

Construction 4.0 in Aotearoa

An ambitious research programme in Aotearoa into transforming our construction sector using an Industry 4.0, data-driven approach that also considers indigenous views will have an impact globally.

BY DR TROY COYLE, CEO, HERA

A 4-year research project focused on transforming the construction sector in Aotearoa New Zealand using Construction 4.0 is being undertaken by HERA.

The need for a large-scale, long-term project to transform Aotearoa's construction sector is long-standing – there is plenty of data and knowledge, but it is not connected, optimised or easy to apply. This is a huge, technically challenging project requiring an Industry 4.0 approach. Industry 4.0 is also known as the fourth industrial revolution.

What the transition to Construction 4.0 means

The new technologies of the fourth industrial age are required to transform construction from a linear to a circular system known as Construction 4.0. This provides the construction industry with a decentralised connection between the physical space and the cyberspace via ubiquitous – on-demand, seamless and secure – connectivity. Consequently, the problem is one of big data management and connectivity.

Currently, there is a profound limitation in the way we perform construction in Aotearoa. Complex decisions are made based on simple data inputs and in linear silos with little inter-connection or data-derived decision support.

HERA's research project will improve design to construction – and beyond – by

bringing together industry and a team of global experts using complexity science to build on existing Construction 4.0 knowledge.

The Construction 4.0 framework and guidelines developed through the project will help yield nationwide sector-driven benefits of:



- better economic performance
- improved productivity in the construction sector
- a larger workforce that is more skilled, innovative and digitally literate
- building resilience and performance within environmental limits
- building and infrastructure affordability
- interfaces with indigenous knowledge – mātauranga Māori
- management of complexity and reduction of uncertainty
- enhancement of information exchange and communication between project stakeholders to increase productivity and quality of output.

Innovation driven by the research programme

The research will be a leader in an emerging area of international interest and create data-driven decision-making for the future of construction. Major advances are likely to make the research globally innovative.

Complex system data management science stretch

The project will take a complexity science approach to construction optimisation using customer input. This means it will consider complex interactions between cost, sustainability performance, structural performance, constructability, and people's subjective preferences using fuzzy logic based on stakeholder interaction and feedback.

Technical science stretch

New approaches will be developed to cover the broad range of practical construction options to be considered in the big data optimisations.

Mātauranga Māori interfaces

The mātauranga Māori and Construction 4.0 research will address the knowledge

gap existing between the two by building a uniquely Māori framework to address the challenges of Construction 4.0. This will provide new information domestically and internationally as an example of indigenous knowledge incorporated into sectoral transformation.

Inclusive of Māori world views

The consideration of mātauranga Māori will be the first time globally that indigenous world views are incorporated into decision support tools using Construction 4.0. The research aims to build a transformational and new concept of Construction 4.0 in Aotearoa without compromising the integrity of:

- tūhonotanga – attachment, joining, link
- ngākaupono – honesty, good faith
- ūkaipōtanga – roots, belonging.

The project will also investigate the challenges of navigating through the concept differences of Construction 4.0 and mātauranga Māori. It will result in the development and production of English and te reo Māori articles addressing challenges and synergies.

The outcomes from all research programmes and themes will be suited for knowledge adoption in te ao Māori environments.

Aims of the broader programme

The wider programme will develop Aotearoa's first standardisation infrastructure for vertical integration of construction participants' systems as well as horizontal integration of the value chain and collaborative networks. These are the key programmes:

- Circular design – using Construction 4.0 enabled data to identify target areas for optimisation and creating a better design. The hypothesis is that a structural synthesis system can fulfil optimisation requirements in which a cost or environmental impact is minimised while

considering constraints on design and manufacturability.

- Smart construction – investigating intrinsic properties and invariant signatures of construction objects such as footings, slabs and beams as well as their synergistic structural performance to create a new end-to-end computational platform for design and manufacture.
- Monitoring 4.0 – developing a framework for objective and improved monitoring and performance assessment of structural systems using in situ data and numerical models as well as optimal instrumentation plans to maximise the information gain while limiting cost.

A global effort required

The application of complexity science and Industry 4.0 in construction is an immature discipline globally, with very few identified experts in Construction 4.0 research. This makes international collaboration key to everything productive and useful that emerges from Construction 4.0.

HERA has brought together a team of global experts to ensure project outcomes meet international best practice and avoid redundancy. We have also incorporated expertise in technology transfer in traditional industries and public policy development so these outcomes will be both ready for adoption and readily adoptable.

To increase productivity and quality, the Construction 4.0 framework and guidelines developed in the research will manage complexity, reduce uncertainty, and enhance information exchange and communication between stakeholders. It will create a step-change in construction sector transformation and upskill the workforce through innovation and digital literacy.

FOR MORE Find out more about HERA and Industry 4.0 at www.hera.org.nz/industry40 ◀