwhakahaere Ngati Paoa Iwi Trust	Meetings Aug 26, Sep 4 2015
	Hinematau McNeill Trustee Tapuika Iwi Authority	Meetings Aug 26, Sep 1 2015
	Diane Turner, Te Rūnanga o Ngāi Tahu	Meeting 9 Sept 2015 to discuss interests in the Challenge; and engagement with Papatipu Runaka
	Ngā Aho Executive Committee	Meeting 19 Sept 2015 to discuss a possible partnership agreement and the Shaping Places Strategic Research Area
	Te Matapihi Trustees	Meeting 18 Sept 2015 to discuss a possible partnership agreement and Hei Papakāinga Ora Research Area
	Neil Challenger	Meeting Oct 7 2015

	Te Tau a Nuku	
	Ngatikahu Ki Whangaroa Trust Board	Meeting Aug 22 2015

The learning space and enquiry by design approaches employed in this SRA, will naturally lead towards the communities in which the research is undertaken becoming skilled in and practicing the new shaping places methods that are developed.

In the case of Waimahia, as a greenfield site, the initial emphasis will be on the success, or otherwise, of pathways implemented by the development consortium with the goal of community formation (e.g. public space design, residents association, informal meet ups) and subsequently community-led process. The transferability of the knowledge, tools and processes developed and trialed across the learning spaces will be tested in other locations and with different population groups over the duration of the Science Challenge.

In the case of the Glen Innes project, the communities will participate in and manage a change process to enhance communication systems, within and between communities and local government, around planning and design for regeneration of the local community and its identity, including and incorporating Māori knowledge and identity where appropriate. The tools and processes developed in this project may be modelled and tested in other areas over the duration of this Science Challenge.

In the case of Christchurch, existing and potentially new networks that operate across orthodox boundaries and sectors will be employed to share and refine the innovative tools and strategies identified in the learning space. The enquiry by design research will generate through co-production alternative ways in which to deliver keys aspects for future neighbourhoods that includes enhanced walkability, better connection to the larger city, better responses to culture and a better sense of well-being. These alternatives will empower communities to better negotiate their neighbourhood futures, when engaging with government, developers and other organisations.

Key findings from the research across the four projects will contribute towards the establishment of the Pataka or toolbox of ideas, processes and solutions, able to be managed and developed by communities and relevant stakeholders. Moreover, the outcomes will be assessed for applicability nation-wide. Over the first three years, similar networks that operate in other cities will be identified though engagement with stakeholders that operates nation-wide (such as the New Zealand Planning Institute (NZPI), the New Zealand Institute of Architects (NZIA), Institute of Professional Engineers New Zealand (IPENZ), for example). This extended network will help create a community of practitioners willing and able to learn, share and enhance capability across New Zealand through newsletters, conferences, workshops, site-visits, post-graduate student work and placements, etc. The final years of the Challenge will, in part, involve the establishment of an enduring 'infrastructure' or 'community' able to continue this work.

2.7.12 Co-funding

Nature of Activity being Co-funded	Source of Co-Funding (Organisation name, Fund type, Cash/in-kind)	Secured/Applied For/Potential
Learning space research	Local Councils, Development agencies, Community organisations, NGOS	Potential

2.8 SRA5: Hei Papakāinga Ora

	Name	Org.*	Annual FTE funded by Challenge	Skills of individual
PI	Dr Kepa Morgan CPEng	UA	0.2	Chartered Engineer with thirty years plus papakāinga experience as designer, trust chairman, project manager, researcher, innovator of whareuku, creator of Mauri Model decision framework.
	Professor Philippa Howden-Chapman	UO	0.2	Co-benefits of public health interventions, participatory social science research including quantitative & qualitative approaches
	Dr Huhana Smith	Independent	0.2	Kaupapa Māori, action, cross-cultural and collaborative research, climate change, environmentalist/kaitiaki, senior curator and artist.
	Anaru Waa	UO	0.2	Māori health, public health, social sciences, qualitative research methods, survey design, intervention design, evaluation
AI	Dr Robyn Manuel	Independent	0.2	PhD (Organic Chemistry), epidemiology, public health, education, isolated communities infrastructure, community empowerment.
	Derek Kawiti	VU	0.15	Architecture, 3D technologies, kaupapa Māori research
	Jade Kake	Independent	0.2	Architecture, kaupapa Māori research
	Dr Rebecca Kiddle	VU	0.2	Urban design, kaupapa Māori research
	Professor Penny Allan	VU	0.15	Landscape architecture, urban design, cross-cultural design, urban and regional resilience, climate change
	Kaye-Maree Dunn	Independent	0.2	Evaluation, kaupapa Māori research
	Martin Bryant	VU	0.05	Landscape architecture, water sensitive urban design, sustainable subdivision
	Ecologist	TBA	0.05	
Research Assistant x 2			1.0	
ME students			2.0	
Community researchers x8			1.0	

*UA=University of Auckland, UO=University of Otago, VU=Victoria University

2.8.1 Outputs

By July 2019 we will deliver

- A framework that identifies:
    - mana whenua, mataakawa and tauiwi community papakāinga aspirations;
    - values relevant to the development process;
    - links between papakāinga and wellbeing
- Co-created prototype papakāinga building solutions of different types that engage the capacity of alternative technologies to reduce dependence on specialist trades professionals in remote and rural contexts;
- Prototype papakāinga solutions with installed monitoring equipment and an evaluation of their performance.
- A collation of success stories from community action projects focusing on Māori housing forums and iwi housing strategies; and principles for successful capacity-building
- Principles and practices which support the initiation, development and on-going success of Māori Housing Forums and iwi housing strategies around the country.
- A range of planning and design typologies based on Māori values that can be used by papakāinga communities which are presented graphically and visually including being exhibited in marae, libraries and galleries.

2.8.2 Context

Papakāinga represents the aspirations of many Māori to re-establish or re-consolidate their place of belonging by living on Māori or general land in ways that are consistent with their values and beliefs. A wide range of papakāinga approaches have evolved in response to the post-colonial paradigm such as:

- papakāinga within rural settlements eg Haumingi1986 planning departure to build ten homes without subdivision on multiple-owner Māori land, Ahuwhenua trust (Voyde & Morgan, 2012)
- papakāinga within urban areas eg development of Kirikiriroa marae in 1990s;
- papakāīnga on Māori land (eg. Manuka papakāinga, Toihau papakāinga, Te Kauri papakāinga, Napinapi papakāinga, Mangapahore papakāinga)
- papakāinga on land held in general title eg Te Ania Way which was recently opened in Ngāruawāhia).

However, there are still significant barriers to implementing papakāinga development.

The lived reality for people in Māori communities differs across contemporary contexts. Many housing solutions situated on Māori land are the result of 'one-size-fits-all' approaches to district planning, finance, governance, and a building industry that evolved with little consideration for the unique needs of Māori whānau (Waa, In press). The values embodied in communal living, where the village raises the child and builds the community, are rarely reflected in modern housing solutions. Through the systematic marginalisation and displacement of Māori communities, social, cultural, infrastructural and economic disadvantage has resulted in homes that do not meet the current minimum standards prescribed by the New Zealand Building code. In urban areas, Māori rates of home ownership have dropped dramatically and most Māori whānau currently live in rental accommodation (Howden-Chapman et al, 2013)

Positive impacts on health, safety, quality of life, and the ability to raise children within healthy environments must be underpinned by spiritual well-being and enhanced mauri of those families and communities. However enhanced mauri will not be possible while solutions involve poor quality materials and construction (eg. leaky homes), lack of relationship to site, and while up-front and ongoing costs of housing force whānau to adopt substandard solutions (Te Kipa Kepa Brian Morgan, 2005) (J.S Cheah & Morgan, 2009). Research has already linked higher Māori hospitalisation and mortality rates to housing characteristics that aggravate the risks of fire hazard and respiratory illnesses associated with sub-standard or unhealthy housing (Baker et al., 2012).

As Treaty claims are settled around the country, iwi and hapū are beginning to turn their attention to developing strategies to improve the wellbeing of their people, manage their assets, and invest sustainably. Iwi and hapū are becoming increasingly active in building and managing housing portfolios, and are beginning to develop strategies to meet the housing needs of their people. However, there is little support for iwi and hapū wanting to develop strategies based on their own values, tikanga and mātauranga. The key outcome of

this research is to critically analyse the barriers that continue to frustrate papakāinga development (in all its forms) and to highlight contemporary solutions that will have the greatest impact on improvements on empowering communities and enhancing mauri.

By creating a range of implemented papakāinga technologies and typologies that reflect the diversity of Māori experiences, this research will empower Māori communities to play an integral part in developing their own solutions. These solutions could include innovative retrofit options for existing substandard dwellings, economically viable 'off-the-grid' solutions, alternative more affordable construction approaches and materials with flexible dwelling layouts that can change over time. This variety of 'types' of dwelling and settlements, accommodating a range of needs and relationships to whenua[ff] will provide alternatives to individual home ownership on individual titles, challenging reductive, 'nuclear family' housing models as the 'required' standard across Aotearoa New Zealand.

Building housing on Māori land needs to be seen in the context of increasingly prominent Māori voices in the health, social sciences, architecture, landscape architecture, urban design, engineering, and planning disciplines in New Zealand. A number of academics and practitioners have highlighted the existence of a distinctly Māori approach to the built environment, and the continuing practice of this approach in contemporary Māori buildings, settlements, and communities (for instance see (Awatere, Pauling, Rolleston, Hoskins, & Wixon, 2008), (Rolleston & Awatere, 2009) (Stuart & Thompson-Fawcett, 2010). Significant work has also been done by Māori researchers and practitioners at the interface of Matāuranga Māori and Western resource management, including Coombes, Johnson, & Howitt (2012), (2013), Smith and Allan (2013), Kawharu (2002), and Matunga (2000).

Awatere et al. state that 'papakāinga development is a process of design' with Māori communities which identified '...rangatiratanga (self-determination), whānaungatanga (social/family relations), whakapapa (genealogical connection), and kaitiakitanga (sustainable environment management) as key traditional values in contemporary Māori driven design and development' (Awatere et al., 2008). Work undertaken by researchers and practitioners has resulted in the Te Aranga Māori Cultural Landscape Strategy (2008), which has been further developed into Te Aranga Māori Design Principles.

Specific work on new construction techniques and materials for Māori communities includes documentation of construction workshops using Uku Harakeke Reinforced Soil-cement Buildings **(**(Te Kipa Kepa Brian Morgan, 2005)**,** (J.S Cheah, Ingham, J.M, & Morgan, 2008)**,** (J.S Cheah & Morgan, 2009)). Exploration of indigenous local materials such as uku has been extended to validating the value of indigenous local materials through community driven decision-making about rural Māori housing(Morgan, 2006).

The desire of many owners of Māori land to build housing on their land has been recognised by central government for at least three decades. In 2002, Ki te hau Kāinga: New Perspectives on Māori Housing Solutions (Hoskins et al, 2002) addressed the lack of culturally appropriate housing for Māori and identified the need to develop new housing solutions tailored to the specific needs of Māori communities. Research has also highlighted similar needs for different housing typologies to accommodate families from Tokelauan and Samoan communities, and other communities internationally (Pene, Peita, & Howden-Chapman, 2009), (Macpherson, 1997) (Sheuya, Howden-Chapman, & Patel, 2007).Hoskins et al**.** (Hoskins et al., 2002) also identified papakāinga as a viable and appropriate model for achieving Māori social, cultural, environmental and economic aspirations; the report outlines both general master planning principles and specific design issues. Further reports by the Office of the Auditor-General and the Productivity Commission highlighted that 'building a house on Māori land was a fraught process. Lessons had not been learned from past attempts, so initiatives were targeted ineffectively and processes were cumbersome' (Auditor-General, 2011). In addition multiple ownership had often made it hard to develop dwellings on Māori land (Productivity Commission, 2012) and '[s]ome Iwi are increasingly important developers in their region. Māori have much to gain from resolving housing shortages' (Productivity Commission, 2015). The Māori Housing Strategy released in 2014 includes six directions to improve Māori housing over the period 2014 to 2025 (Ministry of Business Employment and Innovation, 2014). The Strategy aims to support two major outcomes: Improving housing for Māori and their whānau; and increasing housing choices for Māori by growing the Māori housing sector.

[ff] Whenua means both land and placenta, the ultimate nurturer of people.

Internationally, there is growing interest in artists, ecologists and designers working with indigenous cultures to develop adaptive strategies to global issues. For example 'Arctic adaptations', Canada's award winning exhibition at last year's Venice Biennale, documented architectural history in Nunavut (Canada's arctic north) and argues that modern Inuit cultures continue to evolve and merge the traditional and the contemporary in unique and innovative ways. It questions whether architecture, which has largely failed in the Nunavut region both technically and socially, can be equally innovative and adaptive (Lateral Office 2014).

2.8.3 Opportunity

The New Zealand government is keen to fund the development of Māori land for housing purposes, however, few solutions are appropriate for Māori or can meet scale requirements. This research programme recognises the urgent need for actual solutions that enhance mauri for Māori communities. Researchers will work with Māori communities around the country to support their community aspirations to build better housing. The SRA will focus on housing on ancestral Māori land (including land held under Te Ture Whenua Māori Act, land held in general title by Māori trusts or incorporations, and land returned under Treaty settlement) as well as land owned by Māori organisations who do not have ancestral links to the area in which they live (known as mataawaka[gg] or taura here[hh] organisations).

The Challenge creates the opportunity to bring together a wide range of researchers from throughout NZ to create additionality in the programme. Participants in this SRA have experience from a number of research programmes on Māori worldviews on housing and settlement design, cultural landscapes, innovative indigenous building materials and reflecting Māori identity in settlements including:

- work on the Mauri Model – University of Auckland;
- Tū Whare Ora - Ngā Pae o te Maramatanga/ Landcare Research Manaaki Whenua;
- the Whareuku project – University of Auckland;
- Kaitiakitanga in Urban Settlements – Landcare Research Manaaki Whenua;
- Manaaki Taha Moana: Enhancing Coastal Ecosystems for Iwi and Hapū – Taiao Raukawa and Manaaki Te Awanui Trust, with Cawthron Institute, Massey University and Victoria University of Wellington;
- Taone Tupu Ora - Resilient Urban Futures, New Zealand Centre for Sustainable Cities.

Our team also includes researchers who bring new skills in architecture, urban design, 3D technologies and specific experiences working with Māori communities to build housing developments.

2.8.4 Research Questions

How can we, as a collaborative research community, meet specific Māori housing needs in a way that makes a positive contribution to community wellbeing? This question is considered in relation to four kaupapa (themes) which reflect the areas of research need identified by attendees at hui held in Auckland, Wellington and Christchurch and by Te Matapihi, the National Māori Housing body.

	Primary community	**Primary setting**	**Primary focus**
Kaupapa 1	Mana whenua and mataawaka	Urban Māori communities	Aspirations and values
Kaupapa 2	Ahi kā communities (whānau, trusts, incorporations)	Rural Māori communities	Innovative technologies for dwelling and infrastructure

[gg] **Mataawaka** means Māori who are not in a mana whenua group or do not have ancestral links to the region.

[hh] **Taura here** – Taura here is literally referred to as a fastening rope to a post. Tau is to rest, ra or rā is at a distance. It is used in modern times to distinguish the difference between urban Māori who have migrated to another region under a different tribal authority or Mana Whenua.

Kaupapa 3	Mana whenua and mataawaka organisations; iwi and hapū	Urban and rural Māori communities, at a regional or rohe scale	Capacity building
Kaupapa 4	Ahi kā communities (whānau, trusts, incorporations)	Rural Māori communities	Architecture, ecology

Kaupapa 1:

What aspirations for papakāinga development are held by mana whenua and mataawaka communities?

- What is the interest and potential for mana whenua, mataawaka and tauiwi communities to develop communal housing informed by mātauranga Māori?
- What core values should be expressed within the built, green, social and cultural landscapes of papakāinga communities?
- What processes are seen as important for the development of papakāinga whether they be developed by mana whenua, mataawaka, rural or urban?
- Can mataawaka communities be considered as papakāinga? What relationships do mataawaka building housing need to establish with mana whenua?

Kaupapa 2:

What is the potential of innovative building and construction techniques to address specific barriers to papakāinga development such as dependence on specialist trades required for on-site installation of technologies?

- What are the cost implications of the inherent dependencies on specialist trades and to what degree do these costs inhibit papakāinga development?
- Are there quality and reliability implications if alternative approaches are adopted to on-site installation of technologies by specialist trades?

Kaupapa 3:

How is regional capacity for Māori housing development facilitated through strategic community action projects, such as the establishment of Māori Housing Forums or development of iwi housing strategies?

- What processes and activities do Māori organisations (Māori land trusts, incorporations, service providers, community housing providers, or iwi) utilise to increase capacity?
- How do Māori organisations overcome barriers to enhance capacity?
- How do relationships between community members, professionals, and government change as a result of community action projects?
- How do capacity building practices inform the actions taken by Māori organisations, professionals, and government in the course of the project?

Kaupapa 4:

How can papakāinga in regional areas encourage self-reliance and wellbeing amongst diverse Māori communities?

- What are the barriers to the resilience of regional/rural papakāinga?
- How can papakāinga be active catalysts for community and environmental health?
- How can papakāinga support the development of caring and cohesive Māori and Pākehā communities? What kind of papakāinga models can support intergenerational housing?

How can alternative rural activities (eg. sustainable farming practices or the generation of alternative energies) act as a catalyst for new papakāinga settlement patterns in regional areas?

2.8.5 Research Outline including Projects

This research programme recognises the urgent need for practical solutions that can be implemented to enhance mauri for Māori communities verified through consultation during the development of this Challenge proposal. Papakāinga are more than just buildings, but are living spaces that allow Māori to live according to Māori values. Papakāinga research is about how Māori communities relate to their lands, how those relationships can help shape a community and how to ensure that Māori worldviews of long-term relationships to place and the symbiotic interconnection between lands, peoples and waterways are embodied in the built community.

Empowering Māori communities to identify and implement their own papakāinga solutions will provide the opportunity for researchers to document, evaluate and share ideas about how the needs of these communities can be met. Māori communities seeking implementable papakāinga solutions will benefit from sharing understandings between researchers and communities about successful innovations in papakāinga development elsewhere in Aotearoa New Zealand.

The four kaupapa provide a framework in which research questions are created and answered. The research will, however, be conducted in specific projects which will relate to one or more kaupapa. The set of projects to be undertaken will be selected by June 2016 from the list of potential projects identified to date and listed at the end of this section.

Kaupapa 1: Understanding the potential of papakāinga models for promoting wellbeing among Māori communities

Research will be conducted in two phases within an action research framework.

Phase 1 (2016-2017):

i. Identify project areas
ii. Understand Māori aspirations for papakāinga
iii. Understand the diverse meanings of papakāinga.
iv. Understand mana whenua perspectives on the development of mataawaka communities ie Māori communities that do not descend from the mana whenua of the place in which they are located.
v. Understand how papakāinga models (grounded in mātauranga Māori) are seen to promote wellbeing.

We will collect data through in-depth informant interviews and focus group interviews and analyse this using basic thematic and interpretative phenomenological analysis techniques (as used successfully in Māori research (Jones, Ingham, Davies, & Cram, 2010)) and will help to develop causal understandings of the role papakāinga can play in promoting wellbeing. The interviews will be conducted with key mataawaka and mana whenua representatives, officials from relevant government agencies, and members of mataawaka communities. We will deliver a draft framework to feed into other kaupapa and to key stakeholders and the conceptual basis of q-methodology to feed into Phase 2.

Phase 2 (2016-2019):

i. Identify barriers and enablers for establishing papakāinga.
ii. Explore models for establishing papakāinga or communal living developments, and their potential for contributing to wellbeing.

We will conduct a second set of in-depth interviews to understand barriers and enablers with respect to regulation and planning, financial instruments, settlement and housing design and mana whenua and mataaawaka groups own processes used to develop papakāinga. In addition, a q-methodology study will be undertaken among stakeholders from Māori communities involved in the wider SRA to understand core values around papakāinga development. We will work with project partners to develop the actions they intend to implement and also collect baseline information for assessment of progress towards outcomes.

Kaupapa 2: Indigenous innovation to create affordable and sustainable technologies

Māori Communities will be involved in achieving their own papakāinga solutions in relation to the New Zealand frameworks of the planning, legal, and finance systems. A toolkit of possible construction solutions, such as whareuku, whareuku-container hybrid, and future solutions under development will be developed and offered to communities. We will utilise Participatory Action Research and an 'exemplar' approach to identify and track innovations.

Whareuku, as a building material, has been tested through previous research and will be utilised as a building product in community trials, in conjunction with container solutions. Therefore early research will focus on:

- Development of prototype whareuku container hybrid building designs to suit different locations and contexts involving participating papakāinga communities including consideration of aesthetics
- Development of prototype container solutions for Improvement of existing sub-standard papakāinga housing using container retrofits (in 2 locations).
- Identifying the potential for innovative building and construction to address the potential cost barriers presented by dependence on specialist trade professionals for on-site installation of technologies.
- Identifying quality and reliability implications of alternative building solutions.

Using the trials of innovative building and construction techniques, such as whareuku hybrid and retrofit trials, we will develop an understanding of how alternative building methods can be developed, tested, and implemented within or without the frameworks of the planning, legal, and finance system (note that the retrofits may be on dwellings that are not currently consented or may not require consents depending on the foundation system adopted).

Papakāinga building solutions will also involve integration of new technologies by communities, including phase change materials, stand-alone power systems, wastewater management, embodied artistic treatments, as appropriate to match Māori goals and aspirations for their housing and communities.

The creation of prototype hybrid solutions and physical implementation will generate early confidence in the partnering Māori communities. Two ME students will work with community researchers evaluating new build opportunities and retrofit opportunities and determining the implementation context for prototype solutions. Site preparation will include gathering data on existing housing solutions to baseline the impacts measured resulting from the project. Prototype approaches will then be optimised and final selection and confirmation of trial sites carried out to ensure a spread of prototype applications and regional distribution.

As the implementation of prototype solutions proceeds, the researchers will gather information on constructability and any implementation issues. Data generated regarding associated costs of new builds (whareuku construction) and retrofits (demolition of existing amenities and making good) and the time and skill sets required will be gathered through to completion. Prior to occupation of the housing solutions, monitoring technologies will be installed.

Kaupapa 3: Building capacity for Māori housing - developing Māori Housing Forums and Iwi Housing Strategies

Previous research has noted the need to build capacity within whānau, hapū, iwi, and other Māori organisations to engage in housing development but has not investigated how capacity can be increased in Māori organisations pursuing housing objectives (Hill, 2007). Therefore we will investigate successes of existing regional Māori Housing Forums and iwi housing strategies, working with representatives from local and central government, as well as community members. The research will document the ways in which new community-initiated structures, such as Māori Housing Forums, can deliver successful housing outcomes for Māori. It will use Kaupapa Māori research, emphasising improved whānaungatanga (relationships) within and between Māori communities, and the wider matrix of decision-makers and will respond to tono[ii] (invitations) from communities to bring skills and support required to reach their housing objectives. It will also use community action research, feeding knowledge of best practice into the projects as they develop.

[ii] Tono – to request, to invite, to send or order.

Phase 1 (2016-2018):

- Identify project locations
- Collect baseline data on existing Māori Housing Forums (Northland, Western Bay of Plenty, Waikato and Tāmaki Mākaurau) and existing iwi housing strategies (eg Waikato-Tainui)
- Evaluate the role of Māori housing forums in supporting individual projects to reach their housing development aspirations
- Evaluate and contribute to the development and implementation of iwi housing strategies to support iwi to reach their housing development aspirations
- Monitor Māori housing forums and iwi housing strategies
- Collating success stories from across different approaches to community action projects; identifying the strengths of each approach in different circumstances; consider how Māori Housing Forums and iwi housing strategies are complementary and address needs of different groups.

Phase Two (2018 -2024):

- Through community researchers, support projects emerging from the Wellington Māori Housing Forum or other Papakāinga SRA housing projects
- Provide lessons to emerging Māori Housing Forums and iwi housing strategies
- Evaluate success of new Māori Housing Forums and iwi housing strategies.

Kaupapa 4: Cultural Empowerment/ Cultural Resilience through Papakāinga

iv) Kaupapa 4 aims to:

i. Understand the strengths and vulnerabilities of regional/rural papakāinga

ii. Co-create with two regional communities a range of different papakāinga typologies to address those strengths and vulnerabilities

iii. Evaluate the potential of innovative methodologies to support communities to advance papakāinga projects and disseminate the findings.

The research will utilise:

- Kaupapa Māori, drawing upon key principles including: Tino rangatiratanga - the principle of self-determination; Taonga[ii] tuku iho - the principle of cultural aspiration; Ako māori - the principle of culturally preferred pedagogy; Kia piki ake i ngā raruraru o te kāinga - the principle of socio-economic mediation; Whānau - the principle of extended family structure; Kaupapa - the principle of collective philosophy; Te Tiriti o Waitangi - the principle of the Treaty of Waitangi, (Pihama 2001), and Ata - the principle of growing respectful relationships. (Pohatu 2005).
- Participatory Action Research (grounded in Kaupapa and Tikanga Māori), highlighting the active exercise of Māori values, including kaitiakitanga.
- Research through design, cross-mapping social, cultural and spatial infrastructural issues in a process where communities discuss and own the research results and iterate solutions.
- Research at the interface, affording different belief systems their own integrity, while developing approaches that can incorporate aspects of the belief systems and lead to innovation, greater relevance, and additional opportunities for the creation of new knowledge (Durie: 2004).

[ii] **Taonga** – is something highly treasured, such as He taonga te reo – Māori language is a treasure, or he taonga tuku iho, treasured heirlooms handed down, for instance, whenua – land, cultural property, and heritage.

The research will be conducted in 5 stages:

i. Identify project locations

ii. Understanding and mapping the barriers to the resilience of regional/rural papakāinga. Researchers will work with regional Māori communities through wānanga (deliberate, educative experiences), hīkoi [kk](walking/talking hui on ancestral landscape) and ecological and cultural landscape assessments of respective land blocks, to analyse vulnerabilities and strengths from a local and regional perspective. Using different geographical bases, this approach will provide an understanding of place specific, regional and global issues, such as biodiversity loss, climate change, fragmentation or dispersal of whānau to different rohe (regions) including cities and Australia**,** underemployment, environmental degradation and poor neighbouring farming practices. This work builds on the research of **Manaaki Taha Moana** (2010-2014) (see www.mtm.ac.nz), and will coincide with National Science Challenge Deep South Adaptation Strategies to Address Climate Change Impacts on Coastal Māori Communities (2015-2017) and other research underway in Tairawhiti with Ngāi Tamanuhiri of Muriwai, Gisborne. Two projects will be selected for intensive research in steps iii. – v**.**

iii. Whānau groups and researchers will identify the broad as well as targeted strategies for revitalising papakāinga. Strategies will be selected for their capacity to address multiple issues at once, and for their potential capacity to reinforce each community's papakāinga (or potential papakāinga) relationship to whenua, enhance self-reliance and deliver 'bang for buck'.

iv. Researchers will aid communities in specific values-centred papakāinga design and build testable prototypes using a variety of fabrication methods.

v. From iii. a series of resilient papakāinga models will be developed that can address place based specifics while being useful for other regional papakāinga with similar issues. Criteria for evaluation of the models will be developed with the whānau as Māori communities but are likely to include: the capacity to encourage self-reliance; strengthen intergenerational whānau; enhance resilience; act as a catalyst for them to develop connective relationships with whenua (lands), awa (waterways) and ngahere (forest) as appropriate to land holdings and their built environment, and also acknowledge the range of Te Aranga Māori Design Principles developed by Awatere et al (2008).

[kk] **Hīkoi** – Literally to move, walk or descend upon. In context to Kaupapa Māori research, Hikoi is the conceptual model under which Whariki – a consortium of Māori researchers, carry out evaluation. The Whariki Research Group's name arose from a whakatauaki that underlies the kaupapa of the group.

Related Kaupapa & Community/Setting	Organisation	Aim	Location
K1 Mana whenua aspirations	Auckland Council	Investigating Mana Whenua aspirations for Papakāinga	Tamaki Makaurau
K3 Iwi housing strategies	Ngāti Tahu	Implementing an iwi-wide housing strategy – developing a toolkit for iwi based on social housing	Reporoa (Waiariki)
	Tapuika	Iwi and social housing management strategy	Te Puke (Waiariki)
K1 & K3 Manu whenua urban Māori communities	Pehiāweri Marae	Iterative design process for Pehiāweri papakāinga	Whangarei
	Ngāti Toa	Building a whānau papakāinga	Porirua/Kapiti
	Wellington Tenths Trust	Building an urban papakāinga	Te Whanganui-a-Tara
	Ngāti Whātua o Ōrākei	Housing project with mix of ownership types	Tamaki Makaurau
	Ngāti Paoa	Building an urban papakāinga	Papakura
K1 & K3 Urban mataawaka developments	Wainuiomata marae	Building an urban papakāinga	Wainuiomata
	Professional group based in West Auckland	Building an {intensive) urban papakāinga	Tamaki Makaurau
	Enderley	Building an urban papakāinga	Hamilton
K2 & K4 Rural ahi kā [ii] communities	Ngāti Kahu; Te Whānau o Ketia Manuel Trust	Building a whānau papakāinga Interest in whareuku trial	Karikari Peninsula (Tai Tokerau
	Heremia Romana Ratima Whānau Trust (Hiwarau C)	Building a whānau papakāinga Interest in whareuku trial	Kutarere/Ohope (Waiariki)
	Heke whānau	Building a whānau papakāinga	Mangamuka (Tai Tokerau)
	Herani/Heremia Whanau, or "The Jungle" papakāinga – Kamariera/	Building a whānau papakāinga	Kuku, Horowhenua (Aotea)

[ii] **Ahi kā** refers to metaphoric home fires being kept alight by local people on lands as symbol of longterm occupation and resource use rights.

	Ogden-Bennett/ Manning whānau		
	Ahipara	Building a papakāinga Continuing whareuku trial	Ahipara (Tai Tokerau)

2.8.6 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling including personnel involved
Amber Logan	PhD student		Collaboration with research team
Jonathan Kilgour	PhD student		Collaboration with research team

2.8.7 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Transforming Decision Making for Homes Towns & Cities (TDM)	Kaupapa 2 assesses the ability of Māori landowners to build with alternative materials, construction methods, and infrastructure on their land. This links with the Decision-making SRA which considers the 'architecture of decision-making' around papakāinga development, including planning, financial, legal, and regulatory considerations.
Next generation information for better outcomes (NGI)	
Supporting success in regional settlements (SS)	
Shaping places: future neighbourhoods (SP)	Kaupapa 1 and 4 tests the application of Te Aranga Māori Design Principles to settlement design; Te Aranga principles are also used in Shaping Places to consider how 'sense of place' can be created. Kaupapa 3 recognises diverse Māori community aspirations and applications for papakāinga – project looking at mana whenua aspirations in Auckland to be included in SP.
Transforming the building industry (TBI)	TBI includes a focus on developing indigenous materials; Kaupapa 2 and 4 explore the possibility of using indigenous materials within papakāinga developments.

2.8.8 International Linkages

Organisation	Key International Person(s)	Nature of relationship with THIS SRA
The Harrison Studio, based University of Santa Cruz, California.	Helen and Newton Harrison	Leaders of the Force Majeure or Sagehen projects. These collaborative projects (including indigenous partnership projects) focus on climate change impacts on human well-being. They take a "think globally act globally" approach
Benny and Laura Fillmore	Wa:shaw Nation	Indigenous Leaders from Reno, Nevada who are also working with Harrison Studio. They are developing strong links with our projects in Aotearoa New Zealand.

2.8.9 Vision Matāuranga

The research is informed by Vision Matāuranga and considers kaupapa Māori, collaborative, multi-disciplinary, cross-cultural and participatory action research methodologies to ask the following:

- How might understanding aspects of Mātauranga Māori be explored and developed to inform a new paradigm that **catalyses** best actions to **actualize** better housing, towns and cities, connections between rural and urban regions, all upon resilient whenua (lands) and environments?
- How can indigenous-driven solutions transform long-standing inequities faced by Māori within communities?

The research methodologies are firmly rooted in kaupapa Māori as an indigenous approach to research that draws upon key principles including: Tino rangatiratanga - the principle of self-determination; Taonga tuku iho - the principle of cultural aspiration; Ako māori - the principle of culturally preferred pedagogy; Kia piki ake i ngā raruraru o te kāinga - the principle of socio-economic mediation; Whānau - the principle of extended family structure; Kaupapa - the principle of collective philosophy; Te Tiriti o Waitangi - the principle of the Treaty of Waitangi, (Pihama 2001) and Ata - the principle of growing respectful relationships. Kaupapa Māori research strongly emphasises the need to empower communities by working closely with community members to identify their needs, and to bring in skills from the research or wider community that can assist communities to reach their aspirations.

Our use of Participatory Action Research is grounded in Kaupapa and Tikanga Māori as an experiential research methodology which highlights participation and action, whilst seeking to understand the world by trying to change it collaboratively. In this case it will highlights the active exercise of Māori values, including kaitiakitanga - the responsibility passed down from ancestors, where local whānau, hapū and iwi are charged with caring for place, their natural resources and other taonga as valued assets, even if they exist on remnant, ancestral lands. This research also emphasises improving whānaungatanga (relationships) within and between Māori communities, and the wider matrix of decision-makers, as an output of the research.

The research will contribute to:

Indigenous Innovation: through working with Māori communities to co-innovate new housing solutions for papakāinga including adaptation and inclusion of cutting edge technologies.

Taiao: by co-designing papakāinga which are environmentally sound. Use of indigenous materials, such as uku (clay), harakeke, raupō, and other locally-available resources offers whānau, hapū and iwi an opportunity to connect with Papatūānuku through the design and construction of the house, and through dwelling in it.

Hauora/Oranga: by co-designing housing which is better quality, leading to healthier inhabitants and by creating papakāinga which match the requirements of Māori communities, thus improving social wellbeing of the communities.

Mātauranga: Exploring Indigenous Knowledge and RS&T: this SRA actively promotes Mātauranga Māori as knowledge that is based in the distinct culture and identity of Māori, which also reflects the intergenerational and collective experience of Māori (Ministry of Science, 2007). The combined research kaupapa explore indigenous knowledge as specifically devised for papakāinga, to lift and transform the imagination of Māori to see themselves beyond substandard, rented housing, away from turangawaewae because there appears to be no viable or healthy housing alternatives. This aspiration is underpinned by the term tino rangatiratanga and sums up the capacity to have control over, or determine the course of things Māori and in this case to demand and create better housing by ways of organising and expressing themselves in the destiny they aspire to, as a people uniquely related to and identified with Aotearoa. As retired Sir Professor Mason Durie (born 1938) of Ngāti Kauwhata, Rangitāne would insist in 1998, "Fundamentally tino rangatiratanga is about the realisation of collective Māori aspiration. And despite the many faces of contemporary Māori society and the wide range of views, which exist, there is nonetheless a high level of agreement that the central goal of tino rangatiratanga is for Māori to govern and enjoy their own resources and to participate fully in the life of the country. Māori want to advance, as Māori, and as citizens of the world' (H. Smith, 2011).

2.8.10 Stakeholder Involvement and Pathway to Implementation

Type of Stakeholder	Name of Organisation/Person	Contact to Date
	Auckland Council	
Whanaū, hapū and iwi, Maori land trusts and incorporations and mataawaka organisations	Ngāi Tahu	
	Tapuika	
	Pehiāweri Marae	
	Ngāti Toa	
	Wellington Tenths Trust	
	Ngāti Whātua o Ōrākei	Engagement with research team or attendance at hui to identify research needs and potential projects. Some potential project partners have been contacted with a survey to assess housing need.
	Ngāti Paoa	
	Wainuiomata marae	
	Enderley	
	Ngāti Kahu	
	Te Whānau o Ketia Manuel Trust	
	Heremia Romana Ratima Whānau Trust	
	Ahipara	
	Ngātikahu ki Whangaroa	
	Parihaka	
Central government	Ministry for the Environment	Meeting with Manu Graham (12 Oct 2015) to discuss links between proposed research and Ministry for the Environment papakāinga work programme

Sector body	Te Puni Kōkiri	Meeting with Pauline Tangohau (13 Oct 2015) to discuss links between proposed research and Te Puni Kōkiri work programme
	Te Matapihi National Māori Housing Organisation	Meeting with Trustees to discuss Strategic Research Area and partnership. Collaboration with staff to develop research kaupapa.

Engagement to date: Hui held to shape the NSC11 Challenge in Auckland, Wellington, Christchurch, confirmed the struggles that Māori communities are experiencing trying to build housing. Advice from Te Matapihi National Māori Housing Organisation has emphasised the need to continue to engage with communities who have attended hui or offered projects. Currently, 19 groups have offered potential papakāinga or housing strategy projects for inclusion in the research; most groups have been asked to complete a short survey outlining the characteristics of their land and the proposed development; some of elected to meet face-to-face with researchers before sharing further details. Through this process, projects which are ready to engage with researchers in Phase 1 will emerge; and other projects will emerge as priorities for Phase 2. Ongoing communication is critical to ensure that communities are supported to engage with the research programme.

Partnering with Te Matapihi: Te Matapihi have worked to support the establishment of regional Māori Housing Fora, there are currently active fora in Northland, Western Bay of Plenty, and Waikato. We will utilise these fora to disseminate research findings, and identify opportunities for research partners to be involved in future research (for example, through competitive funding rounds). This research programme complements a proposal developed by Te Matapihi to hold a series of wānanga with Māori communities around the country to build regional Māori housing capacity and 'fast-track' papakāinga development. Wānanga were conceived as the best way to support communities and meet the needs for expertise and assistance identified by Te Matapihi in their work with communities. By introducing a research component to the wānanga proposal, Challenge researchers will not only support the progress of specific projects in individual communities, but develop a comprehensive set of information about successful papakāinga projects in a range of locations and situations. This information can be shared with other potential papakāinga developers, as well as informing industry innovation and policy development. The formal partnership with Te Matapihi is still in development.

Papakāinga symposia: Annual gatherings will be held to share lessons from progress of each of the papakāinga projects. These gatherings could be associated with the biannual Māori Housing Conference held by Te Matapihi. If appropriate, local participants in completed [advanced] papakāinga projects will be invited to share their experiences with papakāinga projects entering into the research process.

2.8.11 Co-funding

Nature of Activity being Co-funded	Source of Co-Funding (Organisation name, Fund type, Cash/in-kind)	Secured/Applied For/Potential
Trial of Whareuku hybrid model	Land Trust and occupiers (land, labour, muka, soil, landscaping, mara kai, infrastructure)	Potential
Trial of container retrofit model	House, land and labour from community	Potential
Wānanga to support Māori housing capacity	Te Puni Kōkiri	Potential
Support for Māori Housing Forum	Te Matapihi	Potential

2.9 SRA6: Transforming the Building Industry

	Name	Org.*	Annual FTE funded by Challenge	Skills of individual
PI	Prof John Tookey	AUT	0.3	Productivity, lean production, supply chain management, logistics, construction process management, quality
	Lynda Amitrano	BRANZ	0.3	Construction process, building performance, materials performance, sustainability
	Prof Suzanne Wilkinson	UA	0.3	Procurement, innovation, industry skills and development, resilience
AI	Dr Mehdi Shazpour	UA	0.1	Innovation and productivity
	Dr Ali Ghaffarian Hoseini	AUT	0.1	Design, sustainability, low energy buildings
	Dr Vicente Gonzalez	UA	0.1	Productivity, lean production, sustainability, modelling
	Dr Regan Potangaroa	VU	0.1	Māori education and training, structural engineering, resilience
	Dr Alice Chang Richards	UA	0.1	Industry skills development, CHCH rebuild, resilience, construction management
	Dr Nicola Naismith	AUT	0.1	Construction costs, performance, skills, educational pedagogy
	Ian Page	BRANZ	0.1	Econometrics, productivity data, construction statistics
	Derek Kawiti	VU	0.1	Digital technologies converging with Indigenous traditional knowledge, practicing architect
	Dr James Lim	UA	0.1	Prefabrication, modelling, structures
	Andrea Stocchero	Scion	0.1	Sustainability, design
	Dr David Moore	AUT	0.1	Health and safety, design, ergonomics
PhD Student		UA/AUT	1.0	
PhD Student		UA/VU	1.0	
PhD Student		BRANZ/VU	1.0	
PhD Student		AUT/Scion	1.0	

*AUT=Auckland University of Technology, UA=University of Auckland, VU=Victoria University

2.9.1 Outputs

Outputs for this SRA will be developed through to June 2016 in concert with research project development.

2.9.2 Context

The challenge our SRA tackles is to create a healthy, smart and innovative building industry fit for the purpose for the 21st Century through reinventing the conservative, constrained, fragmented and inward-focused building industry in New Zealand. Our country has poor quality and extremely expensive housing, with little or no relationship to our cultural identity as New Zealanders or to place, as recognised by the BBHTC Challenge. Infrastructure that has developed piecemeal is now suffering from degradation and in need of replacement. Moreover, the supply of built infrastructure is insufficient for the demands of the growing population. To improve the liveability of our urban environments we need to increase consistency of productivity at a local level, improve innovation and improve the quality of construction products. This requires developing a healthy, coherent, well-functioning construction sector in terms of its levels of **innovation**, **people**, **processes** and **products**.

Research in the broadly defined areas of people, products and processes in the built environment has been conducted internationally but much less well advanced in NZ by comparison with international exemplars. Our 360^0 analysis of previous research (The Productivity Partnership Research Action Plan Stocktake, 2012) indicated a comparatively small pool of existing NZ research which links together the themes of people, product and process in construction. Indeed, New Zealand based research has only progressed to the level where broad sector issues and a baseline have been identified.

We note fundamental questions raised about existing research on building industry productivity which have been put forward by the October 2015 Motu report for BRANZ - Productivity distribution and drivers of productivity growth in the construction industry (Jaffe, 2015). This study draws on firm-level data from the Longitudinal Business Database and uses this to examine productivity in the New Zealand construction industry in a new way. It finds that over the period 2001–2012, labour productivity of the average firm in this industry grew by 1.7% annually and multi-factor productivity by 0.5% annually, compared with 0.5% and 0.1% annually respectively for firms in the measured sector. The findings of this report are significant for this SRA as they question the existing orthodoxy around productivity in the industry.

The building industry is seen in NZ and internationally as a traditional or low-technology sector with low levels of expenditure on activities associated with **innovation**. It is supported by research that businesses that innovate, or 'innovation-active businesses' are more productive, generate more jobs than non-innovation-active businesses and are more efficient. The NZ building sector needs to have a change in attitude to opportunities presented by innovation, and adoption of new technologies including automation and digital tools. However, to change requires a significant industry shift from a focus on delivering immediate needs to a longer term delivery focus where housing will be designed and constructed with consideration of materials, maintenance needs and environmental impacts across not only the design and building phase but the whole life of the building.

Numerous studies have shown that clients can use their purchasing power to demand **innovation** (Widen et al., 2008; Egbu, 2008). However, Reichstein et al.'s (2005) comprehensive survey of UK construction firms indicate that many construction firms are not motivated to innovate in order to remain competitive as they can sustain themselves by meeting local needs of undemanding customers. And a recent Australian construction industry study (Loosemore and Richard, 2015)) found that most construction clients are not interested in innovation but are mainly driven by price. They conclude that for clients to be engaged more with innovation, they need to have a better understanding of what innovation is and its benefits to them. Moreover, the industry lacks drivers towards innovation and skills and expertise to deliver on innovative practices and innovation thinking are not embedded in the building industry. This Australian finding parallels the New Zealand context; as one senior client representative professional observed in consultation, "why would I invest serious monies in a new engineered timber structure when the unknowns, such as long term value and maintenance, are so substantial". As the scale and complexities of construction projects increase, so do the consequences of failure with regards to public safety and loss of investment. This increases the tendency of client and companies involved to continue with the previously tried and tested methods and designs, thus resulting in low levels of innovation (Tawiah and Russell, 2008).

In 1998, Clarke and Wall were arguing that lack of training, inappropriate training, difficulties in attracting **people** into the industry and retaining them, poor employment conditions and pay have all contributed to the image of construction as an unattractive place to work. In 2015, the same comments are found in an industry that seems unable to find an integrated, long-term solution to sustainable education, training and industry careers. Jobs in the industry being perceived as poorly paid and uncertain given the boom-bust cyclic nature ((McGrath-Champ et al., 2011), Allan et al. (2008)). This deters young people from considering the industry as a future employer, penalising the industry (Briscoe, 1988; Hillebrandt, 2000). Having a skilled, well-trained and productive workforce is central to the building sector's growth and success (Agapiou et al., 1995; Chan & Dainty, 2007; Construction Skills, 2005).

Solutions to improve the industry as an attractive place to work have focused on training of transferable skills (Clarke, 2006; Clarke & Wall, 1998), multi-skilling (Burleson et al., 1998), industry promotion (Agapiou et al., 1995; Chan & Dainty, 2007), and the development of new technologies and construction techniques to substitute manpower and to make the industry more attractive mechanistically and technologically. Dainty et al. (2005) suggested that workforce planning needs to take account of a wide range of factors determining both labour supply and demand as the current provision for skills training within the industry does not enable the industry to deliver quality affordable housing. A further greater challenge is to identify future training needs to ensure the industry can adopt innovative and new technologies.

In New Zealand the principal issues with regard to the building industry and its relationship with homes, towns and cities have been poor quality performance on the one hand (Mithraratne and Vale, 2004) and value for money on the other. Housing quality creates extensive problems for society and health (Howden-Chapman, 2004) and the problem of addressing future urban form and its constituent housing in the New Zealand context has been reported on for a number of years (Dixon and Dupuis, 2003). Housing affordability has been on ongoing problem in New Zealand and the issue has become so contentious that the notion of housing as 'An Impossible Dream' for ordinary New Zealanders is starting to be accepted (Tookey, 2014).

2.9.3 Research Questions

The NZ building industry needs to shift to Whole of Building/Whole of Life (WoBWoL); this is a game changer. Understanding, anticipating and designing of all aspects of buildings for the duration of their anticipated lifespan is not new in the sense that architects and engineers have always attempted to consider these. However, in terms of the wider construction sector the concept is novel. Small contractors, suppliers, inspectors and indeed councils share the aspiration of trying to achieve the bare built minimum required to exit a construction site with some money in the pocket and negligible liabilities left behind. It is a widely held idea that 'Building to Code' is the bare minimum of what is legally required for a designer to design to and a constructor has to build to and this thinking permeates the supply chain. Changing this thinking requires a change in the way designers design, builders build and suppliers supply. With this in mind, the unifying questions are

1. **People**: what are the skills, capabilities and competencies that the future professionals, designers, tradespeople and workers need to demonstrate by 2025 in order to deliver true Whole of Building/Whole of Life (WoBWoL) performance? How do the attitudes, expectations and thought processes of key procurement decision takers need to be influenced to think and specify WoBWoL for the future?

2. **Products**: what are the key product system changes (and their performance criteria) that need to be either adopted, refined and popularised amongst professionals, designers and tradespeople by 2025 so the industry can start thinking and working with the aim of delivering housing that provides WoBWoL performance?

3. **Processes**: What are the critical processes that need to be developed and operationalized amongst professionals, designers and contractors by 2025 in order to enable true WoBWoL performance?

2.9.4 Research Outline including Projects

The research is conceptualised through a series of stages to reach whole of life buildings fit for the NZ population. The building industry is a complex system thus is not susceptible to be 'solved' with a uni-dimensional solution; transformation of the building industry will only be achieved through a series of incremental improvements applied in unison.

Innovation is the key to industry growth and development. In the first instance there is a need to establish more completely the actual and potential levels of performance in the building industry with respect to innovation in the domains of **People**, **Product** and **Process** and use these findings to determine where the most pressing issues which are amenable to research solutions. This inquiry

will take place January – June 2016 in the first instance and will draw on findings from other SRA, particularly **Transforming Decision Making**. The research will:

- Confirm the performance metrics and standards required to set the industry as a whole on the pathway towards sustained performance improvement. Once performance measures are established it will be possible to generate the conditions to create an industry that is capable of delivering sustained 'whole of building / whole of life' thinking (Figure 7) and the detailed projects most urgent to achieve this.
- Identify problems of and successful innovation models for different organisational sizes and types.
- Carry out a gap analysis of skills required for innovation in the industry.
- Identify critical new tools and products for introduction of innovation into the building industry as well as methods for ensuring that new product innovations can be introduced to the industry in reasonable timeframes while maintaining standards and safety.
- Work with **Transforming Decision Making** to identify critical areas for research on building industry processes.

By June 2016 the next set of projects for focus in this SRA will have been identified and detailed.

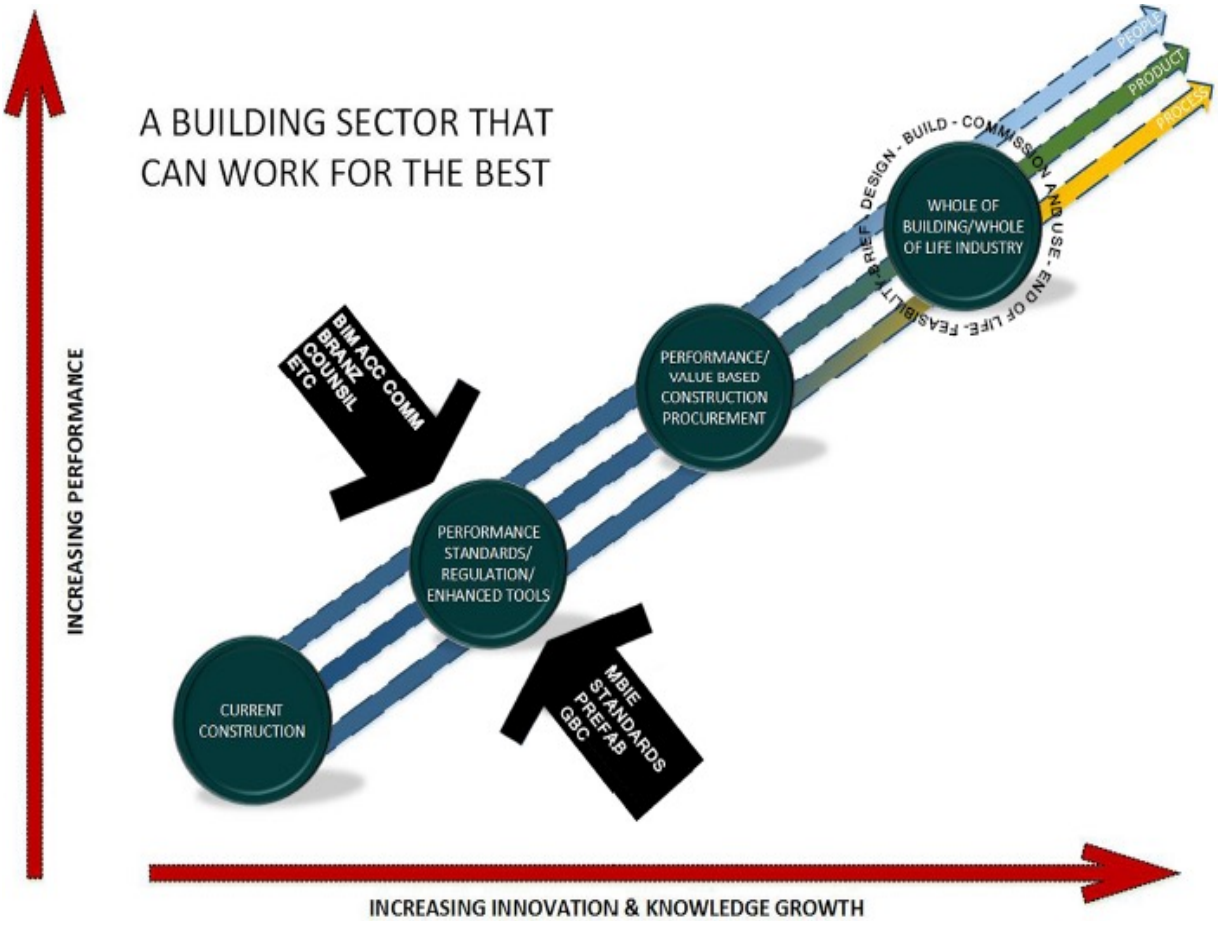


Figure 7 A building industry that can work for the best

2.9.5 Team Upskilling

Name of individual being upskilled	Career point	Ethnicity if specified	Nature of upskilling including personnel involved
PhD 1	Student		Development of PhD skills
PhD 2	Student		Development of PhD skills
PhD 3	Student		Development of PhD skills
PhD 4	Student		Development of PhD skills

2.9.6 Linkages with other Strategic Research Areas

Strategic Research Area	Link
Transforming Decision Making for Homes Towns & Cities (TDM)	The industry needs and indeed relies on many of the actors identified in TDM. This means the decision making processes that are identified and improved will need to align with and support transforming the building industry. In particular the regulatory environment and the industry building processes interweave so the research in each SRA will both reinforce and inform the other. The result of this cross-cutting will ensure the domain "A Building Sector that can Work for the Best' will be strongly supported by two SRA's. TDM will feed into Transforming the Building Industry to inform research on improving building industry processes.
Next generation information for better outcomes (NGI)	The Next generation information SRA and the Transforming the Building Industry SRA will maintain links over data needs across the building industry. Innovation in use of geospatial information collection and dissemination technologies has relevance for this project.
Supporting success in regional settlements (SS)	The results of Transforming the Building Industry will affect SP in the sense that new processes and products will change the dwellings in future settlements.
Shaping places: future neighbourhoods (SP)	The results of Transforming the Building Industry will affect SP in the sense that new processes and products will change the dwellings in future neighbourhoods.
Hei Papakāinga ora (HPO)	Transforming the Building Industry will have a strong link with SRA Hei Papakāinga Ora with research that identifies opportunities for indigenous innovation and use of materials and processes that use local materials that reflects the strong Māori links to the land and place. This will be achieved though projects improve the use of products and innovation and processes that inhibit innovation or have adopted processes that don't meet the needs of Māori.

2.9.7 International Linkages

Organisation	Key International Person(s)
Curtin University (Australia)	
Melbourne University (Australia)	
RMIT (Australia)	Professor Helen Lingard

University of NSW (Australia)	Professor Martin Loosemore
VTT (Finland)	
City University (Hong Kong)	
Hong Kong University	Professor Steve Rowlinson
Institute of Technology Israel	
Kyoto University (Japan)	
Hanze University (Netherlands)	
Charmers University (Sweden)	
Reading University (UK)	Professor Will Hughes
Salford University (UK)	
Sheffield University (UK)	
Loughborough University (UK)	Professor Andrew Dainty
Central Lancashire (UK)	Professor Jack Goulding
UC London (UK)	
Arizona State (USA)	Professor Dean Kashiwagi
San Diego (USA)	
UC Berkeley (USA)	
International Council for research and innovation in Construction (CIB)	
European Network of building Research Institutes (ENBRI-EU)	
Construction Industry Institute (CII-US)	

2.9.8 Vision Mātauranga

The Transforming the Building Industry programme incorporates the participation of leading Māori researchers (Associate Professor Regan Potangaroa and Architecture Senior Lecturer Derek Kawiti) in the built environment to ensure that the programme is setup on robust cultural frameworks so the very best innovation and productivity knowledge can benefit both Māori and all New Zealanders. The most direct link contribution this SRA will make to delivering on the principles of Vision Mātauranga are in the area of hauora/oranga – health and wellbeing. A more efficient industry producing affordable housing for all sectors of the population will have a profound impact on wellbeing of New Zealanders.

2.9.9 Stakeholder Involvement and Pathway to Implementation

Type of Stakeholder	Name of Organisation/Person	Contact to Date
Councils	Auckland Council	Meetings with RIMU
	CCC	
	Wellington City Council	
Research Organisations	Scion	Member of Team
Industry	Fletcher Building	Discussion with members
	Winstone Wallboards	Focus Group
	Hawkins	
	Fulton Hogan	Discussion with members
	Downer	
	HEB	
Industry organisations	Clients Group (CCG)	Discussion with members
	PrefabNZ	Focus Group participation
	NZIOB	Discussion with members
	NZIA	Discussion with members
	RICS	Discussion with members
	NZIQS	Discussion with members
	IPENZ	Discussion with members
	Master Builders	
	BCITO	

Core to transforming the building industry will be our methods of dissemination of information. We have identified a suite of methods which include direct involvement of industry in the research process, training the future industry members and leaders and communication and dissemination of research to the wider industry as follows.

Participatory Research approach: The research will be co-created with the building industry and have at its core the industry as the primary users and use industry as vehicles for dissemination. For instance, innovation processes will be tested with industry to see which mechanisms are the best to use.

Transforming the Building Industry Think Tank: A "transforming the building industry" national think tank of 10 member will be convened in the first 6 months of the Challenge. This panel will include representatives from Māori, national and international researchers and industry. Part of the remit of the think tank will be to develop ways to target small and micro-enterprises (including suppliers to main contractors) through direct knowledge transfer as well as other methods including web tools and continuing professional development activities.

The think tank will link to national organisations (Councils, Government and industry organisations - Building industry Council, Construction Strategy Group, Council for Infrastructure Development). This think tank will link to internationally recognised research organisations, including the International Council for Research and Innovation in Building and Construction (CIB) and the Collaborative Network of Building Researchers (CNBR) to participate directly in international benchmarking activities as well as the dissemination activities of best practice.

Māori involvement as key participants in the Building Industry Think-tank will enable the aims of the Transformation of the Building Industry SRA to offer up solutions that are not 'business as usual'. In the Post-Treaty Settlement era we are currently in Iwi are starting to develop their own infrastructure and land holdings through looking to the past for sustainable practices and values sensitive approaches to enable a better alignment of their built environments with their materials/ products, people and their needs.

Undergraduate teaching

Research findings will be used to inform and develop future teaching materials for undergraduate programmes at all national institutions with a building industry and building industry curriculum (the majority of Universities and institutes of Technology). We will create teaching products (case study and best practice materials for example) to make available to all construction related programmes (i.e. Bachelor of Construction, Diploma, Certificate) throughout New Zealand. Principal distribution mechanism initially will be through our existing networks with MIT, UNITEC and Bay of Plenty Polytech. Once embedded with these institutions and embedded into practice, the training material will be made available for other institutions to include their curriculum.

Transforming the Building Industry National Conference

From Year 2 an annual conference will be held with academic, industry and government agencies. We will co-organise and run an interactive conference with workshops and presentations including examining international best practice. The intent will be to: 1) ensure that the best national and international ideas and developments are disseminated throughout the industry and 2) future "Transforming the Building Industry" research directions are formulated with industry. Throughout the research programme the team will seek to engage with professional bodies across the various building disciplines (i.e. NZIOB, NZIA, IPENZ, NZIQS) and co-host events. Within the conference there would be a component that would provide an opportunity for engagement with consumers and non-professionals to share appropriate research and learnings

Transforming the Building Industry Knowledge Base

The research programme will generate written and presented outputs. These include academic papers, publications to industry, conference presentations as well as teaching material. The Transforming the Building Industry programme website, accessed through the Challenge website, will feature all the outputs from the programme.

Transforming the Building Industry Demonstration Projects

Through the Think Tank relationships, new products and processes developed in the programme will be trialled as demonstration projects, led by industry. Co-funding for these projects will be sought.

2.9.10 Co-funding

Nature of Activity being Co-funded	Source of Co-Funding (Organisation name, Fund type, Cash/in-kind)	Secured/Applied For/Potential
Demonstration projects	Industry	Potential

2.10 Research Quality

The need for high-quality science is a critical consideration of the BBHTC and the research community that will deliver the Challenge. We will regularly review science quality by drawing on three tiers of expertise:

- International researchers including those in our Independent Science Advisory Panel (ISAP, Section 1.4.4)
- internal including the Science Leadership Team (Section 1.4.2.3) and the teams of scientists in the SRAs
- Stakeholders/end-users

This will ensure review from the perspectives of both end-use and science. The Governance Group will have a particular focus on ensuring that key end-users or stakeholders are involved directly in science reviews.

The Challenge recognises that considerable existing research infrastructure including quality management systems exists amongst both the Challenge Parties and other research providers. Accordingly, the Challenge aim is adapt existing systems (from both the contract holder, other Parties and other providers) to meet the needs of the Challenge. We note for example that research providers will still use established internal review processes (for example institutional requirements around quality assurance and peer review). In addition, review is a normal part of research practice in the consideration of research articles and Challenge research publications will follow this norm.

Delivery of research quality will be evaluated against five criteria suggested by the OECD DAC (1991) as shown in (Table 12) below. Mātauranga quality will be evaluated against similar criteria that reflect kaupapa Māori as it is necessary to distinguish between western science goals and the overall goals of NSC11, which extend beyond western science parameters.

Criterion	Description	Key Questions
Relevance	The extent to which the research delivered priorities, practices, products and policies that related to the specified needs of the key stakeholders (recipients and funders)	To what extent are the objectives of the Challenge still valid? Are the activities and outputs of the Challenge consistent with the Vision, Mission and Outcomes of the Challenge and the attainment of its objectives? Are the activities and outputs of the Challenge consistent with the intended outcomes? Was the funder satisfied with the relevance of the research?
Effectiveness	A measure of the extent to which SRAs answer their research questions and deliver specified outputs.	To what extent were the questions answered and the outputs delivered What were the major factors influencing the achievement or non-achievement of the above? Was the funder satisfied with the quality of the research?
Efficiency	Efficiency measures the outputs – qualitative and quantitative – in relation to the inputs. It is an economic term which signifies that the research uses the least costly resources possible in order to achieve the desired results. This generally requires comparing alternative approaches to achieving the same outputs, to see whether the most efficient process has been adopted.	Were research objectives achieved on time? Was the research projects implemented in the most efficient way compared to alternatives?

Impact	The positive and negative changes produced by the research, directly or indirectly, intended or unintended. This involves the main impacts and effects resulting from the research activity on dimensions including social, cultural, economic, environmental, public policy and other indicators. Both intended and unintended results should be considered	What has happened as a result of the research programme or project? What real difference has the research made to the beneficiaries? What is the extent and scale of the impact? (How many people have been affected?)
Sustainability	Sustainability is concerned with measuring whether the benefits of research activity are likely to continue after funding has been withdrawn or the research completed.	To what extent will the benefits of research continue after funding ceases? What are the major factors which influence the achievement or non-achievement of the continuance of the programme or project?

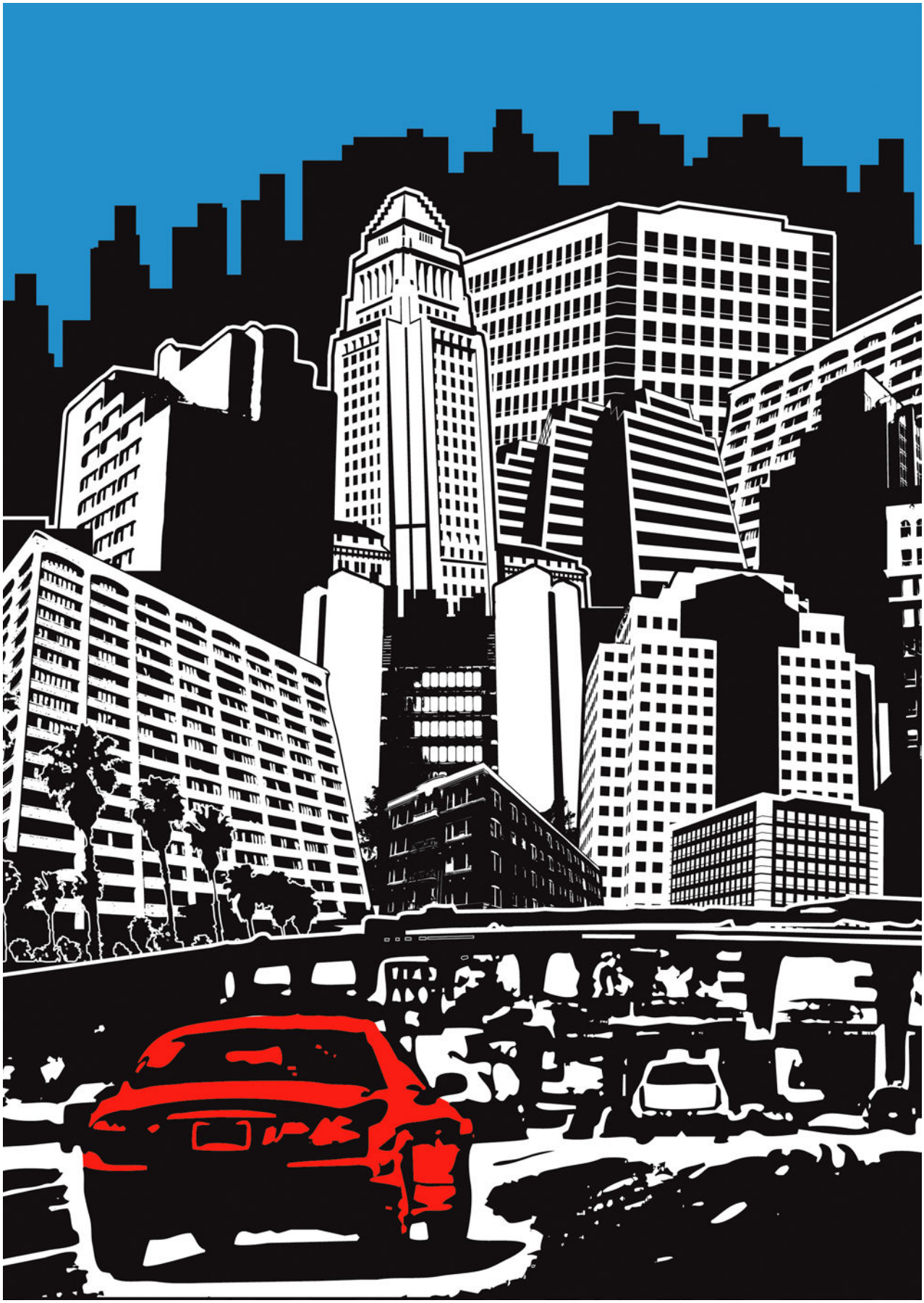
Table 12 OECD Research quality criteria

Activities in the Challenge science that drive and assess quality will be:

- Annual independent science reviews (utilising expertise external to the Challenge such as the ISAP) will evaluate science quality within the Challenge, and reports will be provided to the Challenge Governance Board.
- End-user reviews undertaken as and when required to test and provide assurance that the Challenge is making progress towards its Mission. As noted below, a biennial Challenge the Challenge colloquia has been programmed to provide a structured vehicle for this.
- Activities detailed in Dynamism and Refresh, Section 1.3.7: Research-prompted new ideas colloquia, Challenge the Challenge colloquia, Contestable funding.

The Director and Science Leadership Team will be responsible for organising these reviews and will also participate in them. The Governance Board will provide oversight of the review process, and provide direction on actions to be taken as a result of reviews.

Development of the Strategic Research Areas is a demonstration of how the Challenge intends to ensure research quality. The SRAs were initially developed by six teams of nationally-leading researchers, subjected to review of quality and direction in light of Vision Matāuranga through workshops, hui and by 3 international experts to test the Challenge's research quality and direction in light of Vision Matāuranga. Further refinement and quality-check of the SRAs, including by the ISAP, will be carried out as the SRA projects commence and specifically as Hei Papakāinga Ora and Transforming the Building Industry identify their specific research activities.



3 BUSINESS PLAN

3.1 Challenge Structure

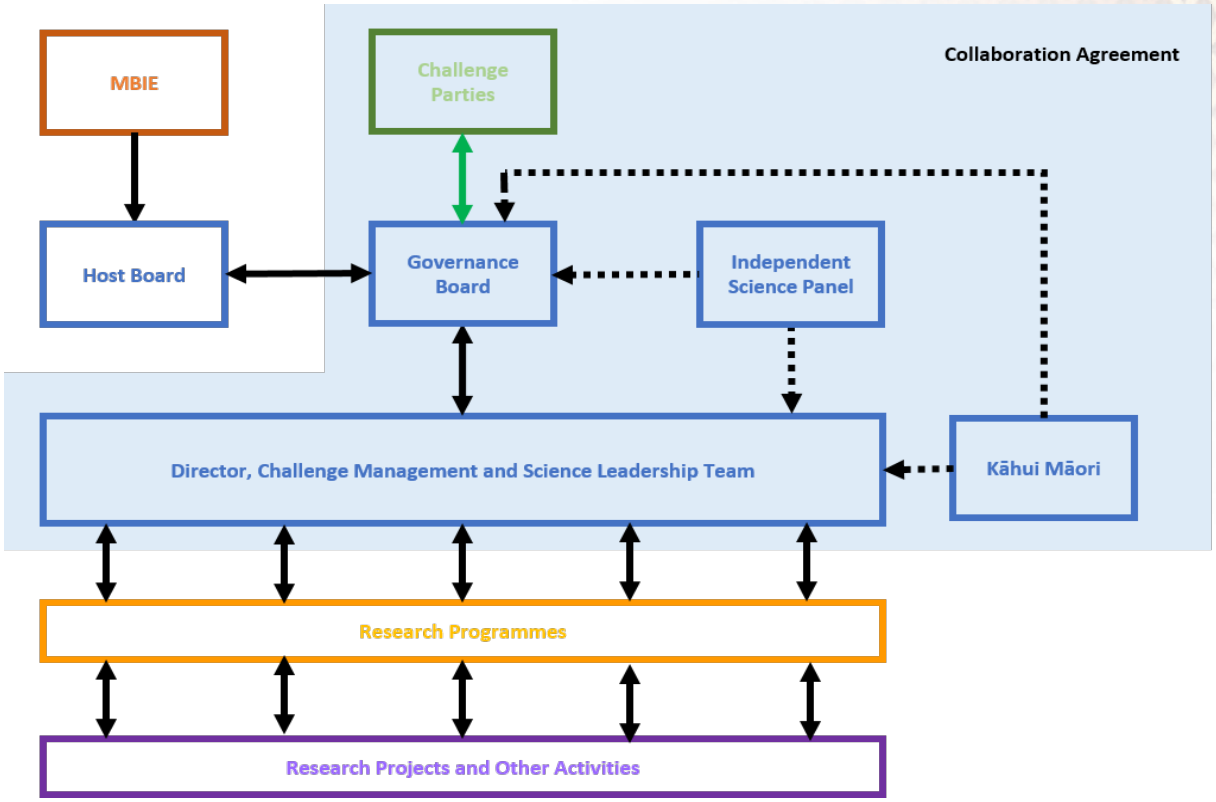


Figure 8 Challenge Governance Structure

3.2 Host Organisation & Challenge Contractor

The Challenge Contractor (BRANZ) will be accountable for overall delivery of the Challenge goals through its investment contract with MBIE. BRANZ will provide a management office for the Challenge and establish Directorate and Board business processes and other administrative matters as stated in the Challenge Agreement BRANZ brings demonstrated financial control systems, robust monitoring, reporting and evaluation processes, HR, IT, communications and other support systems to the Challenge. As a transdisciplinary organisation working in a range of fields of research, BRANZ has a collaborative ethos and established relationships with multiple agencies. BRANZ will facilitate strong linkages between the Challenge Board, Challenge Parties, MBIE and end users.

As stated in the Heads of Agreement, BRANZ's role as Challenge Contractor will confer neither an advantage nor disadvantage to BRANZ in either the operation of the challenge nor in the provision of research to the Challenge. BRANZ will manage the Challenge according to the following guiding principles:

- focus the Challenge Research and Related Activities on the delivery of the BBHTC Mission, recognising that aligning and integrating interests across multiple organisations will provide a greater national outcome than if the Parties acted independently;
- align resources and collaborate in the pursuit of the agreed BBHTC Mission through the Research Plan, and ensure that BBHTC Challenge activities remain in scope, thereby avoiding duplication of research and enabling access to specialist facilities, resources and expertise of all the Parties;
- pledge to a genuine, enduring collaboration built on mutual trust and a sense of collective responsibility;
- make the best use of skills and expertise of New Zealand, regardless of institution, to build multi-disciplinary, high quality teams;
- embed Vision Mātauranga principles and concepts throughout the BBHTC Challenge, through Māori involvement in the governance, management and research of the BBHTC Challenge, to ensure that the BBHTC Challenge is able to deliver on the needs and aspirations of Māori;
- incorporate Māori, industry, central and local government and communities in the BBHTC activities to ensure research relevance, societal trust in science, outreach and the implementation of the research findings;
- provide clear leadership and accountability within the governance, management and science of the BBHTC Challenge, while avoiding institutional capture;
- as appropriate, use independent, expert scientific advisors and reviewers to ensure that the BBHTC Challenge delivers research that is effective and follows international best practice;
- implement financial arrangements that are sound and enduring, including the use of standard operating/financial models based on the full-cost funding of research;
- allocate the BBHTC Challenge funding through an objective, transparent process, and provide a basis for supporting new researchers, organisations and capability relevant to the Mission; and
- ensure that robust and transparent processes are in place at an early stage to manage conflicts of interest, at both individual and institutional levels, in the direction-setting and funding-allocation processes.

3.3 Governance Arrangements

The Challenge will be governed by the Challenge Board, assembled to provide experienced strategic oversight of the Challenge, including research directions and risk management. While the Board remains accountable to the Challenge Contractor, its focus will be on ensuring the Challenge achieves its stated strategic objectives defined in the NSC Investment Contract. The Board will be charged with ensuring the interests of the Challenge remain the focus of decision making and Board members will contribute relevant perspectives based on their professional and leadership roles and experience, they will not act as 'representatives' of any agency, sector or interest.

The Board will comprise:

- The Independent Chair appointed by the Board of the Challenge Contractor, in agreement with the Challenge Parties. The Chair will be chosen for skills in governance, national prominence and stakeholder management. The Chair will be appointed for a term of three years, subject to approval in advance of appointment by the Ministry, which may be renewed for further three year terms, on the mutual agreement of the Parties and Ministry approval should the Chair be replaced. The Chair will be independent of any research provider, stakeholder or end-user affiliation.
- Additional members (not less than 4 nor more than 6, with the option to co-opt where required) appointed by the Challenge Contractor Board in agreement with the Challenge Parties in keeping with a mix of skills, capability and strategic knowledge relevant to the BBHTC Mission, including but not limited to Māori, housing and urban environments, policy and planning, engagement and outreach, research and finance.

Board meetings can also be attended by observers who shall not have voting rights but who may attend and speak at meetings. The Chair will have the right to ask any observer to withdraw from the Board meeting if sensitive discussion, or conflicts of interest related to that observer's organisation, are to occur:

- One or more MBIE observers, as appointed by MBIE
- One or more observers from the Challenge Contractor (BRANZ as the Challenge Contractor does not intend to have a representative as a member of the Board)
- One or more observers from Challenge Parties.

Selection of the Chair of the Board is underway. Recruitment of the members of the Board will follow their appointment. The aim is to have the Board complete by mid December 2015. A short list of potential candidates has been assessed against a matrix by the interim Governance Group.

Challenge Board members will selected on the basis of the expertise needed to deliver Challenge objectives, including:

- Governance experience
- Research leadership and expert knowledge of the Challenge landscape – housing quality, housing supply, urban environments
- Knowledge of national and regional sector priorities
- Understanding of the application of built environment research innovations, including project evaluation and impact assessment skills
- Financial management skills
- Understanding of the principles of Mātauranga Māori.

The key responsibilities of the Board are summarised below, as per the Terms of Engagement included in the Collaboration Agreement

- Provide strategic direction to, and ultimately approve, the Research Plan, budgets and project funding investment recommended by the Director and Science Leadership Team
- Monitor and review progress against the Research Plan, including delivery of the Challenge mission.
- Ensure that the activities of the Challenge stay true to the mission and values

- Appoint the Director (subject to ratification by BRANZ) and annually complete a formal review of his/her performance
- Approve appointments to the Science Leadership team, on the recommendation of the Director
- Ensure that the science activities the Challenge undertakes include appropriate engagement, education and communication programmes with relevant stakeholders, to increase public understanding of how science contributes to New Zealand's well-being
- Approve changes to the Parties to the Collaboration Agreement (both leaving and joining the Challenge).
- Ensure that the Challenge gives effect to Vision Mātauranga objectives, including governance of the Challenge, and observes kaupapa Māori research principles
- Adopt and give effect to the Dispute Resolution Policy and Processes as described in the Collaboration Agreement.

The Challenge Board will meet at least four times per year or more frequently if it deems necessary. The Chair will engage regularly with the Challenge Director to ensure governance and management approaches are complementary and mutually reinforcing. To ensure effective links between the Science Leadership Team and Challenge governance, the Chair will meet every 6 months with the Science Leadership Team, and, as needed, with other advisory groups convened to undertake specific functions within the Challenge.

By unanimous agreement, the Parties may request the Board of the Challenge Contractor to remove either the Chair or any Board member, should they be deemed to be failing to meet their obligations and responsibilities as a member of the Board, but must notify MBIE.

3.4 Management Arrangements

The Challenge research programme will be managed by the Challenge Director, supported by a Science Leadership Team's scientific expertise and programme management skills, and an advisory Independent Science Panel. A small Challenge management team (a Challenge manager and administration support) will support the Director.

3.4.1 Challenge Director

The Director of the Challenge will be employed by the Challenge Contractor in accordance with an appointment process determined by the Board. Given the scale and complexity of the Challenge, the Director must demonstrate exceptional programme leadership, sector knowledge and programme, project, financial and relationship management skills (see Job Description in Appendix 4). The role has a focus on collaboration with a particular view on the criticality of this to the overall success of the Challenge. The Director will report to the BBHTC Board in respect of delivery of the Challenge and to the Challenge Contractor in respect of employment or non-BBHTC Challenge activities.

The Director will have the following responsibilities:

- Coordinate and operate the BBHTC Challenge in accordance with all contracts and agreements, and their associated policies, principles, processes and procedures, to deliver the Challenge mission.
- Prepare, for approval by the BBHTC Board, any Annual Plans and budgets and any annual or other reports required under all contracts and agreements, or any other documents as agreed by the BBHTC Board.
- Recommend to the BBHTC Board, on behalf of the Science Leadership Team, any decisions concerning allocation of Project Funding for Research and Related Activities based on the Research Plan, peer review and a best teams approach.
- Provide leadership to the Science Leadership Team, and recommend to the BBHTC Board for approval the members of the Science Leadership Team.
- Meet all reporting, review and record keeping requirements of the NSC Investment Contract or the BBHTC Board, associated with the management and performance of the BBHTC Challenge.
- Coordinate, support and monitor management of the Subcontracts for Challenge funded projects, including Challenge projects undertaken by the Challenge Contractor. Approve and monitor expenditure against the approved budget within delegated authority.
- Coordinate and monitor projects supported through Aligned Research and Party resources so they are guided by the BBHTC Research Plan and priorities.
- Performance manage the overall programme of work to ensure integration of the Challenge Research and Related Activities, stakeholder engagement and technology transfer, international collaboration, and that the outcomes sought by the Ministry are achieved over the term of the NSC Investment Contract.
- Oversee any Challenge Hui, meetings or workshops, including community engagement and outreach, and address or delegate Challenge media and publicity.
- Ensure that the Challenge is giving effect to Vision Mātauranga.
- Implement a re-prioritisation process to enable response to any change event that would affect the ability of the Challenge to meet its objectives and Mission. Such change events could include review results, loss of research capability or logistics, changes in national strategy or Challenge funding levels.
- Maintain overview of relationships with relevant stakeholders and promote activities that champion its value to external stakeholders.
- Provide input into performance management of the Challenge manager and administrative support.

3.4.2 Science Leadership Team

The Science Leadership Team (SLT) comprises science leaders with track record of excellent programme management and project delivery (the members of this team are listed in Section 1.4.2.3). The Director will recommend the members of the SLT to the Board for approval. Members of the SLT will be appointed for a term of three years in the first instance. There will be a subsequent rotation, at which time members with skills deemed highly relevant to ensuing phases may be selected for a second term, as approved by the Board. The SLT will comprise:

- Challenge Director (Chair) (up to 1FTE)
- The Leader of each BBHTC SRA within the Research Plan and any other members deemed necessary by the Board

The Science Leadership team will be responsible for:

- Overseeing the strategic planning process in the establishment phases of the Challenge;
- Driving the delivery of high-value, high-impact research and promote relevant research linkages;
- Setting strategic priorities for the Research Plan and allocating resources accordingly;
- Monitoring and reporting regularly to the Challenge Board – via the Director – on performance against the terms of the MBIE contract;
- Embedding the principles of Vision Mātauranga in the Challenge;
- Identifying issues/risks (constraints to delivery, high-risk research) and methods of risk mitigation; and
- Facilitating internal and external communication, engagement and public outreach.

The Director will Chair meetings of the SLT and seek majority rule consensus decision making on all issues. Where a consensus cannot be reached, the Director may seek other advice and inform the Science Leadership Team of his/her proposed decision to ensure decisions are made in a timely way. If the decision of the Director is not acceptable to any member of the Science Leadership Team, they may request a review from the Chair, who may confirm the Director's decision or refer the matter to the BBHTC Board.

3.4.3 Challenge Manager

As noted, the Challenge will be led by its Director who will chair the Science Leadership Team. The Director will be supported in Challenge operations by a Challenge Manager (.6FTE) and Challenge administrative support (0.2FTE). The Challenge Manager and Administrative support will be recruited through normal HR processes, including advertising with a formal job description and assessment of candidates by the Director.

The Challenge Manager will be responsible for:

- Day-to-day management;
- Actioning decisions of the SLT;
- Establishing and implementing Challenge policies and processes (such as contestable funding rounds, communications and events);
- Managing the performance of the research portfolio and associated funding;
- Ensuring that funding is allocated through appropriate contracts;
- Co-ordination and receipt of reports on research projects; and
- Supporting the Director with reporting to the Governance Group and MBIE.

3.4.4 Project Management Arrangements

The Challenge Contractor is well-placed to translate its experience in successfully managing large-scale, long-term research funding portfolios. It has experience of employing demonstrated programme management approaches such as centralised project information storage, regular 'dashboard' reporting on KPIs, 'red flags' and standardised approaches to managing projects not meeting milestones.

The Challenge Contractor will apply its corporate protocols to Programme and Project management, budgeting, auditing, subcontracting, invoicing, quality assurance, reporting, and forecasting to the Challenge. In consultation with the Challenge Board, the Challenge Contractor will review (and if necessary revise) its risk management and monitoring framework for application in the Challenge.

Individual organisations with projects funded through the Challenge will be required to implement their own project management systems, and BRANZ will use its project management system to manage subcontracts and activities of the multiple research providers involved, including reporting, timelines and performance monitoring.

3.4.5 Science Review

Science reviews will take place as described in Section 2.10 on Research Quality. The form of reviews will be agreed by the Board. The Director and SLT will be responsible for implementing any reviews, providing a report of the findings of the review and outlining any required adjustments to the Research Plan and/or activities accordingly. Any proposed responses and/or changes in response to any review will be submitted by the Director to the Board for approval.

3.4.6 Financial Management

The Challenge Contractor and other Parties are significant organisations with a track record of financial stability. Challenge Funding will be managed on behalf of the Parties by the Challenge Contractor, BRANZ, which has extensive experience in managing large-scale research programmes and public research funds and brings demonstrated financial controls; robust monitoring, reporting and evaluation processes to the Challenge. The draft Challenge budget is provided in Appendix 3. The budget will remain draft until executed via the Challenge Programme Agreement.

The Parties are committed to maximising the amount of Challenge funds used to support Challenge research projects and related activities. Principles that will guide financial management within the Challenge will include:

- **Challenge Contractor Responsibilities:** BRANZ as the Challenge Contractor, will be responsible for, and cover, the costs of managing the NSC Investment contract with MBIE, and the administration and sub-contracting of Challenge funds. BRANZ has well established financial and project management systems to manage and monitor the Challenge funding envelope, which meet company audit standards. Based on these systems, it will provide reports on expenditure against budget to the Challenge Director, who shall report financial information no less than quarterly to the Challenge Board, including identifying any variances against budget and providing sufficient explanations.
- **Challenge Funding:** will be managed according to Challenge Contractor procurement policies and delegations and the Challenge Contractor will regularly monitor and audit funds for unusual expenditure and provide financial reporting on use of Challenge Funding to the Challenge Director and the Challenge Board. The Challenge Contractor will maintain discrete accounts for Challenge Funds within its financial system. Funds may be transferred from these accounts to Challenge Parties in line with researcher participation in Challenge Programmes, as defined in subcontracts between the Challenge Contractor and respective Challenge Parties. This approach retains flexibility to integrate aligned/co-funded work with Challenge-funded work and supports the Challenge's focus on achieving outcomes (not outputs).
- **Challenge Administration Costs:** any overheads will be charged at the standard overhead rate according to the Challenge Contractor's internal policies and practices.
- **Challenge Board Costs:** Remuneration rates for members of the Board are based on standard rates for Crown Directors. The total cost of the Board is not expected to exceed $80k per annum.
- **Challenge Kāhui Māori & Independent Science Advisory Panel Costs:** the costs of travel of these members to meetings will be covered.
- **Challenge Director, Science Leadership Team and management costs:** the salary and direct costs of the Challenge Director and Challenge Manager will be covered by Challenge funding. Direct costs (travel and accommodation) for the Science Leaders will be covered by Challenge funding, along with up to 0.05 FTE of time commitment above and beyond any SRA/project commitments.
- **Full Cost Funding:** all projects and activities are expected to be fully costed, including any cost of capital. In principle, funds will not be used to fund capital expenditure, and any required capital equipment is to be provided separately by the Parties and participants in the Challenge.
- **Co-Funding:** is expected to be secured and managed via the participants in the Challenge.
- **Sub-contracting:** appropriate sub-contracts, consistent with the purpose and principles of the Collaboration Agreement, will be negotiated by BRANZ with each organisation receiving Challenge funds. This will take place after the Challenge Programme Agreement is put in place. Payment of the funds will be based on invoices received from subcontractors on provision of information to satisfy monitoring requirements of the Challenge contractor.
- **Research funding:** all research funded by the Challenge will be approved by the Board on the recommendation of the Director, subject at all times to the NSC Investment Contract. Access to Challenge Funding will be open to all research capability

in NZ with relevant expertise to the Challenge Mission, Objectives and Strategic Research Areas. International research partnerships are expected as part of the best team approach and Challenge funding can be made available to support these relationships. The Challenge Director and Science Leadership Team will have responsibility for managing research funded by the Challenge Funding Envelope. In practice, this will involve leading teams of researchers drawn from multiple Challenge Parties, as specified in subcontracts between the Challenge Contractor and respective Challenge Parties. Integrating aligned or co-funded research activity from the various Challenge Parties will be a critical feature of this research leadership.

  - Research funding will include staff salaries, direct costs and indirect costs at the standard overhead rate of the subcontracted organisation according to its internal policies and practices.
  - PIs are expected to contribute at least 0.2FTE to a project unless specifically negotiated otherwise.
  - There is a clear expectation given that the funding should be applied to the cost of research, rather than creating a large leadership group.
- **Contestable Funding:** the Board will put aside a minimum of 5% and a maximum of 25% of the available Challenge research funding and make these funds open to contest by all NZ-based researchers/research organisations for the purpose of providing opportunity for the inclusion of new researchers/capability/research refresh within the Challenge. The Board will work with the Director and SLT to establish a robust contestable process which will include a Quick Response Mechanism as well as biennial funding (as described in Section 1.3.5).

Prior to each financial year the Director will prepare, and submit to the Challenge Board for approval, a budget for the use of the Challenge Funds. The budget will provide for:

- **Administration Funding:** to cover the Challenge administration and management costs:
  - payments to the Challenge Board, Kāhui Māori, Independent Science Advisory Panel
  - salary costs of the Director and Challenge Manager,
  - general administration costs, travel, accommodation, event management, promotions and other agreed direct costs
  - if included, indirect costs of the Challenge administration and management.
- **Research Funding:** for approved research or related activities, administered by way of subcontracts. Research funding includes:
  - research funding for approved research or related activities by way of internal research project within the Challenge Contractor
  - research co-funding provided by the Challenge Contactor, a Challenge Party or another Party for a specific Challenge project.
  - contestable funding.

3.4.7 Indicative Budget

The indicative budget for the first funding period (CPA 1) up to 30 June 2019 is $23.1M (available funding of $23.585M minus commencement phase funding of $489K), and $24.325M for the period 1 July 2019-30 June 2024. The budget is provided in Appendix 3 and has been adjusted to accommodate a small forecast underspend in commencement phase investment.. This budget has been calculated on the basis that, if approved, research funding will start from January 2016.

The budget allows for the fees and direct costs of the Governance Group members. There is provision for salary and salary related costs (including overheads) for a Director (1FTE) and Challenge Manager (0.6FTE), with 0.2FTE and 0.2FTE allocated for administrative support and finance/corporate support, respectively. To ensure it achieves its circuit-breaking goals, the Challenge will maintain strong relationships through interaction and engagement including in-person meetings, hui, tele- and videoconferencing between Challenge operations, governance, the Science Leadership Team, advisory groups (Independent Science Advisory Panel, Kāhui Māori, stakeholders), and with the broader Challenge stakeholders as New Zealand public over time. The indicative budget includes costs for travel to meetings and workshops, costs for venue hire and catering, and for ongoing communications costs (as outlined Communications Plan).

Research projects have been costed, applying personnel rates and overhead rates, based on established practice relevant to each research institution. There was a clear expectation given that the funding should be applied to the cost of research, rather than creating a large leadership group.

The indicative budget does not include co-funding for research projects from third parties that is not received by the Challenge as this funding is or will be received and managed by the party receiving the funding.

We will regularly (at least annually) review the budget, as funding commitments to Challenge projects are confirmed. Annual budgets for the Challenge will be developed by the Science Leadership Team for consideration and endorsement by the Governance Group, and final approval by the Challenge Contractor.

3.5 Risk management

This risk register (Table 13) is based on an assessment of Challenge risk as at October 2015. The risk register will be maintained by the Director and provided to the Governance Group as a standing item at Governance Group meetings. At the time of agreeing a new Challenge Programme Agreement this register will be revisited in depth.

Risk Category and Description	Potential Impact	Likelihood	Impact	Proposed Risk Management/ Mitigation strategy	Risk Manager(s)
Significant delay or failure in recruiting high quality independent Governance Group (GG) Chair.	• Lack of independence in commencement phase. • Delay in appointing GG • Delay in appointing Director • Delay in getting input to • Challenge Governance and Management arrangements. • Reputational risk to the Challenge.	Medium	High	• Parties use existing networks to identify prospective candidates and move quickly to appoint GG Chair. • Continue to utilise existing interim governance arrangements (IGG).	Chair of Interim Gov. Group (IGG), IGG
Failure or significant delay in recruiting Governance Group members.	• Lack of independence in commencement phase processes. • Delay in getting input to Challenge Governance and Management arrangements. • Risk to delivery of initial Challenge activities • Reputational risk to the Challenge.	Medium	Medium	• Chair and Parties use existing networks to identify prospective candidates and move quickly to appoint GG members • Continue to utilise existing interim governance arrangements (IGG) as needed. • Work with MBIE to ensure clear communication around status and progress.	Chair of IGG, IGG
Failure or significant delay in recruiting high quality Director	Slower progress in implementing the Challenge. Risk around ability to meet Challenge deliverables within acceptable timetable.	Medium	Medium	• Recruitment has begun during commencement phase. • Interim Director(s) to remain in place to maintain Challenge focus through IGG, SLT.	Chair of IGG, BRANZ

Failure to get agreement of all Parties to Collaboration Agreement	Ability to proceed to contracting with Parties is placed at risk while Agreement is re-worked. Loss of support from MBIE.	Low	Medium	The Collaboration Agreement has been agreed in principle by the Challenge Parties (subject to any changes required post assessment/Science Board)	Chair of IGG, IGG members
Disagreement on the Challenge SRA priorities contained in the proposal	Loss of support from Challenge Parties and other organizations who have been involved in the submission of the application and Outline	Low	Medium	• Development of SRAs through open and clear prioritization model. • Science Leadership Team involvement across development of all SRAs. • Independent science review to support SRA choices.	Chair of IGG, SLT
Challenge proposal fails to realise initial proposal strengths, potential and promise around Vision Matāuranga	Loss of support from Challenge Parties, Māori researchers and key stakeholders. Damage to relationships which undermines future Challenge delivery	Medium	High	• Strong engagement with Māori throughout development of proposal. • Significant contribution to SRA development and Challenge leadership by Māori Science Leadership team. • Further development of Tane Whakapiripiri framework to underpin the Challenge.	Chair of IGG, SLT
Failure to create the right conditions for effective industry transformation	Inability to translate research in to meaningful solutions/change.	Medium	Medium	• Designing and agreeing on SRAs and outcomes To look beyond research to include pathways through to outcomes for the built environment. Recognition by Challenge participants that research activity per se is only one element. • Work carried out (and will continue during	SLT

				more detailed project scoping and initiation) on the identification of the best-placed partners to carry out the activities that the Challenge isn't best placed or mandated to deliver. • Securing "mission critical" partners to sign up to a proposed research and delivery programme during the commissioning and detailing of Challenge research.	
Failure to build on the framework and the new approach to *BBHTC* research **(as articulated in the initial proposal) during research plan development.**	• Loss of support from Challenge Parties and stakeholders involved in the initial submission and development of original mission and vision. • Lack of support for the research plan by MBIE Science Board or by assessment panel. • Loss of support for the Challenge from MBIE	Low	High	• Build on strengths of initial proposal • Clearly identify how new proposal has responded to feedback from Science Board and Assessment Panel • Maintain clear focus in directions from IGG and SLT to build on the original Challenge framework. • Ongoing and regular engagement of Parties and stakeholders in development of research plan. • Regular engagement with MBIE officials during development process.	IGG, SLT

Table 13 Risk Register

3.6 Open data

The underlying purpose of the Challenge is to create benefit to New Zealand by delivering on its Mission. With this in mind, all Parties to the Challenge will adhere to the principles of the Data Management Plan (DMP) outlined below, which lies in accordance with the New Zealand Government Open Access Licensing framework (NZGOAL) and the New Zealand Data and Information Management Principles (NZDIMP):

- The Challenge is committed to the principle of open access to publicly funded research data and information, with an emphasis upon the public dissemination and access to the Intellectual Property (IP) generated by the Challenge. Subject to ethical, privacy or cultural reasons, or issues of commercial sensitivity, publicly funded research data from the Challenge will be made open for public access and re-use.
- Insofar as practicable, data will be captured and stored in a suitable format for long-term information management.
- Supporting metadata and other documentation will be accurate and comprehensive
- An accessible repository of research data created or held by the Challenge will be made available to the public, with search mechanisms in place to permit the discovery, access to and reuse of research data.
- Data and information will be released:
    - At source, with the highest possible level of granularity
    - In re-usable, machine-readable format(s)
    - With appropriate metadata; and
    - In aggregate or modified forms if they cannot be released in their original state.
- Data and information released in proprietary formats will also be released in open, non-proprietary formats.
- Digital rights technologies will not be imposed on materials made available for re-use.

The above principles do not preclude Parties to the Challenge from reserving the right to charge for data and its manipulation, or to recover costs relating to provision of access to data or its interpretation. Parties may also restrict data access within the Challenge for a limited period after data collection to enable publication of research findings and appropriate quality assurance

3.7 IP management

Emphasis will be given to public dissemination and access to the Intellectual Property (IP) generated by the Challenge. The expectation is that Māori, key stakeholders and end-users will be actively involved with the Challenge (most commonly through co-funded projects) and that they will be able to freely engage with, adopt and make use of research findings for sector, iwi and community benefit. That said, some Challenge-funded research may result in commercially applicable IP.

Arrangements for ownership and protection of IP and publication are agreed through the Collaboration Agreement (Appendix 2). The principles, below, give due consideration given to the open-access principles to which the Challenge Is committed:

- Challenge Project IP shall be dealt with in the best interests of New Zealand. Subject to ethical, privacy or cultural reasons, or issues of commercial sensitivity, publicly funded research data from the Challenge will be made open for public access and re-use in accordance with the New Zealand Government Open Access Licensing framework (NZGOAL) and the New Zealand Data and Information Management Principles (NZDIMP). Projects undertaken in the Challenge that generate data and/or information will be required to give effect to the application of open access principles, standardised data and metadata management, and data federation and interoperability techniques.
- Where Challenge Project IP does not have any expected future commercial application, Parties will provide open access to relevant Project information to the public.
- Pre-existing IP will remain the property of the owner who shares it for research purposes.
- Cultural IP (Mātauranga Māori) treated as proprietary, which is contributed or developed as a result of collaboration with Māori, remains, as appropriate, in iwi, hapū or whānau ownership.
- Where a Challenge Project seeks to use such Mātauranga Māori, the Parties involved in that Project will consult with relevant iwi, hapū or whānau to reach kotahitanga (consensus) on how the IP is to be used in the Project.
- Challenge Project IP arising from a research project will be owned by the Party or Parties that create(s) it, and they will be responsible for protecting, managing and commercialising that IP.
- Jointly-created Challenge IP suitable for commercialisation will be assigned to the Challenge Contractor through a process of agreement of all the Parties involved in its creation. The Challenge Contractor will be responsible for protecting, managing and commercialising that Challenge Project IP and sharing revenue with the joint creators as agreed.
- The IP owner of any Challenge IP not suitable for commercialisation will provide a non-exclusive, royalty-free license to other Parties, as relevant, for the purpose of undertaking research or educational purposes related to the Challenge.
- All Challenge IP will be reported to the Challenge Director, who will keep a record of this for reporting purposes.

3.8 Monitoring and Evaluation

3.8.1 General principles

The major Outcomes of the Challenge will be realised through the uptake and application of research outputs by stakeholders in areas including, policy, behaviour change, practice and regulation. We are developing a Challenge specific framework for evaluating fidelity of the research programme and assessing progress towards Challenge outcomes. The framework is informed by work previously developed by Motu (Jaffe, 2015) and is in keeping with the established MBIE framework to ensure seamless reporting and impact evaluation.

A set of key principles drawn from Motu's work has guided the development and structure of the Challenge evaluation framework including:

- **Stakeholder participation**: There are many stakeholders with an interest in the Challenge's progress, but they may hold differing expectations. Therefore, their perspectives will be part of the construction of the evaluation framework and in measuring Challenge outcomes.
- **Assessing consequences:** By introducing performance and other measurement metrics into a system, there is a risk of unintended consequences, such as a focus on metrics rather than on what the metrics are supposed to be indicating (the big picture). Many organisations, including Statistics NZ, Land Information New Zealand (LINZ), BRANZ, regional and local government agencies and the private sector, already collect a range of qualitative and quantitative metrics that may be relevant to the Challenge. Where possible and appropriate we will use existing metrics and indicators and we will work with stakeholders to agree common metrics that allow evaluation across groups of projects.
- **Taking a systems approach:** The evaluation framework is being developed to cover all aspects of the Challenge, to allow analysis at key decision making points.
- **Isolating *"treatment effects"*** where possible. It is important that we strive to assess the extent to which the Challenge has a causal influence on any outcomes achieved over its timeframe, as opposed to outcomes that may have reasonably expected to occur in the absence of a Challenge input. This requires the ability to conceptually separate the contributions of the Challenge from other potential factors that might affect outcomes. In the course of evaluating outcomes we will ensure, as far as reasonably possible, that we include evidence that an impact would not have occurred if the Challenge input had not occurred.
- **Using multiple lines of evidence:** No single data source or type will be sufficient to establish progress and evaluate impact in our Challenge. Therefore, the evaluation design will use mixed methods to gather qualitative and quantitative information that demonstrate patterns and give confidence in causation.
- **Timeliness:** The lag between research and its impact can be long and is always uncertain. This lag effect can mean that significant effects of the Challenge may be under-valued at early evaluations. Therefore we will use the outcomes model to identify intermediate outputs and proxy measures that are indicators of progress and likelihood of eventual benefits being realised.
- **Integrate with reporting systems:** KPIs and evaluation processes will be integrated with reporting systems, including the BRANZ Strategy Monitoring and Reporting Framework, and the MBIE NSC reporting framework to facilitate any necessary decision-making.
- **Provide resources for evaluation:** Resourcing, including funding outside expertise, where appropriate has been allocated within SRA and overall Challenge financial planning. In line with principles two, three and four we will evaluate the measures and metrics in the framework regularly to ensure that the framework remains fit for purpose.

3.8.2 Evaluation framework

We will use the evaluative framework described in Section 1.7 to assess delivery to and towards Challenge Outcomes. We will thus ensure that the value, merit and worth of the Challenge activities deliver to the Challenge Outcomes through:

- The research findings and processes at the level of projects, Strategic Research Areas and across the breadth of the Challenge
- Mātauranga Māori leadership, engagement and contribution
- A collaborative interdisciplinary approach.

The evaluation will be conducted as an ongoing three yearly cycle consisting of:

- formative planning and review in preparation for the next phase of the Challenge

- assessment of how the Challenge is being implemented in practice
- review of progress towards Challenge outcomes.

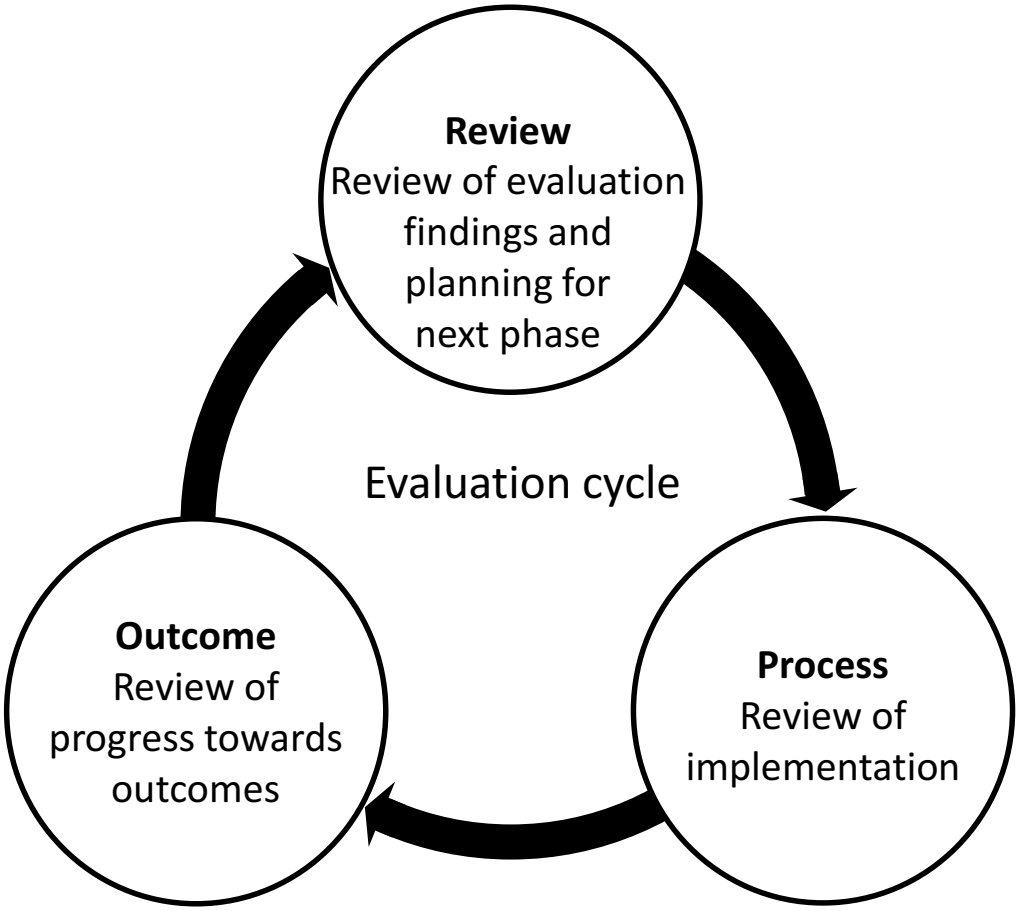


Figure 9 Evaluation cycle.

Planning and review

To develop the Challenge proposal we have we have effectively completed the first stage of the cycle by engaging with stakeholders, reviewing evidence, and convening meetings to plan the research programme for the Challenge presented in this document. The next planning and review phase will be scheduled for 2018. A this time we will review process and outcome evaluation findings to date, identify any emerging issues or opportunities and work in partnership with key stakeholders to develop and refine the research programme for the next [three] year cycle. Key questions for the planning and review phase will include:

- To date what has worked and what has not
- Are we achieving the results we expected?
- Is the Challenge producing unexpected results?

- Are there any emerging issues?
- How can we include the above questions to further develop or refine the research programme?

The planning and review phase will also be an important opportunity to engage the wide range of stakeholders who have had input in to the present proposal to ensure that Challenge continues to be of relevance to their work.

Process evaluation

An important feature of the Challenge is the co-production of research with stakeholders at a range of levels from small communities through to central government. As such how the Challenge is conducted is as important the research findings it produces. In addition to the standard evaluation and monitoring requirements (e.g. stakeholder surveys) we also conduct evaluation activities focused on:

- Whether the SRAs are being implemented as intended
- Documenting any rationale for changes to the how the SRAs have been implemented (and whether the change is justified)
- Assessing stakeholder perspectives of how the Challenge is being conducted, their experiences of the Challenge, and whether it will produce useful results.
- Recommendations for how the SRAs could be refined to ensure achievement of key outcomes.

The Science Challenges provide a unique opportunity for a diverse range of researchers, communities, and stakeholders to work in existing and new collaborations which identify opportunities where research can improve homes, towns,and cities and then to conduct the resaerch. As such the potential of BBTHC to be a knowledge incubator for researchers, communities, and other stakeholders alike is a fundamental principle underpinning the whole Challenge. Understanding how the Challenge enables 'knowledge incubation' will also be an important component of the process evaluation. This will be explored as part of assessment of stakeholder perspectives, interviews with researchers engaged in the Challenge, and a review of outputs that the Challenge produces. Findings will be included as part our reporting to MBIE against the overarching Challenge questions.

Research findings and processes delivering to Challenge Outcomes

The high level goal of NSC11 is to deliver outcomes, which exist at multiple scales, and which collectively lead to achievement of the Challenge Mission and Vision. The Outcome Model (Figure 6, Section 1.7) displays these in the white boxes at the right hand side. Challenge Outcomes will not all be measureable in the lifetime of a Strategic Research Area or indeed the Challenge, but they provide the purposeful framework for the projects and research questions that will be investigated under the auspices of the Challenge. The logic underpinning the outcomes model will act as a proxy for predicting longer term change.

What is measureable are the outputs and in many cases their immediate impacts (e.g. references to Challenge publications in local government planning material) from the Strategic Research Areas (SRAs) as described in the text of Section 2, which have been designed such that they deliver to the Outcomes, and progress towards achieving Challenge outcomes. Each SRA is inter-connected with all of the other SRAs. Therefore rather than evaluate each SRA independently we will conduct a meta-evaluation across all of SRA outputs outputs (and where possible immediate impacts). This will provide a mechanism for narrating the inter-related and collective contributions to knowledge that the Challenge projects seek to provide. (A visual outcomes model of this meta-evaluation is under development).

We will develop specific evaluation and monitoring plans for each SRA to project level in the first quarter of 2016. SRA research teams will work with the evaluation team to develop the SRA models. The Director, Science Leadership Team and the evaluation team will work collectively to develop the cross SRA and challenge level models and the KPI framework layer.

We will assess research quality, and its impact on delivery of Outcomes, as described in Section 2.10.

Matāuranga Māori Leadership, Engagement contributing to Challenge outcomes

Vision Mātauranga is woven through all of the Challenge spaces and places both conceptually and in relation to specific projects. The importance of producing meaningful and useful outcomes for Māori is demonstrated in specific outcomes for Māori identified in the outcomes model. Māori heritage is also one of the key factors that make a homes, towns, and cities unique in the world. We firmly

believe that Matauranga Māori, and Māori values woven in to our proposal will not only benefit the Challenge but our towns and cities as a whole. We will measure the impact of kaupapa Māori Research with the Mauri Model Decision Making Framework (Morgan 2013. The relevance of the Mauri Model Decision Making Framework in this context is that it:

- is oriented to align with the purpose of the Resource Management Act
- facilitates assessments of four dimensions of Mauri, that parallel the four well-beings considered by decision makers acting under the auspices of the Resource Management Act (1991) and the Local Government Act (2002). The Mauri dimensions are Ecosystem Mauri (environmental well-being), Iwi Mauri (cultural well-being), Hapori Mauri (social well-being) and Whānau Mauri (economic well-being). The alignment reflects the context within which the well-being impacts are experienced.

The framing of the Challenge in this manner will facilitate holistic approaches to research, necessitated by identified indicators within stipulated dimensions.

The framework for measuring success of the whānaungatanga outcomes is represented in the Visual Outcomes Modelling (Figure 10).

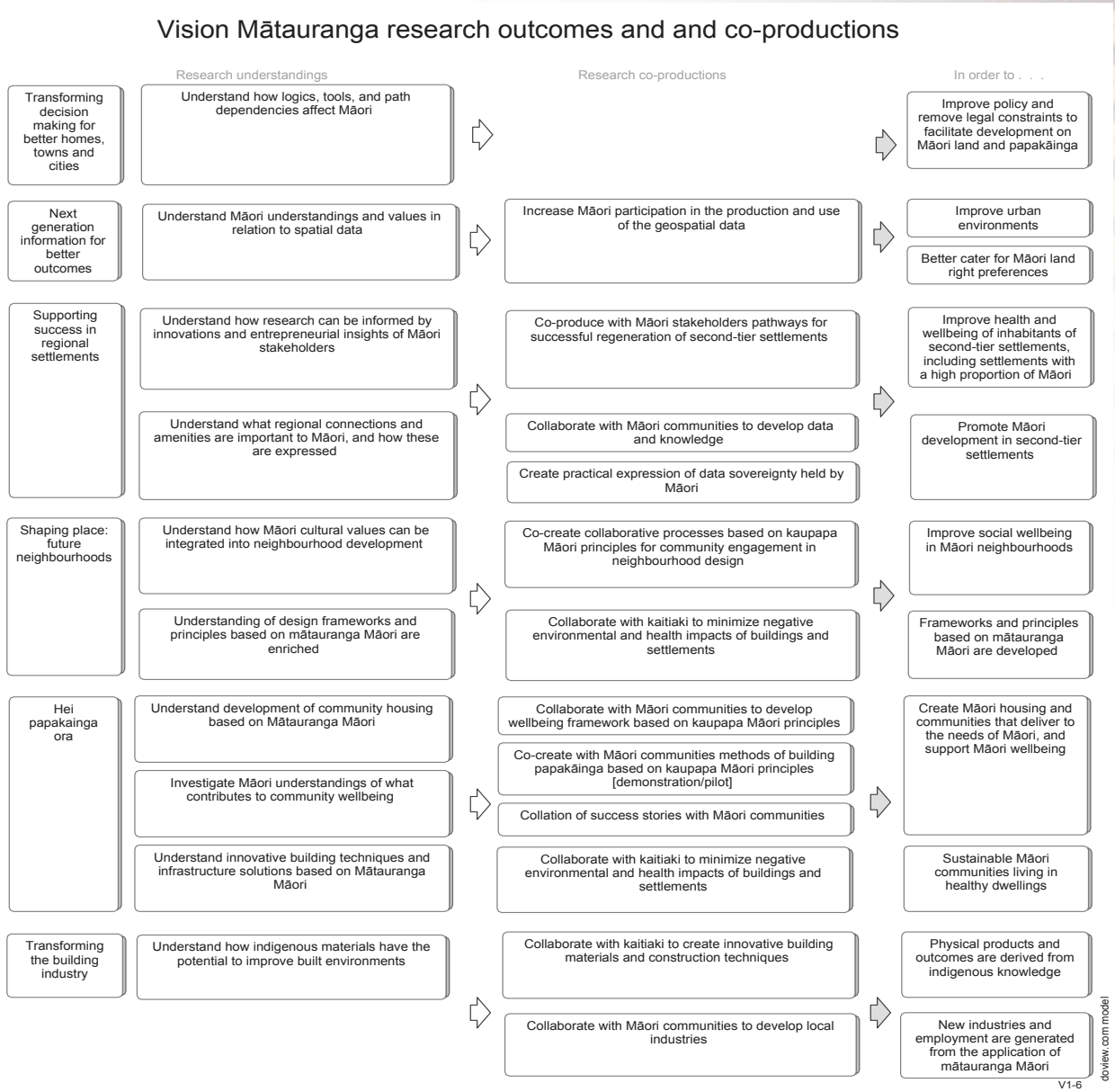


Figure 10 Representation of the expression of Vision Matāuranga within the outcomes model.

3.8.3 Reporting

Starting in Year 2 of the programme we will begin reporting progress against the framework on at least an annual basis. A comprehensive review of Challenge progress towards delivery of the outputs and achievement of high level impacts will be carried out at annually.