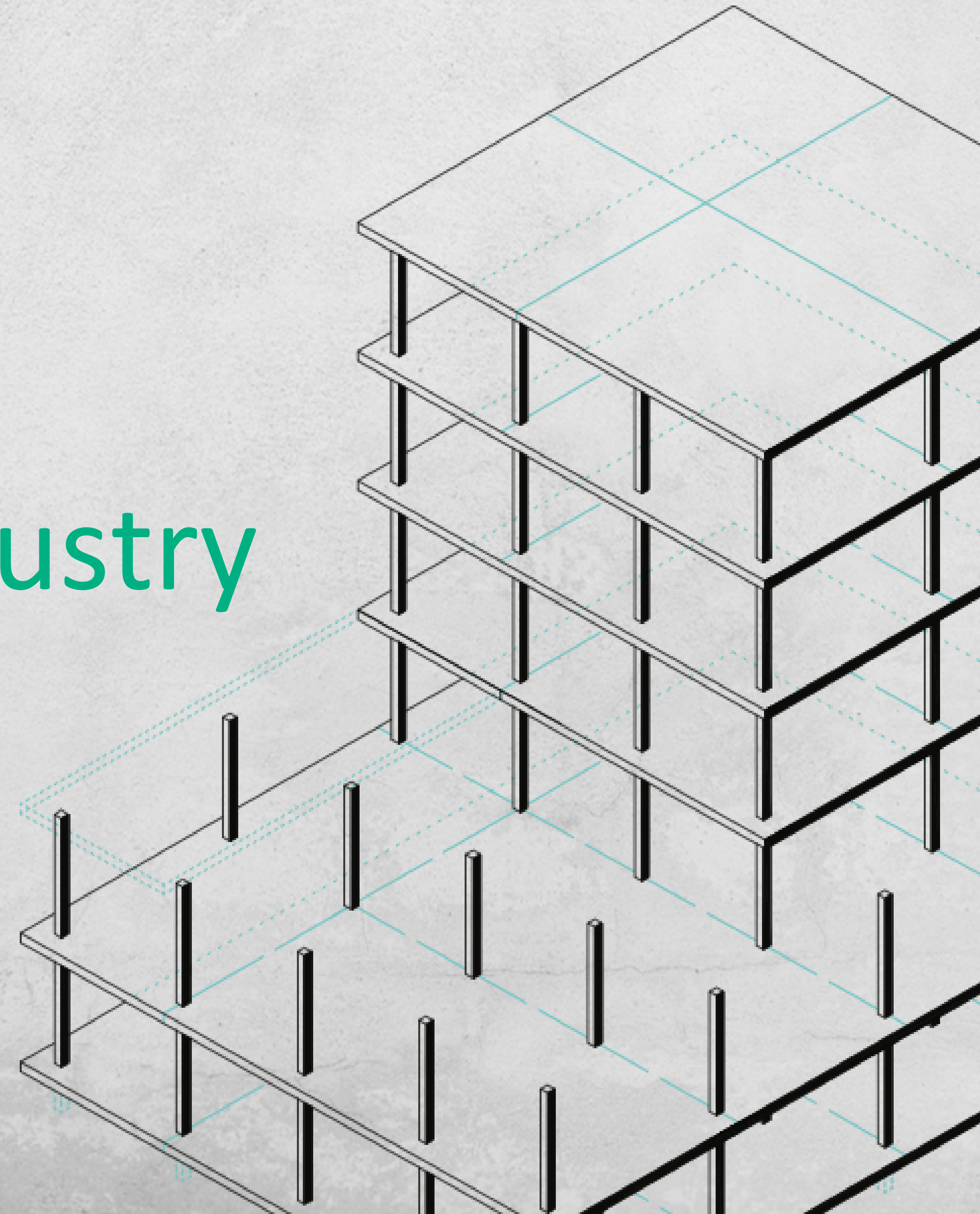
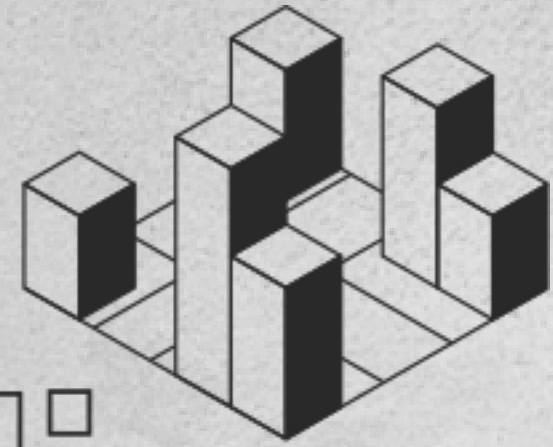


building
4.0 crc

Building Leaders Brief Industry

—





building
4.0 crc

Prof Chris Knapp PhD RAIA

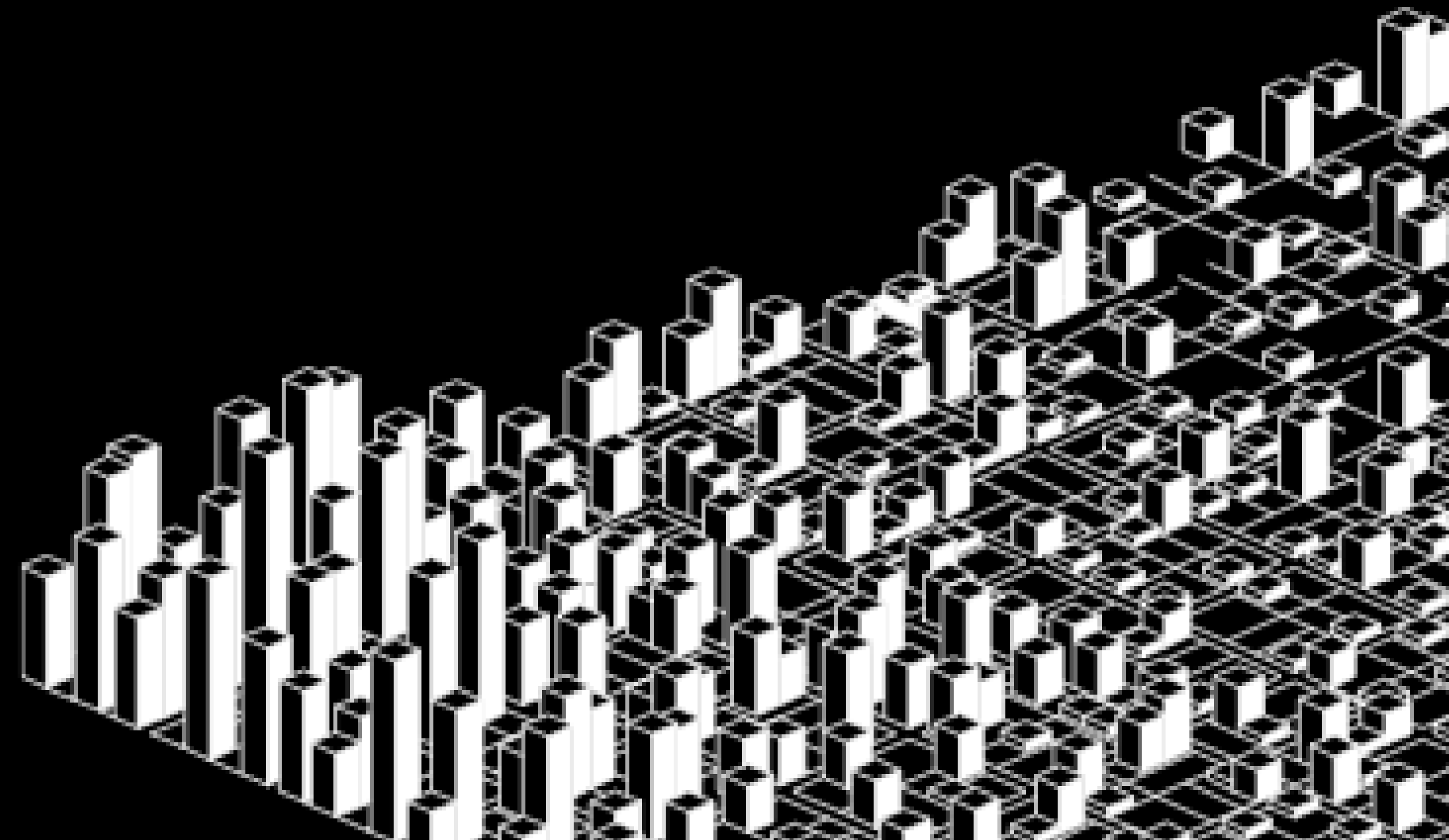
—
Research Director

9 August 2023

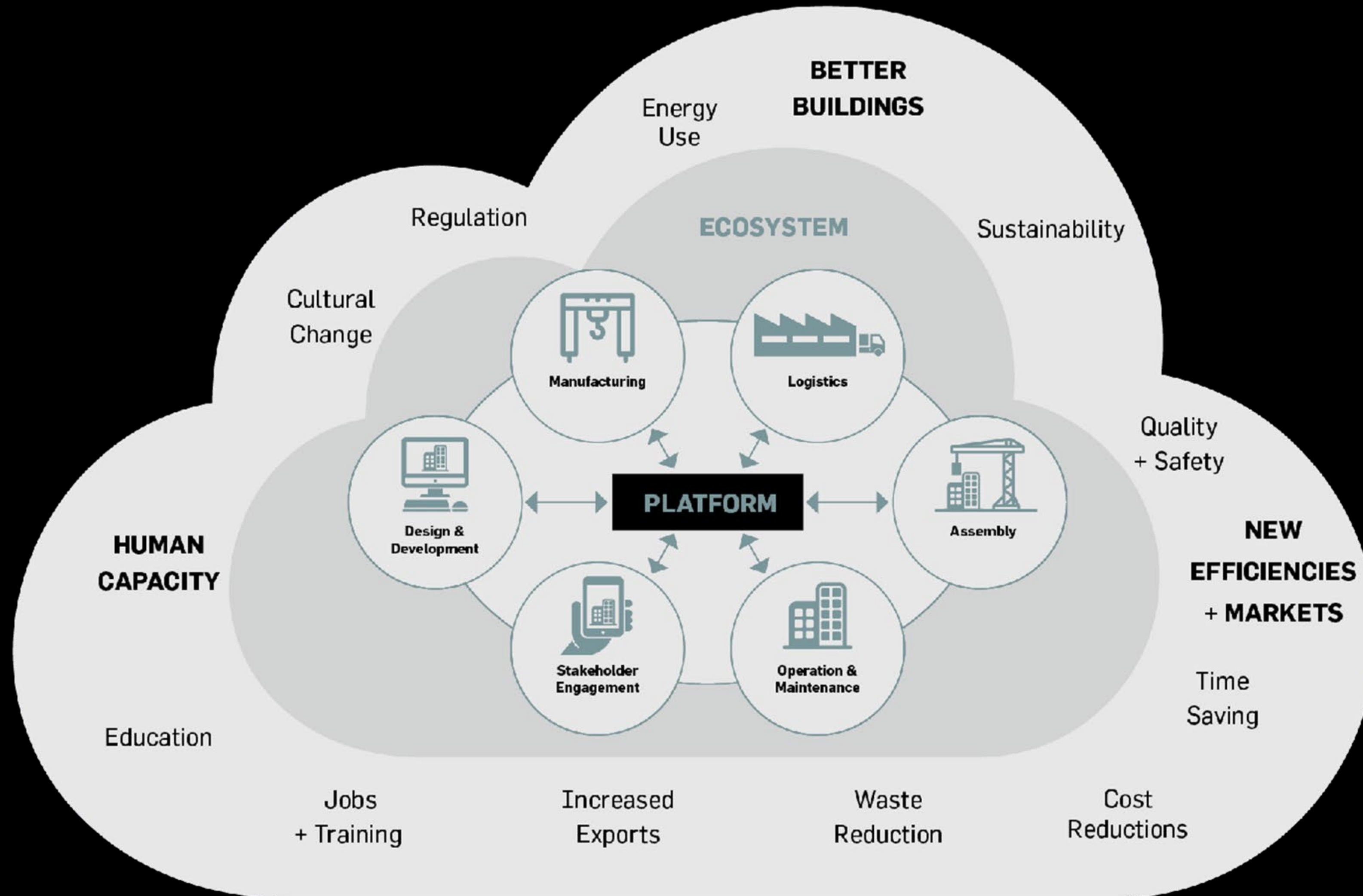


Better buildings through increased digitalisation, industrialisation, culture change, and sustainability

—



B4.0 CRC - BUILDING THE FUTURE INDUSTRY



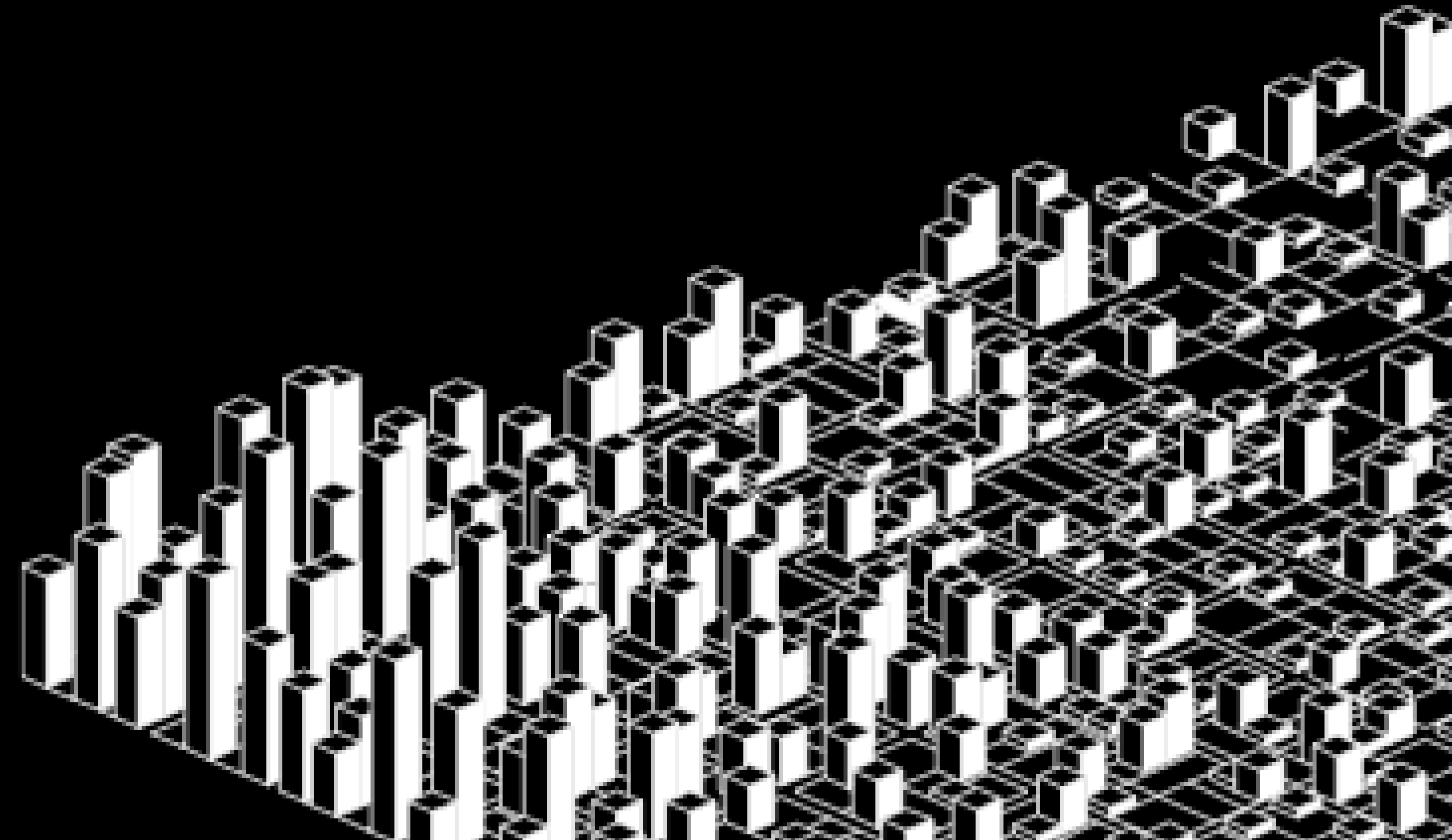
7 YEARS

3 UNIVERSITIES

~30 INDUSTRY PARTNERS

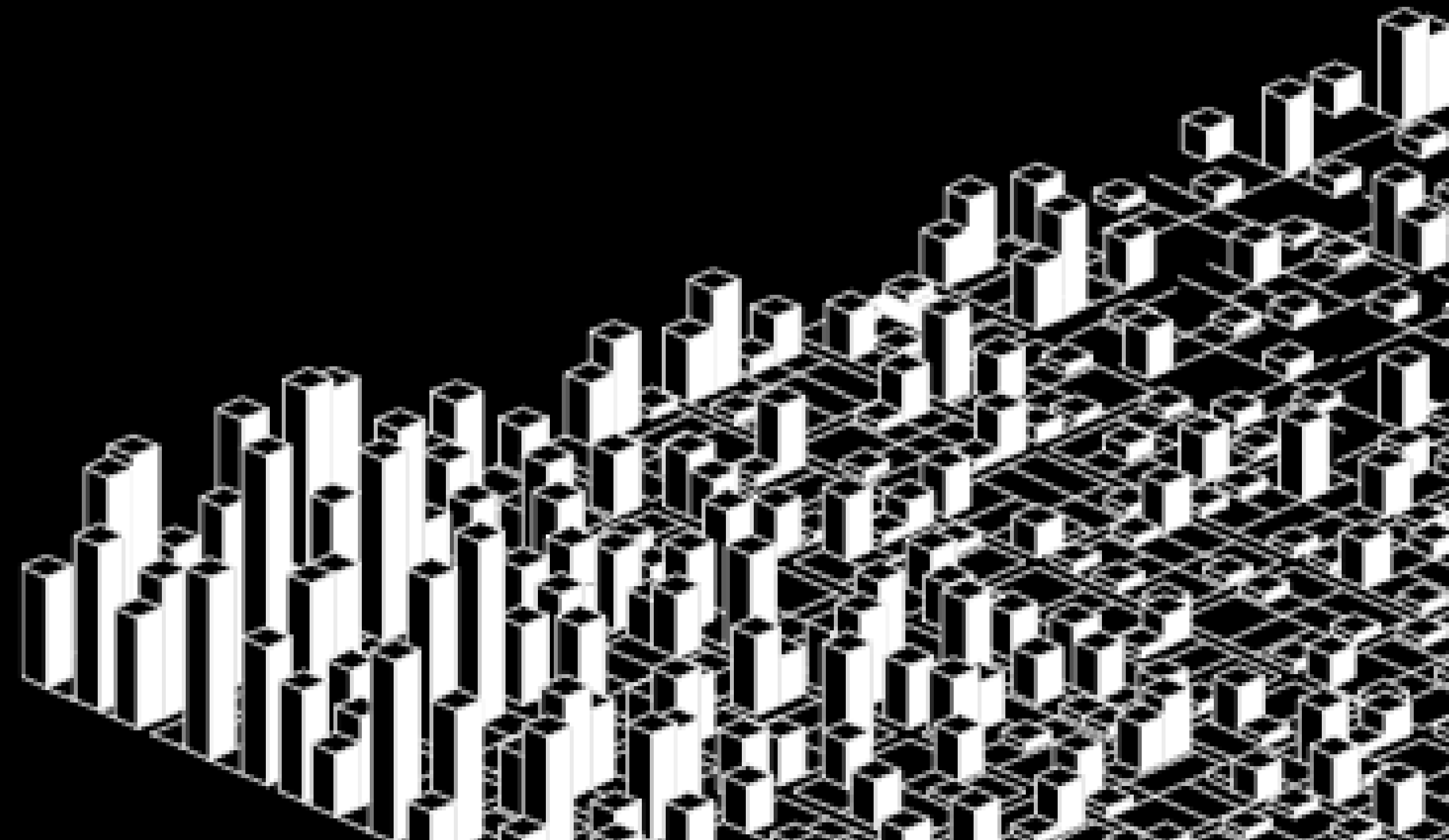
\$130M TOTAL RESEARCH VALUE

—



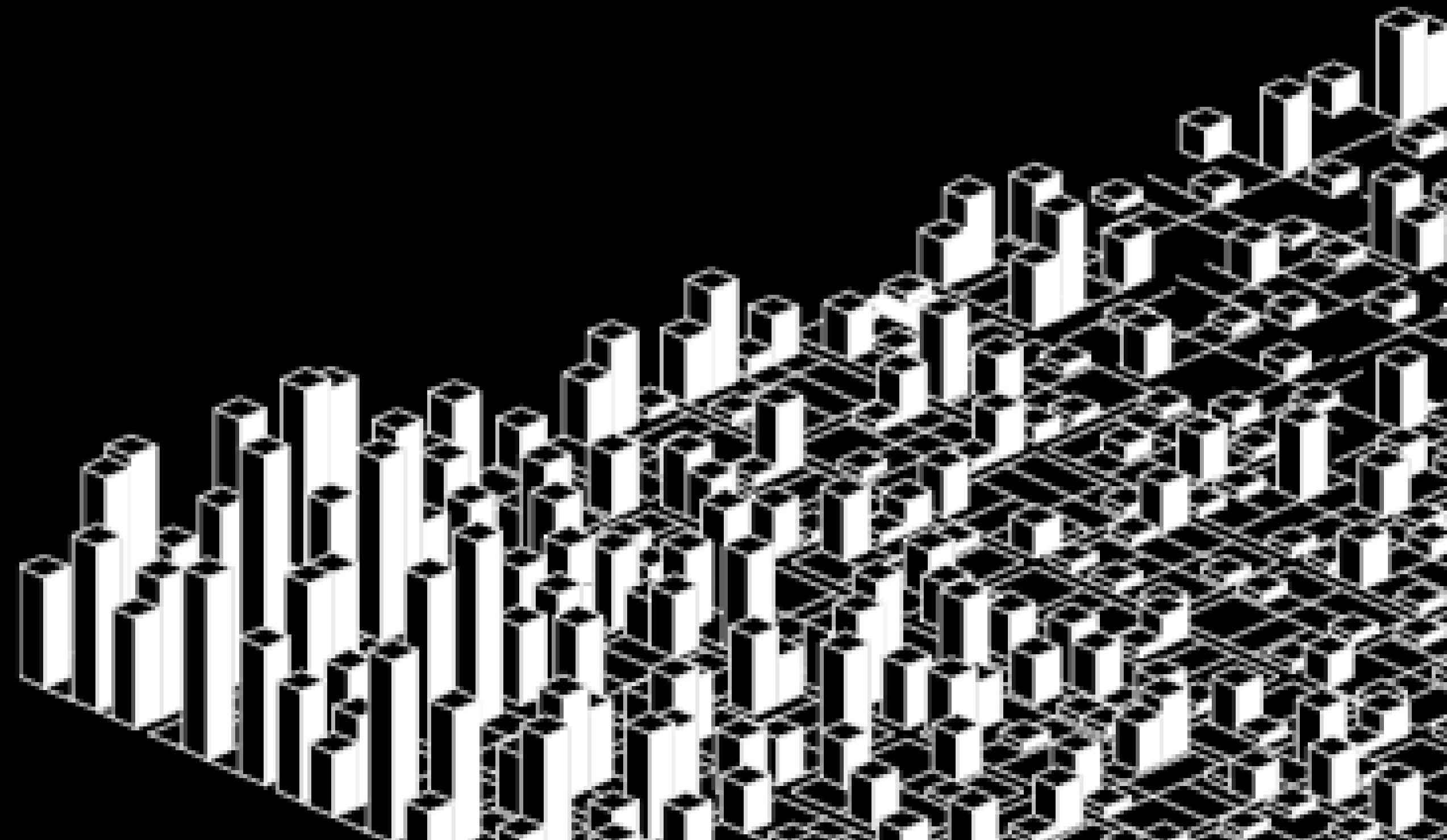
SINCE JULY 2020:

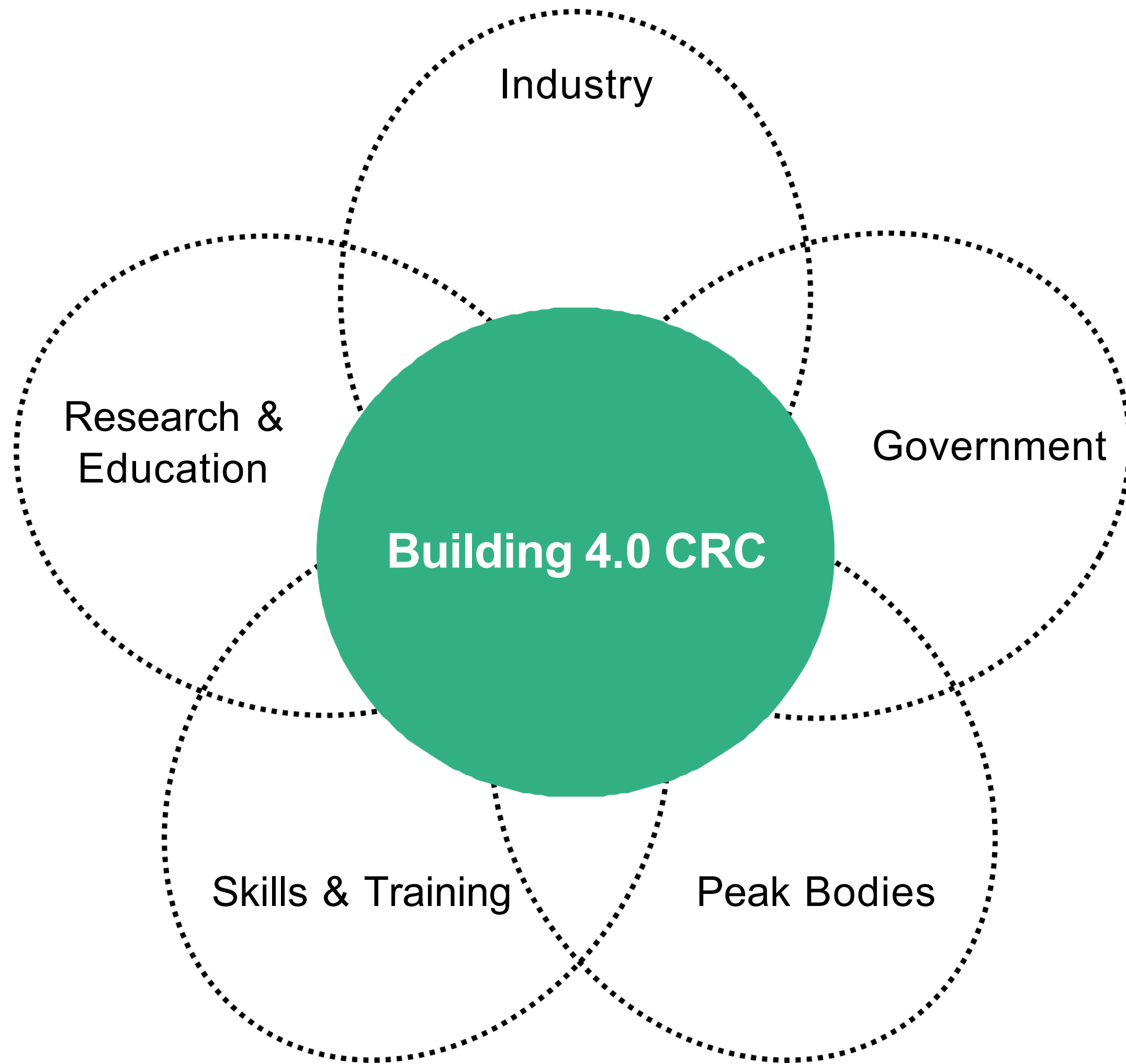
- 32 COMPLETED PROJECTS
- 18 ACTIVE PROJECTS
- 44 PIPELINE PROJECTS



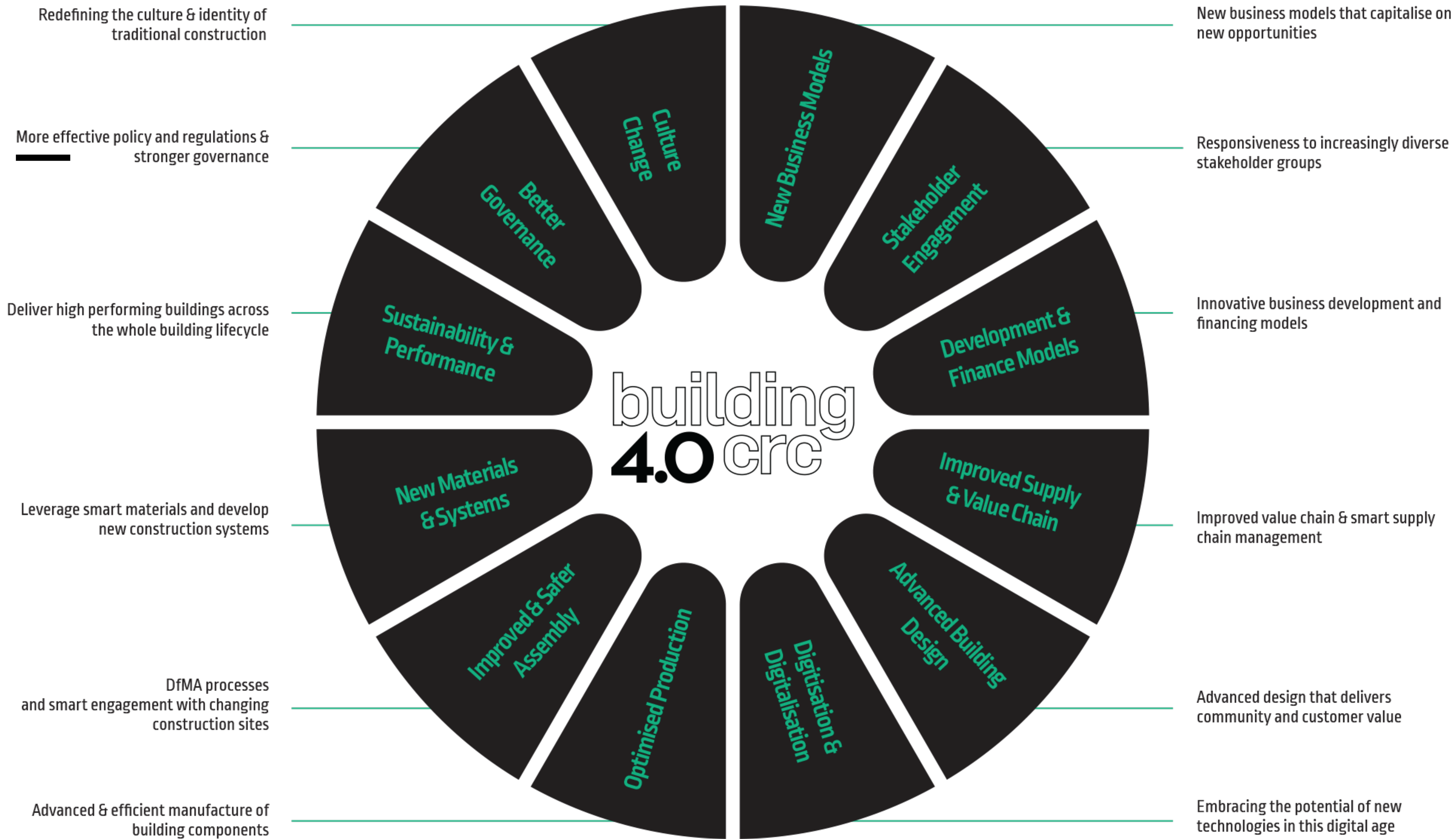
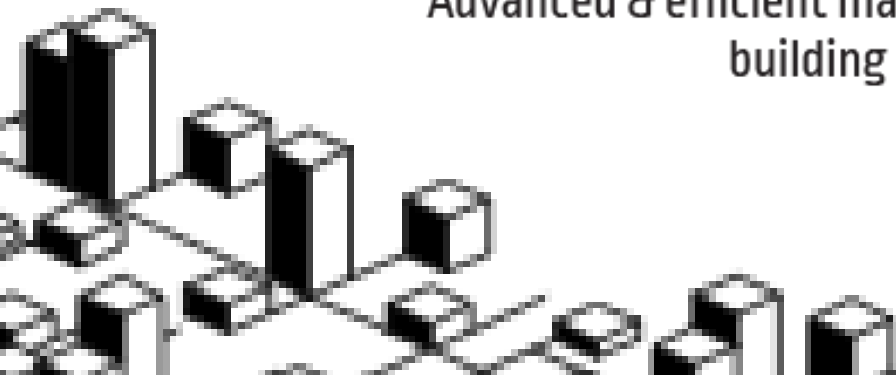
BY 2027:

- 36 PHD COMPLETIONS
- >1000 MASTERS STUDENTS
- >7000 VET/TAFE STUDENTS





Building 4.0 CRC specialises in R&D that leverages our unique reach within the building innovation ecosystem.



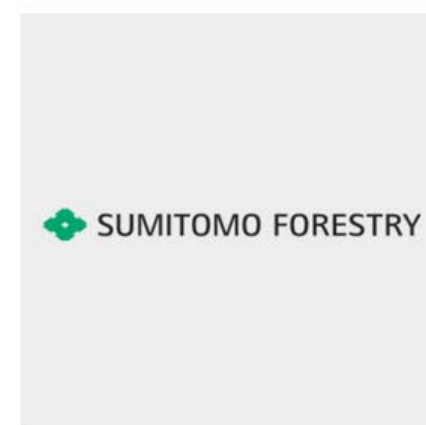
Partners team together on projects



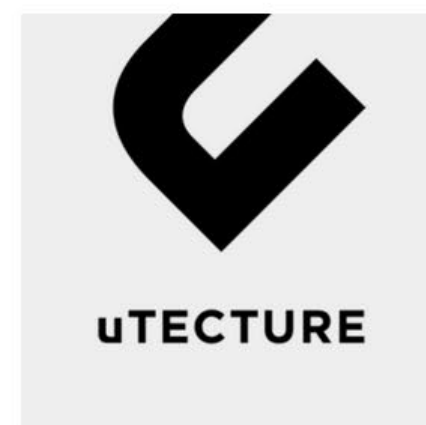
[Lendlease](#)



[BlueScope](#)



[Sumitomo Forestry](#)



[uTecture](#)



[Donovan Group](#)



[Bentley Homes](#)



[Monash University](#)



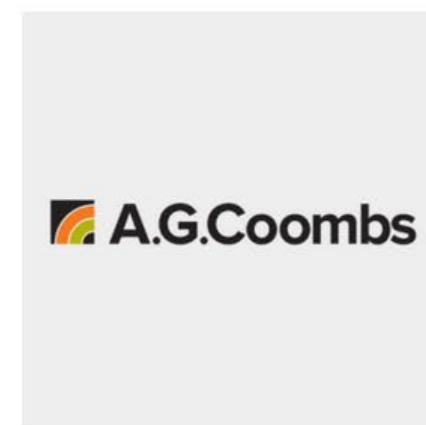
[University of Melbourne](#)



[QUT](#)



[Salesforce](#)



[A.G.Coombs](#)



[Coresteel Buildings](#)



[Ultimate Windows](#)



[Hyne Timber](#)



[M-Modular](#)



[Victoria State Government
Jobs,
Precincts and
Regions](#)



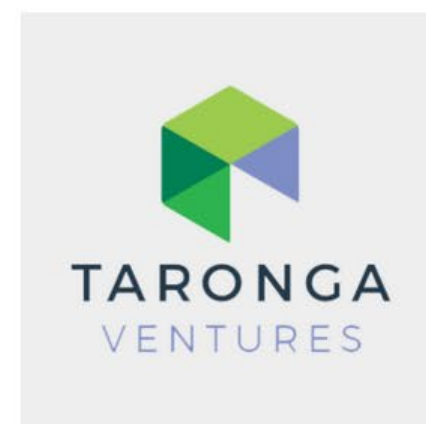
[Victorian
Building
Authority](#)



[Fleetwood Australia](#)



[Amazon Web Services](#)



[Taronga Group](#)



[Schiavello](#)



[Ynomia](#)



[VIRIDI Group](#)



[VERTON](#)



[Master Builders
Association Victoria](#)



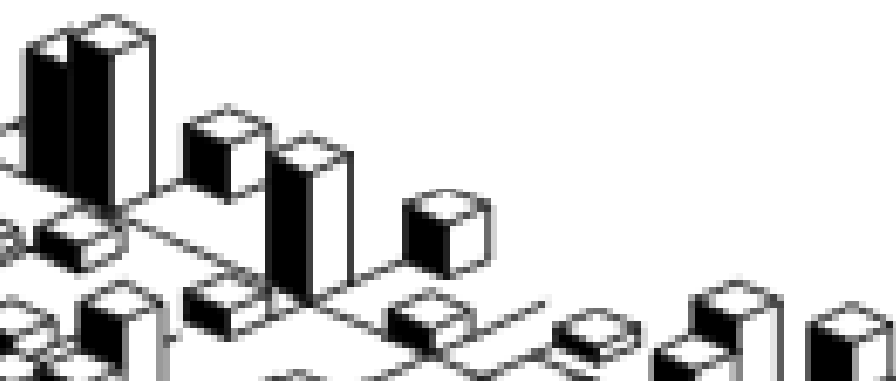
[Green Building
Council of Australia](#)



[PrefabAUS](#)







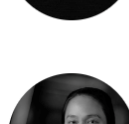
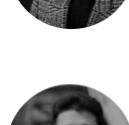
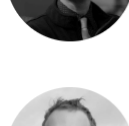

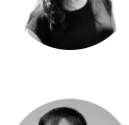









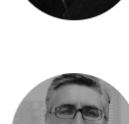

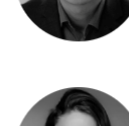
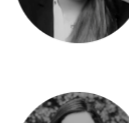
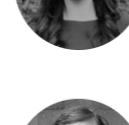

[Standards
Australia](#)







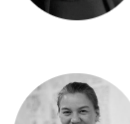
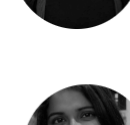

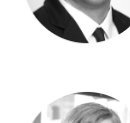
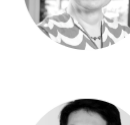


Research team: overview

















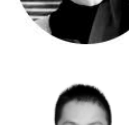


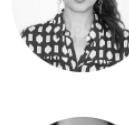







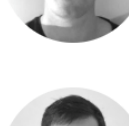
Theme Coordinators

-  DR ABDALLAH GHAZLAN
Computational Design
-  DR ANGELA SOLARTE
CASTANEDA
Fire Safety
-  DR BEHZAD RISMANCHI
Complex Systems Modelling
-  DR CHAO CHEN
Digital and Automated
Fabrication (Robotics)
-  DR ERIC WINDHOLZ
Policy and Regulation
-  DR ILANKAIKONE
SENTHOORAN
Optimisation
-  DR JENNY ZHOU
Indoor Environmental Quality
-  DR MEHRDAD ARASHPUR
Construction Management
-  DR PHILIP CHRISTOPHER
Sustainable Materials and
Design
-  DR SARA OMRANI
Building Operation and
Performance
-  DR TAI THAI
Structural Optimisation
-  DR YIHAI FANG
Connected Construction Sites

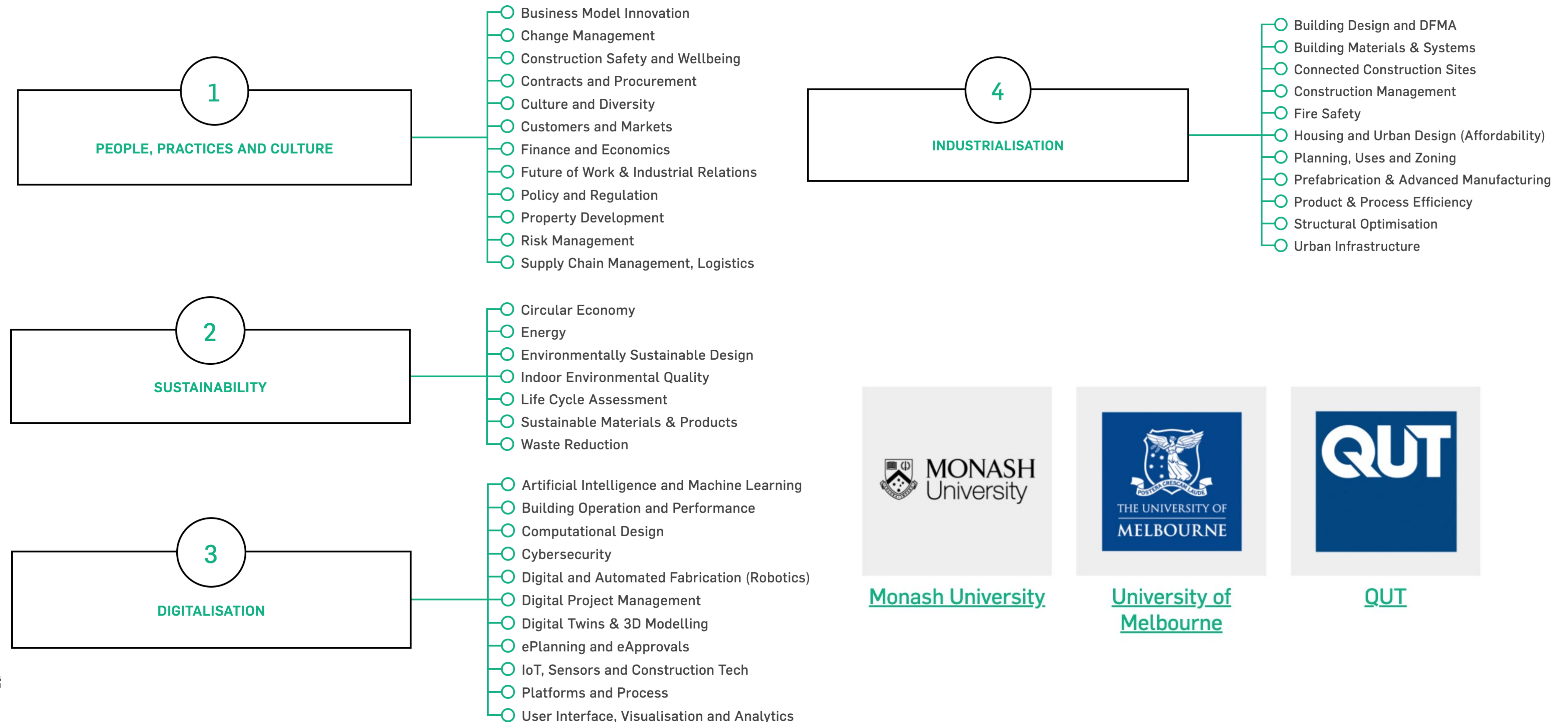
-  ALEXA GOWER
Planning, Uses and Zoning
-  DR ARAVINDA RAO
IoT, Sensors and
Construction Tech
-  DR BUSER SAY
Artificial Intelligence and
Machine Learning
-  DR DAVOOD SHOJAEI
ePlanning and eApprovals
-  DR FELIX HUI
Production and Process
Systems (Advanced
Manufacturing)
-  ILSA KUIPER
Procurement and Contracts
-  DR KOUROSH KHOSHELHAM
Digitising and 3D Modelling
of Physical Assets
-  MING XU
Risk Management
-  DR RACKEL SAN NICOLAS
Materials and Systems
Innovation
-  DR SARAH ERFANI
Cybersecurity
-  DR VICTOR BUNSTER
ESD, LCA and Energy
-  DR ZAHRA SEYEDGHORBAN
Customers and Markets

-  DR ALI RASHIDI
Digital Project Management
-  DR BARRETT ENS
User Interface, Visualisation
and Analytics
-  DR CAROL HON
Construction Safety
-  DR DUNCAN MAXWELL
Platforms and Process
-  DR GILLIAN MATTHEWSON
Culture and Diversity
-  IVANA KUZMANOVSKA
Building Design and DFMA
-  DR LEE-ANNE KHOR
Housing and Urban Design
(Affordability)
-  DR NIHARIKA GARUD
Change Management
-  DR ROBERT MOEHLER
Business Model Innovation
-  DR TANJA TYVIMAA
Finance and Property
Development Economics
-  DR WEN LI
Supply Chain Management,
Logistics

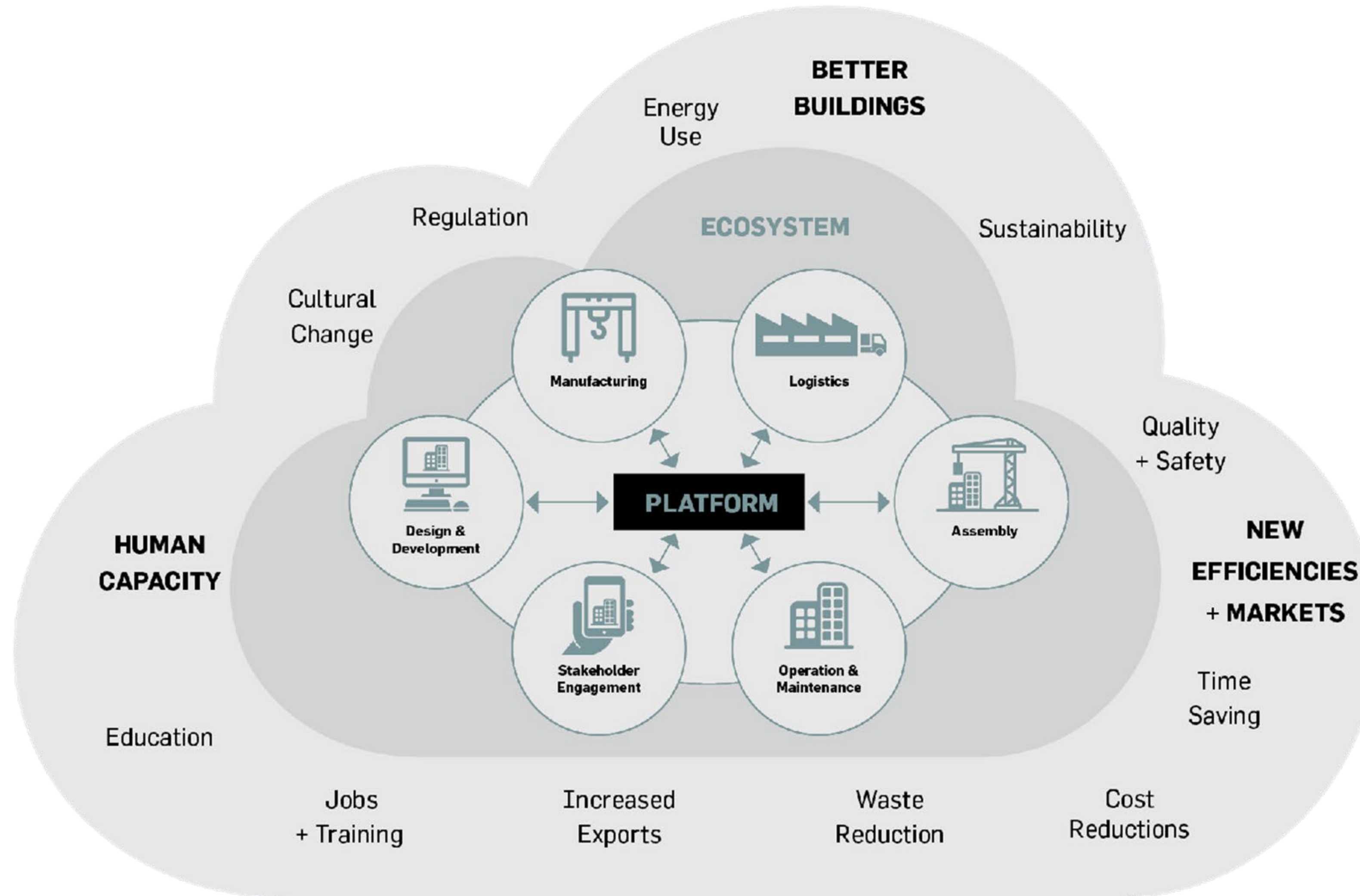
PhD Scholars Science/Research

-  ANKIT SHRINGI
-  FERNANDO PAVEZ
-  MARKO RADANOVIC
-  PEYMAN JAFARY
-  SAJJAD EINI-ZINAB
-  TOBIAS KRAMER
-  ALI PAKDEL
-  DILSHI DHARMARATHNA
-  RAJENDRA PRASAD
BOHARA
-  SHAHED KHAN
-  BRANDON JOHNS
-  KAREN TANFIELD
-  MOHAIMEEN ISLAM
-  REBECCA DICKSON
-  SON TUNG VY
-  YUSSRA RASHED
-  CHENG ZHANG
-  FUCAI KE
-  RAZEIH KARIMI
-  THE SON (TYSON) KIEU
-  FERESHTEH BANAKAR
-  KAVEH MIRZAEI
-  NAZLI
SOLTANMOHAMMADLOU
-  RINU ANN SEBASTIAN
-  THAIS GONCALVES SARTORI
-  CHRIS MATHWIN
-  NGHIA PHUC TRAN
-  RICHARD NERO

Research Themes / Areas of Expertise

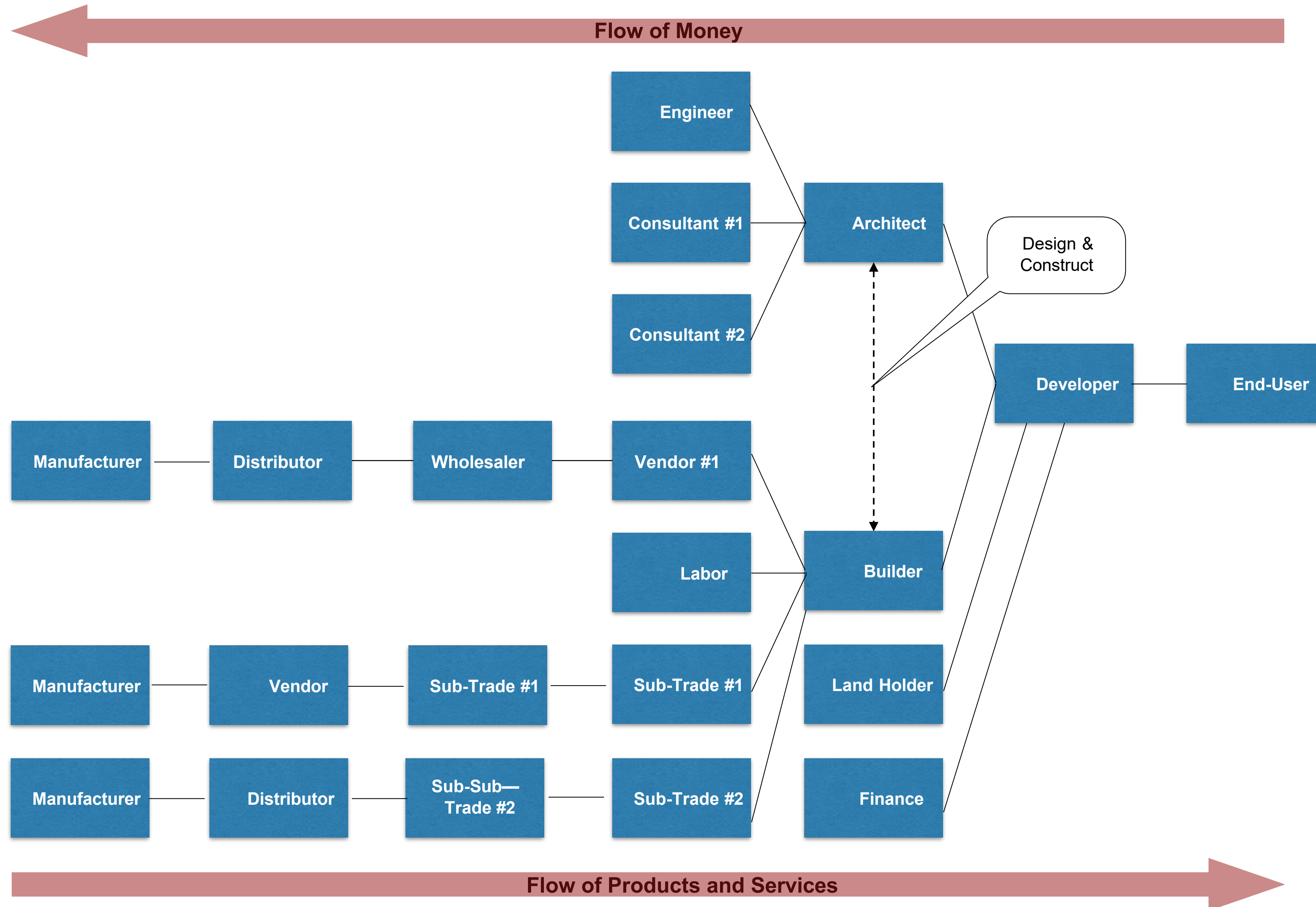


B4.0 CRC — Building the Future Industry



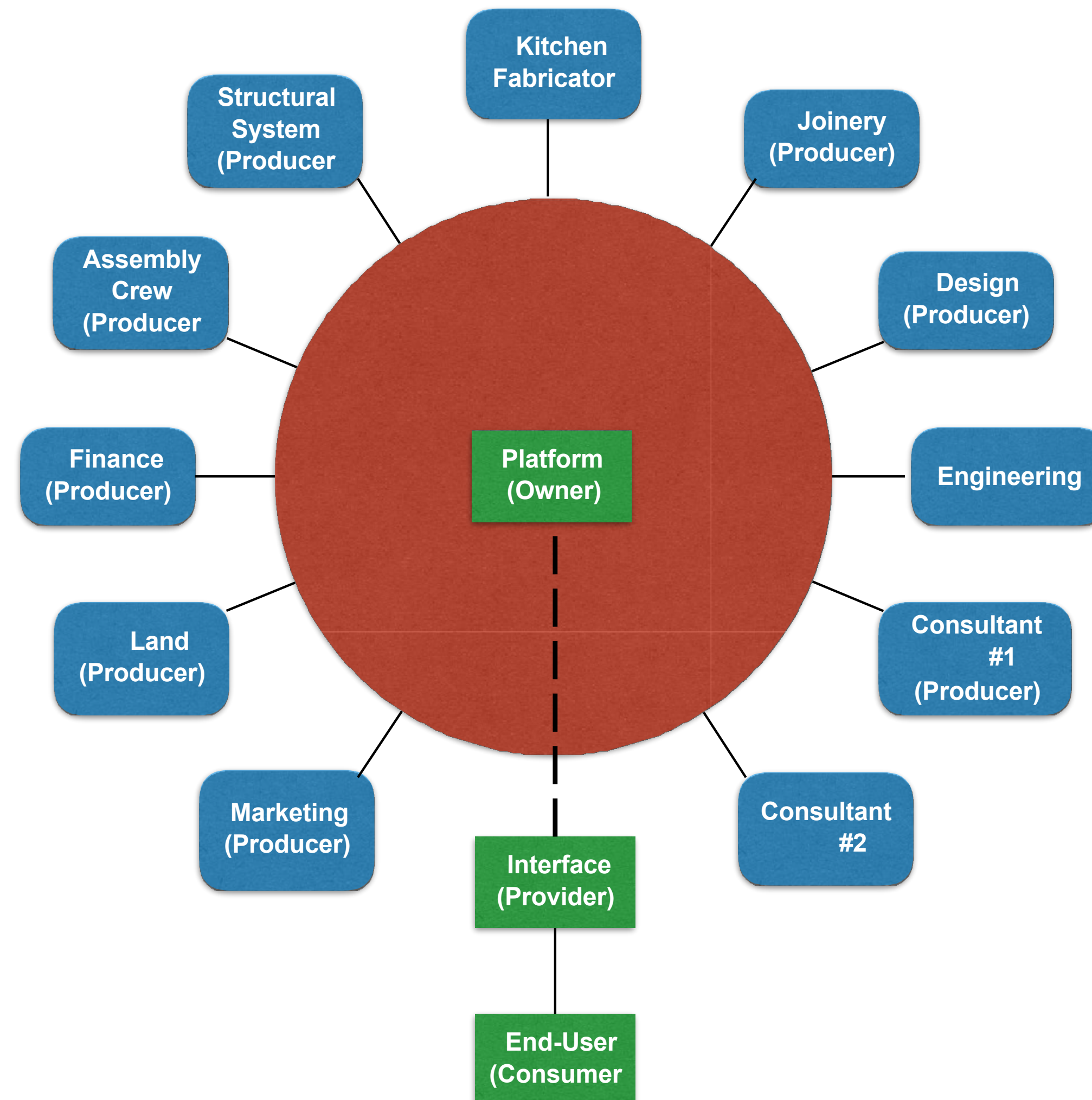
Traditional Construction Value Chain

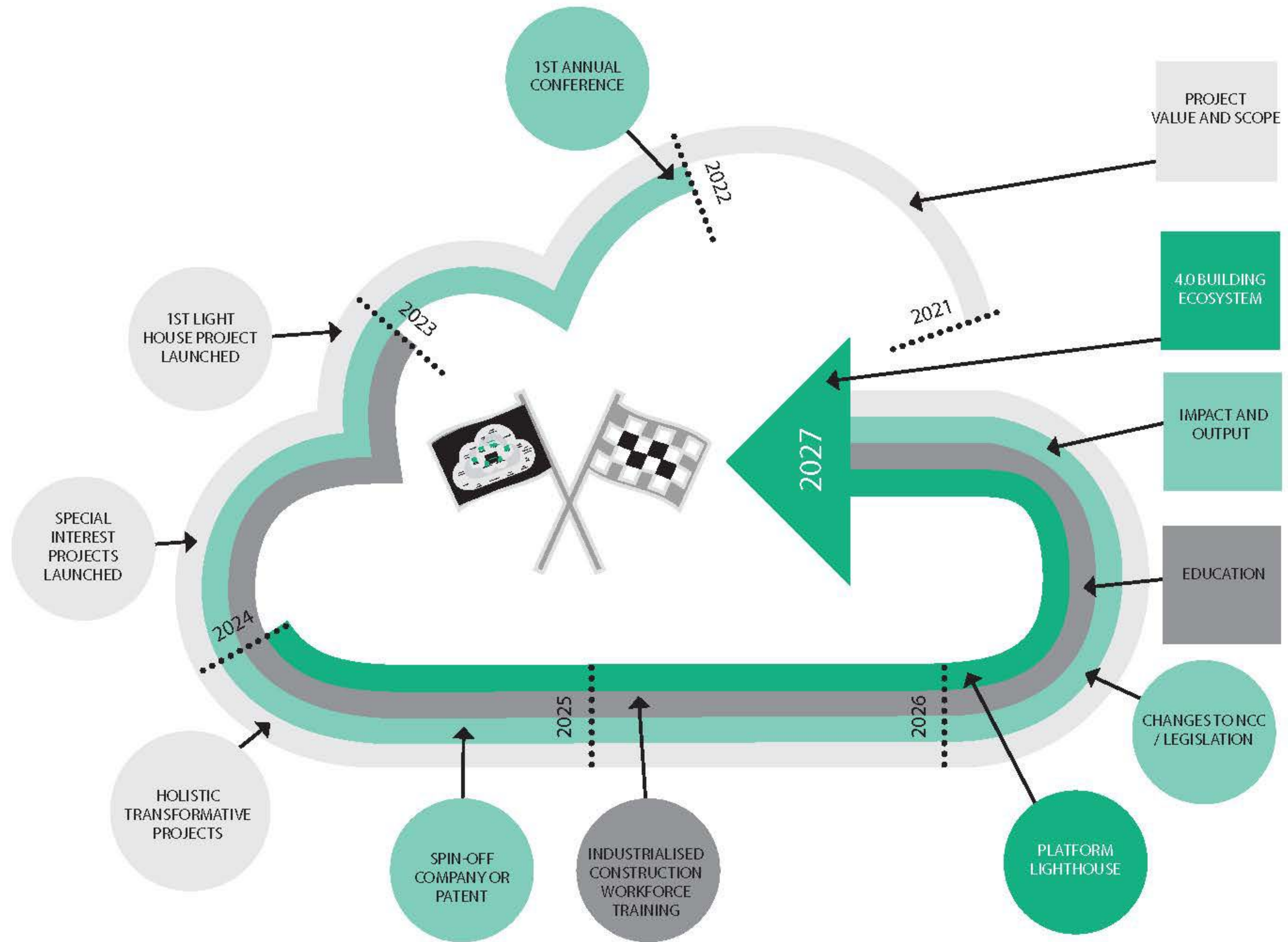
Pipeline Model (Adapted from Macomber, 1990)



Future Value Chain

How might such a structure appear in construction?





Projects: pipeline, active, completed

Sustainability

- Project 11 - Environmental Credentials for Building Technology Platforms
- Project 18 - Long-span Low-Carbon Floor Systems (Scoping Study)
- Project 19 - Hybrid Timber-Steel Structural Systems for Mid to High Rise Buildings
- Project 27 - Environmental Decision-Support for Structures
- Project 35 - Prefab Housing Solutions for Bushfire & Disaster Relief
- Project 37 - Aust Timber Fibre Insulation Scoping Study
- Project 39 – Hybrid Timber-Steel Extension
- Project 46 - Data analytics for structural fibre resources optimisation
- Project 48 - Shared Interest Project: Circular Economy
- Project 50 - Automation of energy rating tool
- Project 54 - HVAC in a post-covid world
- Project 59 - Strong Floor
- Project 68 - Post and Plate CLT Scoping, Optimisation, and Testing
- Project 72 - PassivHaus Tower Performance Evaluation

Digitalisation

- Project 01 - e-Planning / e-Approvals Phase 1
- Project 04 - Computational Design & Optimisation Tools for Prefab Building Systems
- Project 06 - Field data collation to support real-time operational management
- Project 12 - VR/AR Technologies in Vocational Education / Training
- Project 16 - Fire Safety in Advanced Building Systems
- Project 22 - Design Automation methods for Steel Framed Buildings Phase 1
- Project 38 - Victorian Govt Digital Build
- Project 42 - Workflow Automation Tools for Home Designs
- Project 44 - Generative Architectural Design Engine
- Project 53 - Automated Design Optimisation and AI Tools for Prefab Systems (Ext to 4)
- Project 55 - Smart Contracts / Smart Finance in construction industry
- Project 57 - Wind Comfort Simulation and New Engineering Design Process
- Project 62 - Digital Building Approvals
- Project 71 - Automated Resolution of BIM Clash Incidents
- Project 73 – LLM for Material Tracking and Part Library

People, Practices & Culture

- Project 02 - Auto tracking of materials for supply chain logistics and provenance
- Project 09 - Implementing DfMA & Lean Construction Principles
- Project 14 - Building Products Supply Chain Naming Conventions and Standards
- Project 15 - Resource optimisation Studies: Forest to Building
- Project 21 - Regulatory Reform for Industrialised Building
- Project 29 - Workplace Safety
- Project 33 - Remote Compliance Inspections
- Project 56 - Training and Optimising CRC Research in Construction
- Project 58 - Construction Wellness
- Project 60 - Mass Timber Wellness
- Project 66 - Future of Construction Education

Industrialisation

- Project 03 - Projects to Platforms
- Project 08 - Prefab, Integrated Wall Systems - Scoping Study
- Project 17 - Implication of Industry 4.0 for the construction industry: smart prefab
- Project 19 - Hybrid Timber-Steel Structural Systems for Mid to High Rise Buildings
- Project 20 - Sys & methods for robustness of mid-rise Light Gauge Steel (LGS) buildings
- Project 23 - Prefab: Barriers & opportunities in the Australian housing market
- Project 24 - Robust and Fire-resilient Light Gauge Steel Systems for Mid-Rise Buildings
- Project 25 - Framework of steel fabrication & processing in the OSM & prefabrication
- Project 26 - New materials for windows of the future
- Project 28 - Componentised Internal Wall Systems for multi residential applications
- Project 31 - Demystifying Volumetric Construction: A Study of the Bathroom Pod
- Project 32 - Acoustic Flanking performance of mid-rise Light Gauge Steel (LGS)
- Project 34 - Acoustic flanking (Scoping Phase 1)
- Project 45 - Prefab Wall Integrated System Demonstration House & Market Study
- Project 61 - Productivity
- Project 63 - Componentised Internal Walls – Extension and Prototyping

Lighthouse Projects: pipeline, active, completed

Conducted in the physical world on real sites

LHP #1 – Better Communities through Technology – Digital Twin Integration at the Monash Smart Manufacturing Hub

LHP #2 – Retrofit Kit

LHP #3 – Platform DfMA to Deliver a New Independent Living Lab for Monash Health

LHP #4 – Queen Victoria Markets

LHP #5 – Smart IoT Cranes

LHP #6 – Prefab Timber Housing Performance at Malvern East

LHP #7 – WA Affordable Housing using Off-Site Digital Collaboration

LHP #8 – Low Embodied Carbon Smart Steel Structures

LHP #9 – Singapore Building and Construction Authority Demonstration Project

LHP #10 – Factory of the Future at Tonsley Institute/Flinders University

LHP #11 – Fishermans Bend Prefab Activation

LHP #13 – Mixed Reality Construction Demonstration at CRC Annual Conference

LHP #14 – Singapore JTC Demonstration Project

LHP #15 – BCA Commcentre

LHP #16 – DfMA Timber and Adaptive Reuse of Steel at Launceston Stadium

LHP #17 – South Australian Women and Childrens Hospital Site Village

LHP #18 – AI Design Tools and Digital Value Chain

LHP #19 – NSW Platform Delivery Staging Facility

LHP #21 – NSW Platform Delivery of Social Housing

LHP #22 – VIC Platform for Digital Delivery of Middle Infill Housing

LHP #23 – Netzero Carbon Sustainable Home/Office Prototype



Project Number

#45

Project Title

Prefab Wall Integrated System – Phase 2
Demonstration House and Market Study

Focus Area

Industrialisation

Date Commenced and Duration

July 2022; 24 months

Project Parties

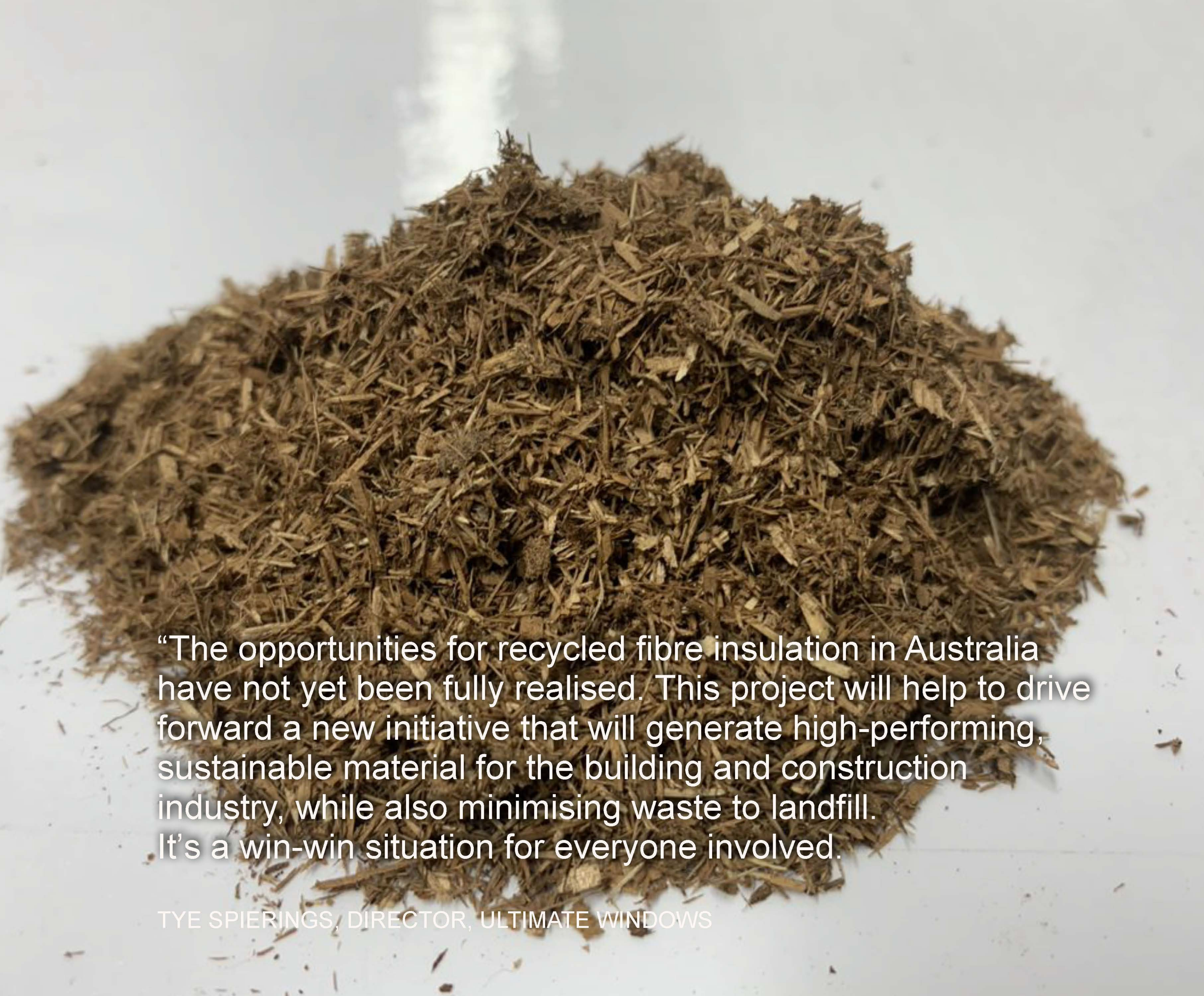
Bentley Homes
The University of Melbourne
Ultimate Windows

Project Overview

This project will see the concept realisation and demonstration of an NCC compliant, high-performance prefabricated wall system that can deliver both 7-star and 8-star NatHERS homes for the Australian market.

As part of this project an 8-star demonstration home will be constructed and documented to refine and improve delivery, construction and assembly methods for a next generation of high-performance home.

The project will also develop a better understanding of the market perceptions of prefabrication while quantifying energy performance benefits of the high-performance wall system homes.



“The opportunities for recycled fibre insulation in Australia have not yet been fully realised. This project will help to drive forward a new initiative that will generate high-performing, sustainable material for the building and construction industry, while also minimising waste to landfill. It’s a win-win situation for everyone involved.

TYE SPIERINGS, DIRECTOR, ULTIMATE WINDOWS

Project Number

#37

Project Title

Australian Timber Fibre Insulation Scoping Study

Focus Area

Sustainability

Date Commenced and Duration

February 2022; 9 months

Project Parties

Hyne & Son Pty. Limited
The University of Melbourne
Ultimate Windows

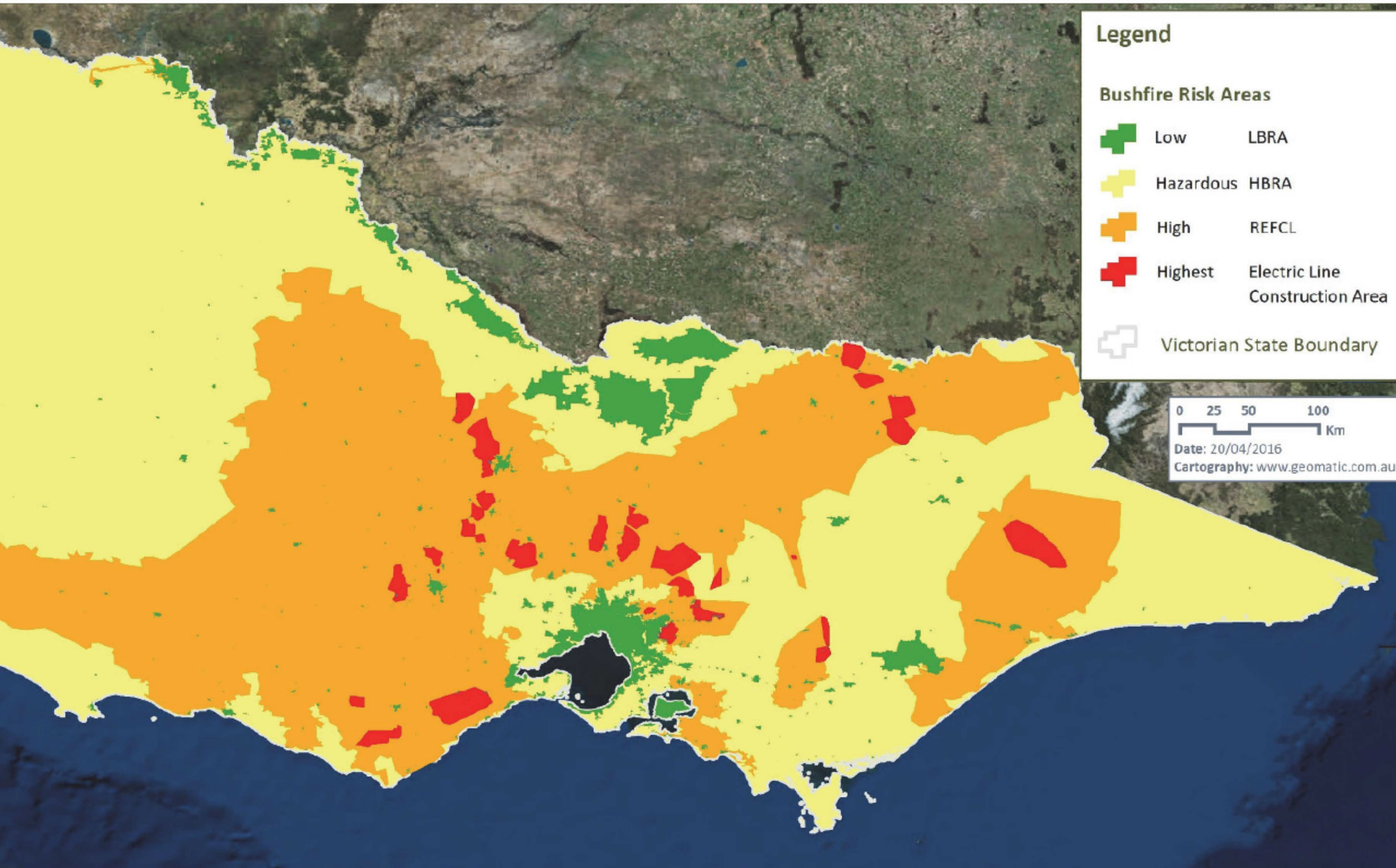
Project Overview

The Australian timber industry generates significant quantities of low-grade by-products, in the form of chips and sawdust, through the manufacturing of sawn and mass timber products. Most problematic among these are the H2 and H3 treated products that are not currently re-purposed into other products.

In addition to this timber waste stream, there are large amounts of other low-to-no value feedstock such as bark (currently exceeding 400,000 tonnes annually), single use timber pallets and other non-timber waste streams such as shredded plastic fibres. These by-products have the potential to be manufactured into higher value fibre insulation products for the Australian market. Currently, such products are not manufactured in Australia with importers servicing the market instead.

This presents a potential opportunity to divert considerable quantities of waste from landfill to produce a high performance, locally made, low carbon, natural fibre insulation product for the domestic and commercial building industry in Australia.

This project is a scoping study with the intention to assess the techno-economic feasibility and opportunities associated with the creation of a timber fibre insulation manufacturing facility in Australia.



Project Number

#35

Project Title

Prefab Housing Solutions for Bushfire & Disaster Relief

Focus Area

People, Practices and Culture

Date Commenced and Duration

July 2021; 12 months

Project Parties

AMGC and Prefab Innovation Hub (Funding body)
 Various Building 4.0 CRC Industry Partners (submissions and contributions will be received from all Industry Partners in the CRC)
 Monash University
 The University of Melbourne
 Queensland University of Technology

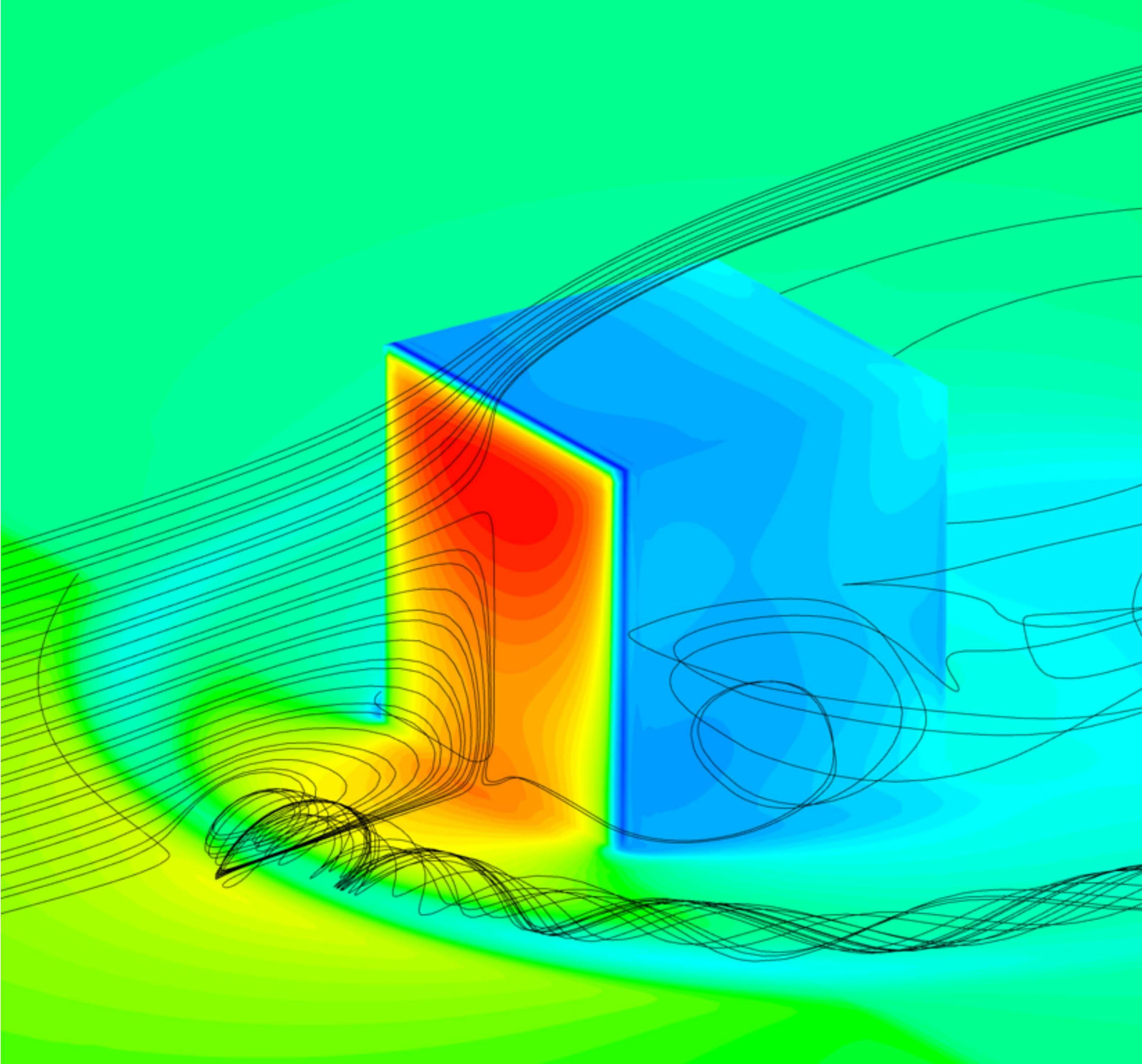
Project Overview

This project aims to develop prefab housing designs that are fire safety compliant and resilient to different natural hazards, low cost and sustainable for both temporary and long-term accommodation.

The team will bring together the leading experts in the field to develop prefab housing solutions for bushfire & disaster relief in Australia and to provide recommendations and strategies for improving disaster preparedness. A coordinated approach by the AMGC Prefab Innovation Hub will be used, and the research team will work closely with the other projects on Sustainability and DfMA.

The outcome will also contribute to lowering the carbon footprint of housing in Australia and improving the resilience of building industry against natural hazards.

Source: DELWP <https://www.audit.vic.gov.au/report/reducing-bushfire-risks?section=#33658--5-powerline-bushfire-safety-program>

**Project Number**

#57

Project Title**Wind Comfort Simulation and New Engineering Design Process****Focus Area**

Digitalisation

Date Commenced and Duration

July 2022, 24 months

Project PartiesLendlease Digital
Monash University**Project Overview**

For a typical engineering project, Engineering design (upstream) and operation (downstream) commonly follow a linear process through multiple contracting parties.

Such a process is inefficient and unsustainable for continuous improvement and IP retainment. This project aims to alter the linear process and reframe as a feedback loop through the following mechanisms:

1. Benchmark the current CFD studies and calibrate the results with data.
2. Create a Feedback loop pathway to link the operational data back into the design process.
3. Outline an Autonomous Engineering Design Roadmap.
4. Explore applications to other engineering design disciplines including but not limited to fire, water, thermal, occupancy, lighting, electricity, and connectivity.

Building 4.0 CRC: Research Project Lifecycle

On Boarding (~4 weeks)

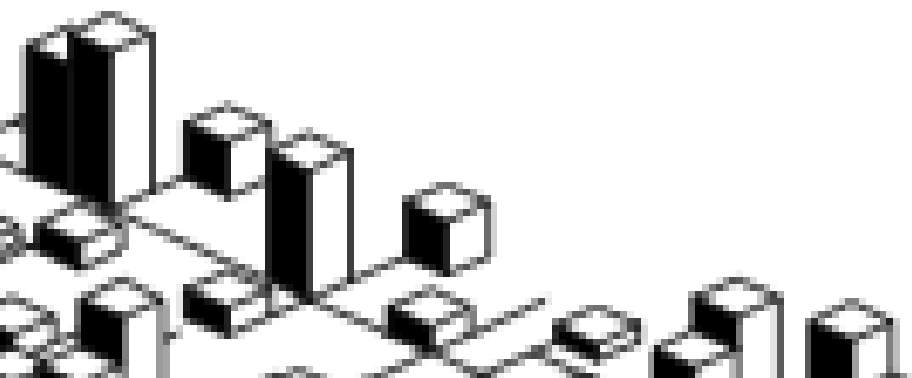
- 1) Agree research question with academic and industry partners
- 2) Scope research timeline, resources, milestones, budget & target outcomes
- 3) Agree engagement model, information sharing protocols and commitments
- 4) All participating partners execute joint project agreement

Research Phase (6-36+ months)

- 1) Project initiation, methodology, detailed project planning
- 2) Research, collaboration, data collection, sharing and creation
- 3) Leverage scientific tools and experts
- 4) Milestone check-ins, recalibration as needed, focusing in on highest value
- 5) Findings write up, insights, new research ideas

Outcomes & Benefits (post project completion)

- 1) Product / technology prototyping
- 2) Business / government / supply chain process change
- 3) Intellectual property creation for commercialisation from R&D
- 4) Publishing as an authority, recognised thought leadership
- 5) Hypothesis testing, insights discovery, independent 3rd party validation



Building 4.0 CRC: Partnership Models

Sole Participant Agreements

Annual contributions

Funds applied 100% toward research projects

7.5% goes into Shared Interest Projects fund

Inherent collaboration

One-off Project Partners

Project by project basis

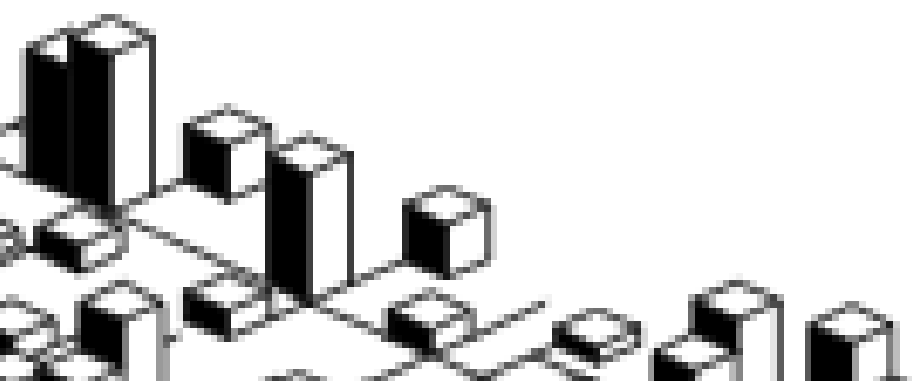
Key Conditions

Project funds are match \$1:\$1 through Commonwealth

2x cash In-Kind

1.5 cash in-kind from Universities

IP and Commercialisation



Building 4.0 CRC: Partnership Models

Sole Participant Agreements

Annual contributions

Funds applied 100% toward research projects

7.5% goes into Shared Interest Projects fund

Inherent collaboration

One-off Project Partners

Project by project basis

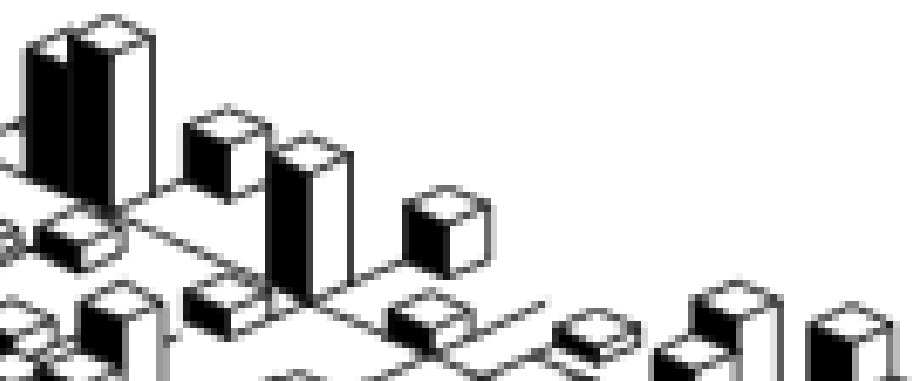
Key Conditions

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IP and Commercialisation



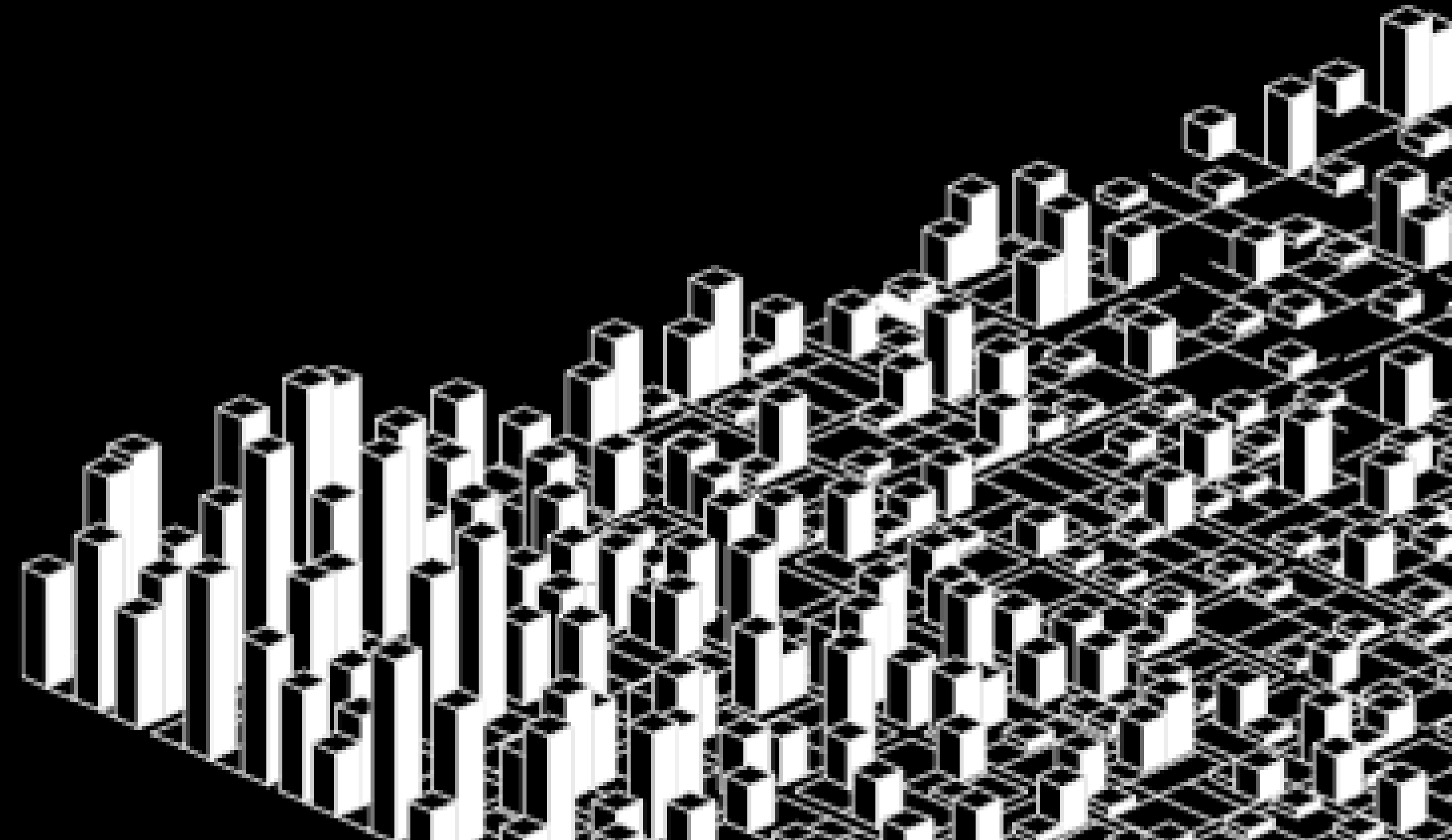
2x upcoming reports

2x current projects to launch

Lighthouse projects

How to get involved

—





#17: THE IMPLICATIONS OF INDUSTRY 4.0 FOR THE BUILDING INDUSTRY

TOWARDS A ROADMAP

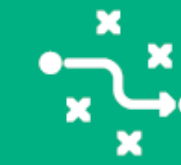


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3. INTERNATIONAL BEST PRACTICE

Penetration of Industry 4.0 into the building sector varies around the world. However, we can learn key strategies and initiatives from global leaders of Industry 4.0. Although these strategies do not necessarily directly focus on construction, they can be applied in a way that considers the complexity and diversity of construction, as we will discuss. A summary of international best practice examples is presented below, with more specific case studies detailed in Section 4 (Global benchmarking).



National Strategies and Initiatives:

Example: Germany's "Industrie 4.0" initiative is a national strategic plan that aims to strengthen Germany's position as a leader in advanced manufacturing which includes funding for research and development, support for SMEs, and collaboration between government, academia, and industry.



Collaboration and Public-Private Partnerships:

Example: Singapore's Advanced Remanufacturing and Technology Centre (ARTC) is a public-private partnership that brings together government agencies, research institutions, and industry partners to develop advanced manufacturing technologies and drive adoption in the manufacturing sector.



Digital Infrastructure:

Example: South Korea has made significant investments in its digital infrastructure, including widespread availability of high-speed internet and the development of 5G networks. This infrastructure supports the implementation of technologies like IoT and enables the integration of smart factories.



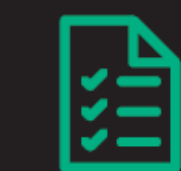
Skill Development and Education:

Example: Switzerland has a dual education system that combines classroom learning with practical training. The Swiss Vocational and Professional Education and Training (VPET) system prepares students with the necessary technical skills for Industry 4.0 by offering apprenticeships and specialized vocational training programs.



Innovation and Research:

Example: The United States has established innovation hubs and technology parks, such as Silicon Valley and Research Triangle Park, which serve as ecosystems for collaboration, entrepreneurship, and technological advancements. These hubs attract startups, research institutions, and venture capitalists, fostering innovation in various sectors.



Regulatory Frameworks and Standards:

Example: The European Union's General Data Protection Regulation (GDPR) sets standards for data privacy and protection. It establishes rules for the collection, storage, and processing of personal data, ensuring that businesses adopting Industry 4.0 technologies comply with stringent data privacy regulations.



Testbeds and Demonstrators:

Example: The Netherlands' Smart Industry Field Labs are physical environments where companies can experiment with Industry 4.0 technologies and solutions. These field labs provide a collaborative space for businesses, research institutions, and technology providers to test and validate innovations before scaling up.



International Cooperation:

Example: The Japan-Germany Industrial Cooperation Initiative promotes collaboration between Japanese and German companies in areas such as robotics, automation, and digitalization. Through this initiative, companies from both countries share knowledge, expertise, and technologies to drive advancements in Industry 4.0.



BUSINESS MODEL INNOVATION

Unlocking the next chapter of building through a platform ecosystem model

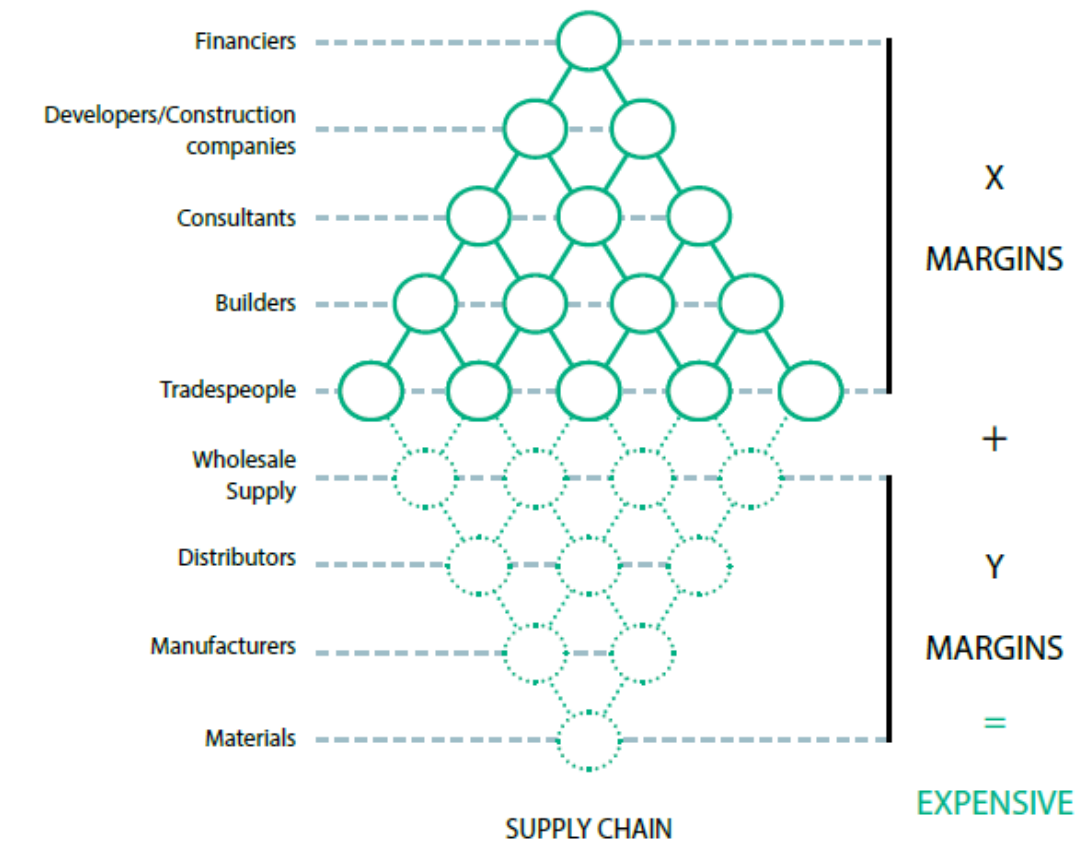
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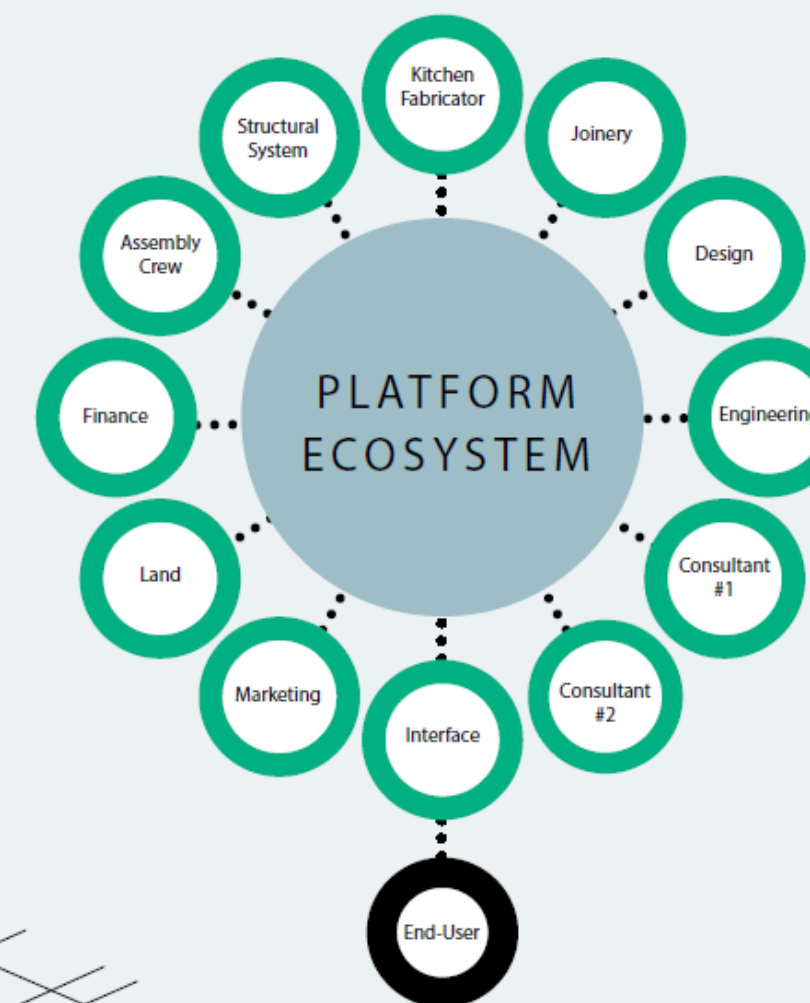
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TRADITIONAL INDUSTRY STRUCTURE



The current industry structure is a large part of the problem with the industry. It operates project to project, on low margins, with a margin-on-margin approach largely due to the deep fragmentation and subcontracting model.

PLATFORM BUSINESS MODEL



Within a platform business model, each part of the value chain interacts with the platform owner. This leads to disintermediation, and allows for a 'capital lite' approach to growing industry capacity.

#21 – Regulatory Reform for Industrialised Construction

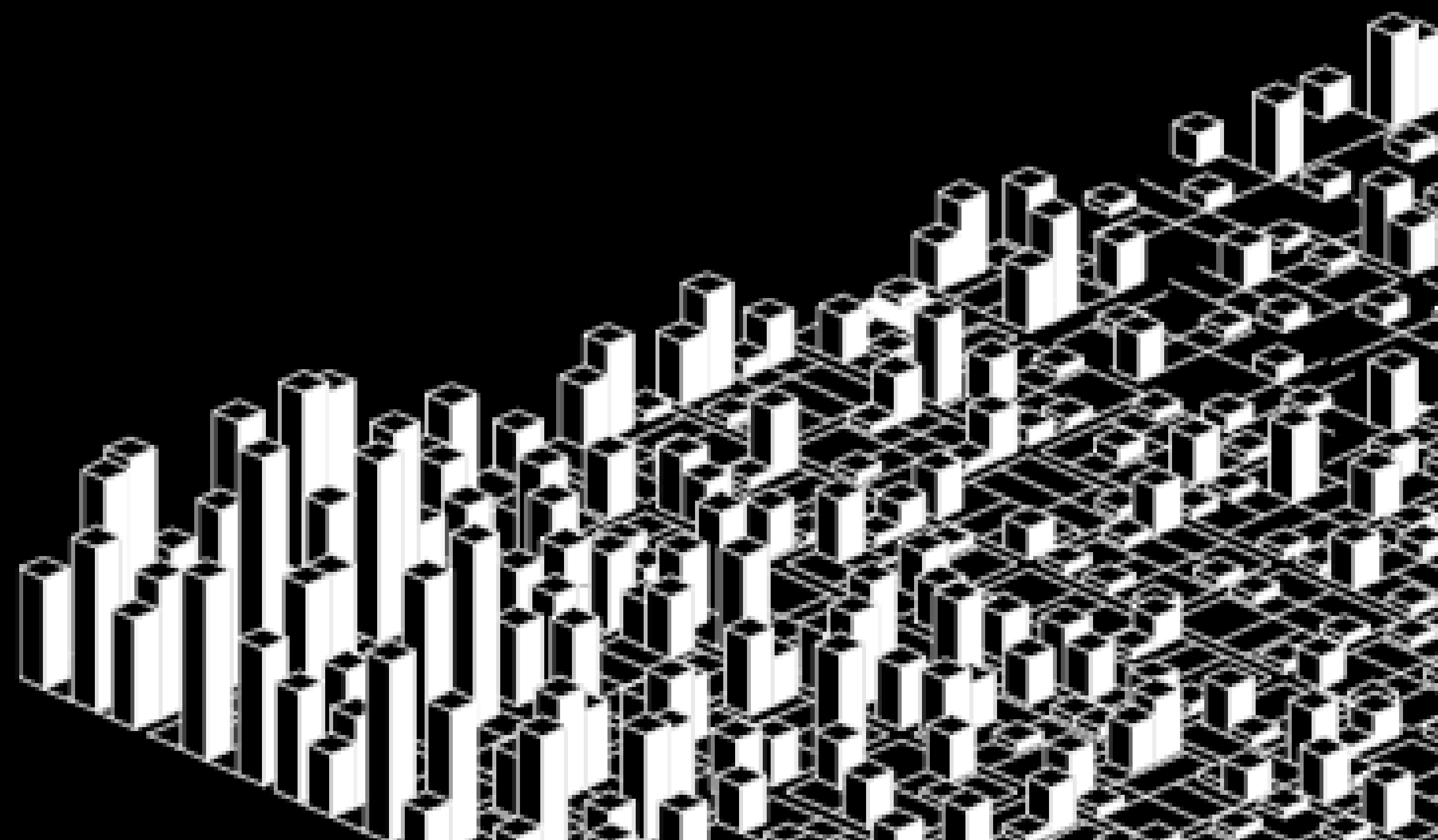


#66 – Future of Construction Education



Lighthouse Projects

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Artist impression



Ngerren biik Queens Corner Building

A Hub of
Research and
Innovation –
Building 4.0 CRC
– Lighthouse
Research Project



Lighthouse Projects

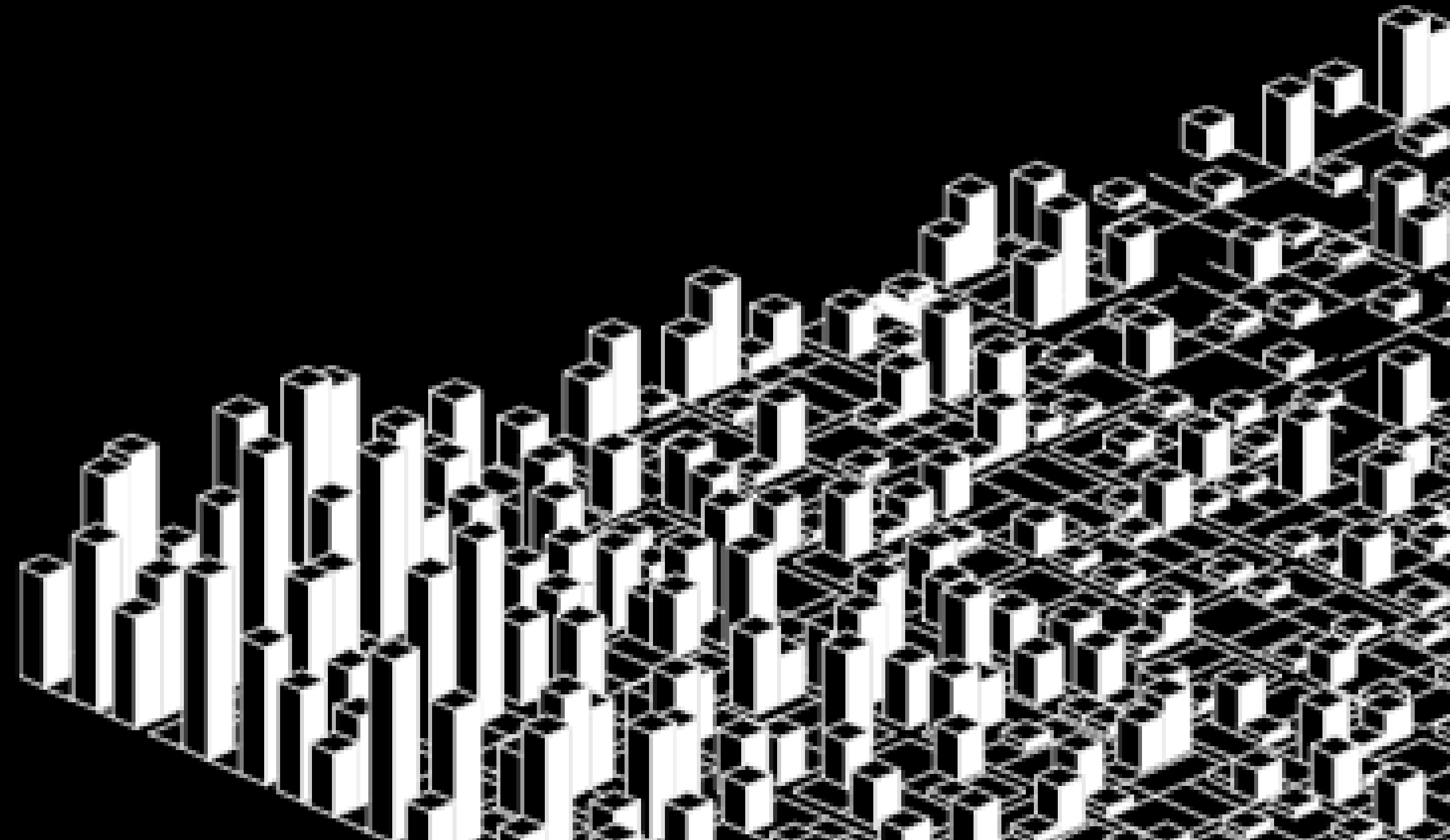
*Currently developing proposals in all AU states
with industry and government partners*

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Get involved!

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CULTURE OF INNOVATION

B4.0 CRC Annual Conference

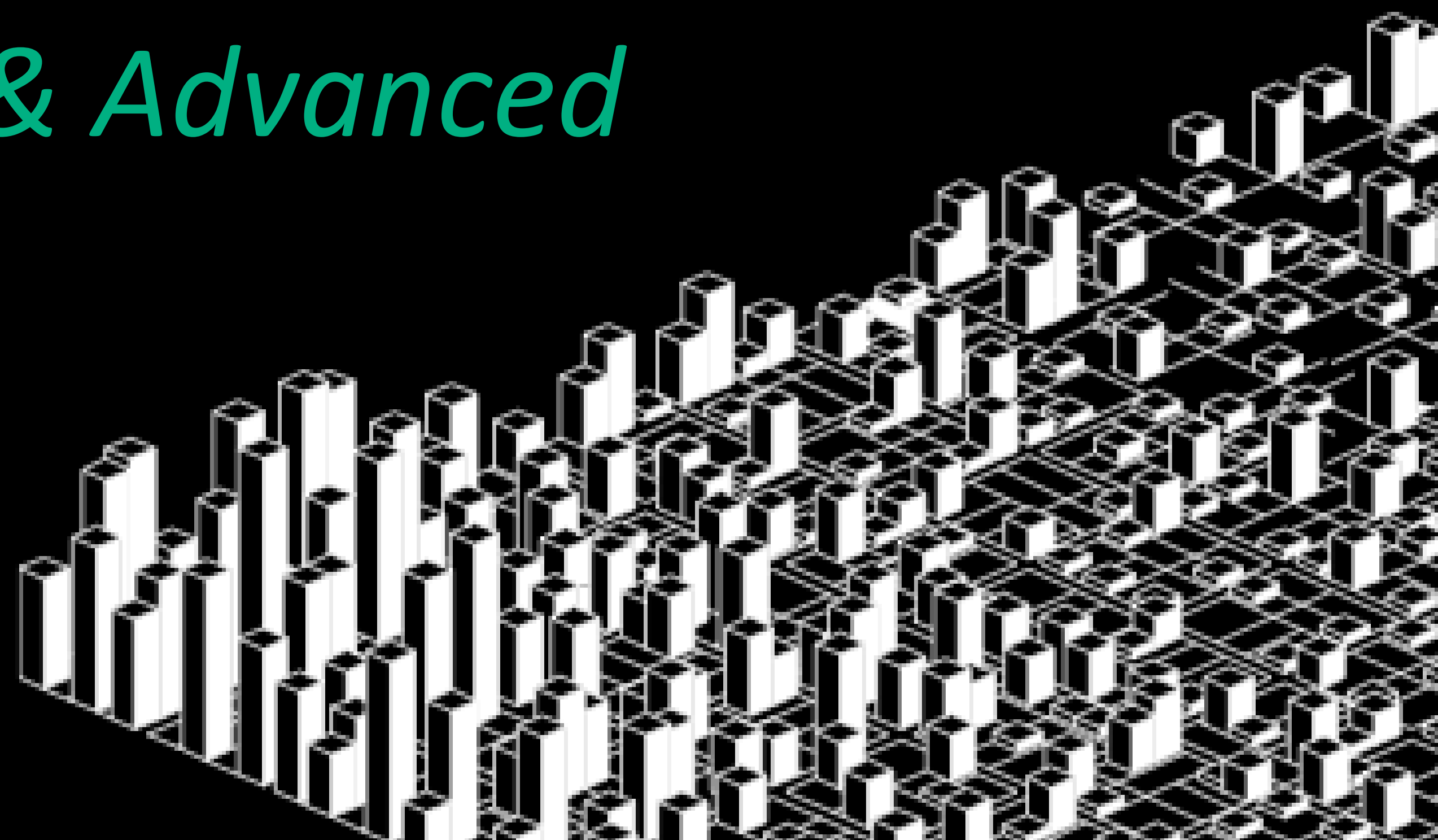
Wednesday 11 October, Melbourne



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