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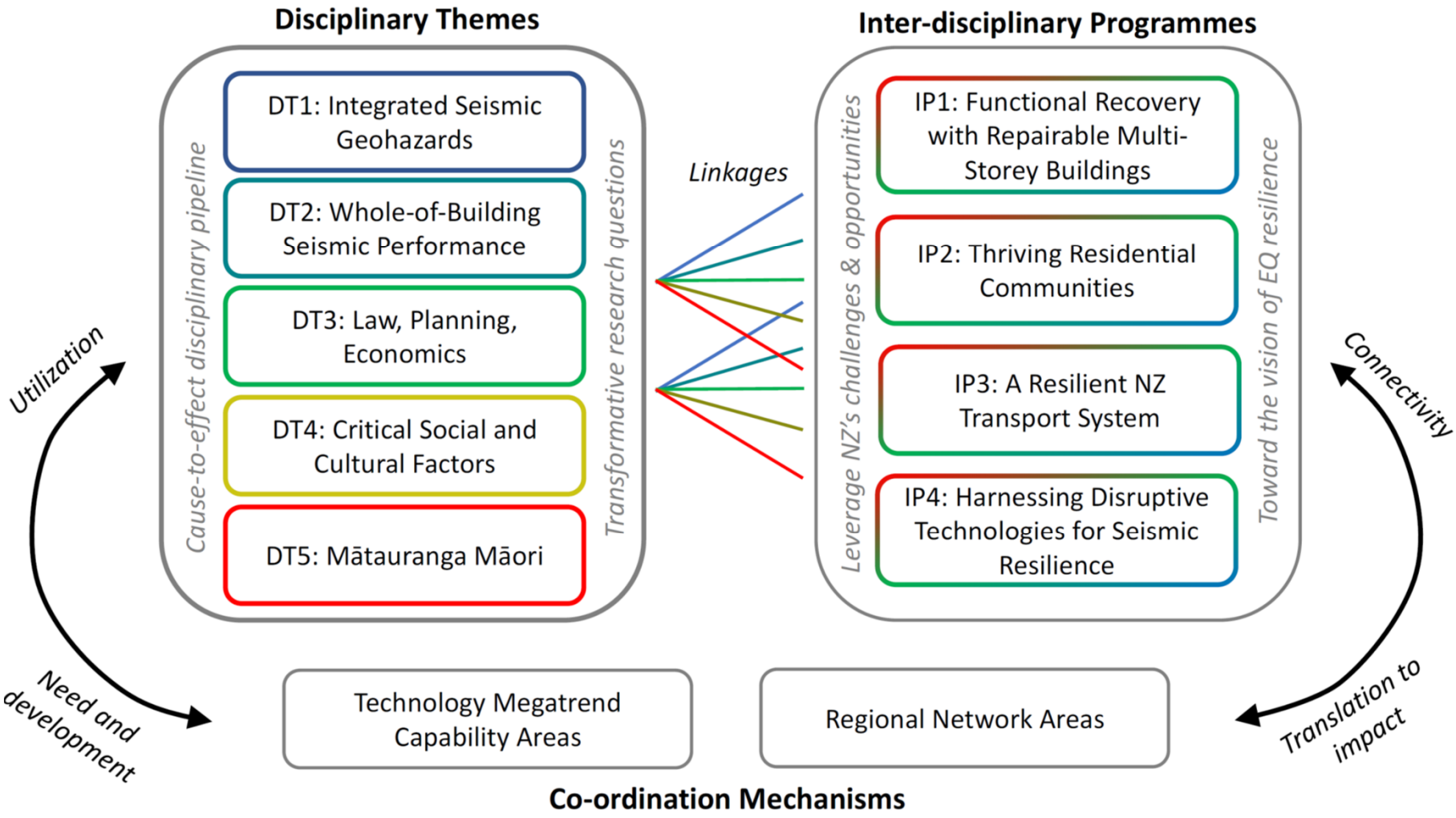
Te Whare Wananga o Waitaha
CHRISTCHURCH NEW ZEALAND

QuakeCoRE
NZ Centre for Earthquake Resilience

QuakeCoRE Rebid Update

1. Welcome & Update on QuakeCoRE rebid (Tim)
2. Whole of Building Seismic Performance (Rick)
3. Functional Recovery with Repairable Multi-Storey Buildings (Ken)
4. NZSEE Resilient Buildings Project (Helen)
5. Closing discussion (ALL)

à QuakeCoRE has been shortlisted for next stage of CoRE approval process.


Disciplinary Themes
DT1: Integrated Seismic Geohazards
DT2: Whole-of-Building Seismic Performance
DT3: Law, Planning, Economics
DT4: Critical Social and Cultural Factors
DT5: Mātauranga Māori
Cause-to-effect disciplinary pipeline
Transformative research questions
Linkages
Inter-disciplinary Programmes
IP1: Functional Recovery with Repairable Multi-Storey Buildings
IP2: Thriving Residential Communities
IP3: A Resilient NZ Transport System
IP4: Harnessing Disruptive Technologies for Seismic Resilience
Leverage NZ's challenges & opportunities
Toward the vision of EQ resilience
Utilization
Need and development
Connectivity
Translation to impact
Technology Megatrend Capability Areas
Regional Network Areas
Co-ordination Mechanisms

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QuakeCoRE Grand Challenge:

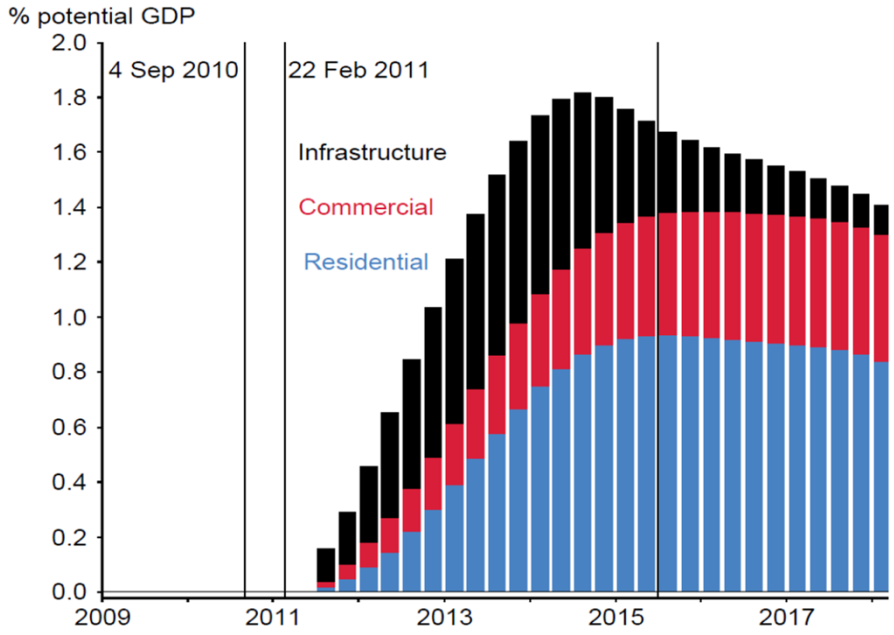
Resilient Homes

Tim Sullivan

Why residential buildings?

à New Zealand's residential buildings satisfy life-safety needs.

à However, residential = $16 billion of $40 billion total rebuild cost!



Source: Statistics New Zealand and RBNZ estimates.

Figure from Wood et al. (2016)

à Housing damage also has negative social impacts.

à NZ is in process of building 100s of thousands of new houses… likely to be just as vulnerable!

Research Questions

- What are the structural and geotechnical engineering innovations that can lead to a drastic reduction in earthquake-induced physical damage to housing?
- How can land use planning and geotechnical engineering be synthesised to avoid the construction of new housing in highly vulnerable areas?
- How can lifeline infrastructure servicing residential areas be fortified in a cost-effective manner? What are the policies that can drive the development of new earthquake-resilient housing and communities; and incentives, or public awareness initiatives, for owner-funded retrofit of existing housing?
- Is there a mismatch between owner/tenant expectations of housing earthquake resilience, and, if so, how do communities feel that addressing this should be financed?

Main engineering research objectives

Underpinning engineering research is needed to develop new and improved construction materials, methods, and design procedures, that can lead to improved performance via prescriptive standards and legislation.

Specific research objectives that will be considered include:

(i) Identify transformative changes to traditional housing and foundation systems that mitigate losses and disruption in future earthquakes;

(ii) identify new single-dwelling and medium density housing construction solutions that offer the potential of accelerated construction speed and quality control,

(iii) develop cost-effective retrofit solutions for existing buildings.

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Thanks
Kia Ora

Disciplinary Themes: Research areas that collectively span the disciplinary pipeline of earthquake resilience and focus on transformative research questions in which NZ researchers have shown global leadership.

DT1-Integrated Seismic Geohazards: Advance understanding and modelling of individual earthquake-induced geohazards (ground motions, liquefaction, and slope instability), as well as unified data collection and modelling approaches to enable an integrated prediction in order to more efficiently mitigate future impacts and stimulate rapid advances in the profession.

DT2-Whole-of-Building Seismic Performance: Develop fundamental understanding, and methods and models for the quantification of, whole-of-building seismic performance through direct consideration of structural and non-structural component interactions, as well as advances in seismic design and assessment considering life-cycle analysis.

DT3-Law, Planning, Economics: Investigate economic impacts of earthquakes, and create the evidence base to inform regulation for effective planning, policy and mitigation to build resilience - including whole-of-economy earthquake impact modelling, assessment of specific resilience-building legal and planning tools and processes, and behavioural 'nudges' to incentivize resilience.

DT4-Cultural and Social Factors Shaping Resilience: Collaboratively understand, model and improve the critical cultural and social factors determining societal resilience to earthquakes in NZ, including human responses to earthquakes, temporal and spatial variation of risk, and building an earthquake-resilient society.

DT5-Mātauranga Māori and Earthquake Resilience: Community-led and co-designed participatory research to create and innovate mātauranga Māori (Māori knowledge) that will facilitate achievement of the earthquake resilience aspirations of tangata whenua. Knowledge translation of research findings will encourage increased understanding within QuakeCoRE, of iwi, hapū and whānau perspectives on earthquakes and disaster risk reduction.

Inter-disciplinary Programmes: Inter-disciplinary research that leverages NZ's unique situation and challenges to advance the vision of earthquake resilience. These programmes draw on expertise in multiple disciplinary themes.

IP1-Functional Recovery with Repairable Multi-storey Buildings: Repair of earthquake damage is a critical component to the recovery after an earthquake disaster. After recent events, the time to return the commercial and industrial building stock to functionality has been hindered by the lack of understanding of residual capacity and repair. This programme will identify time-to-functionality targets and repairable building solutions, thus providing the underlying science to support the development of the world's first functional recovery-based seismic design standard.

IP2-Thriving Residential Communities: The Canterbury earthquakes illustrated the potential for large financial losses ($16B of $40B total) and multi-year disruption to NZs residential sector, with significant implications on mental health and the disaster insurance market. This programme will tackle the problem of resilient housing – including effective engineering and technological solutions, land-use planning, improved insurance processes and frameworks, effective legislation, and communication and engagement strategies.

IP3-A Resilient NZ Transport System: A resilient transport and logistics system is critical to the ongoing and future viability of businesses and communities across the country, supporting the efficient movement of goods and people. This programme will integrate component- and system-level modelling of networks and their users, consider interaction between different transport and logistics modes, and the social and economic impacts of disruption, to inform policy and investment decisions on the transport and logistics systems of the future.

IP4-Harnessing Disruptive Technologies for Earthquake Resilience: This programme will identify how transformational (i.e. order of magnitude) advancements in NZs infrastructure resilience can be achieved through strategic adoption of disruptive technologies, via government and market-led initiatives. A central hypothesis is that rapid adoption of several disruptive technologies (e.g. distributed solar power) will result in a significantly greater resilience gain than the conventional wisdom of incremental investment to improve existing asset classes (e.g. centralized transmission networks).