

Design for Manufacturing and Assembly (DfMA), and Modular Construction in Australia



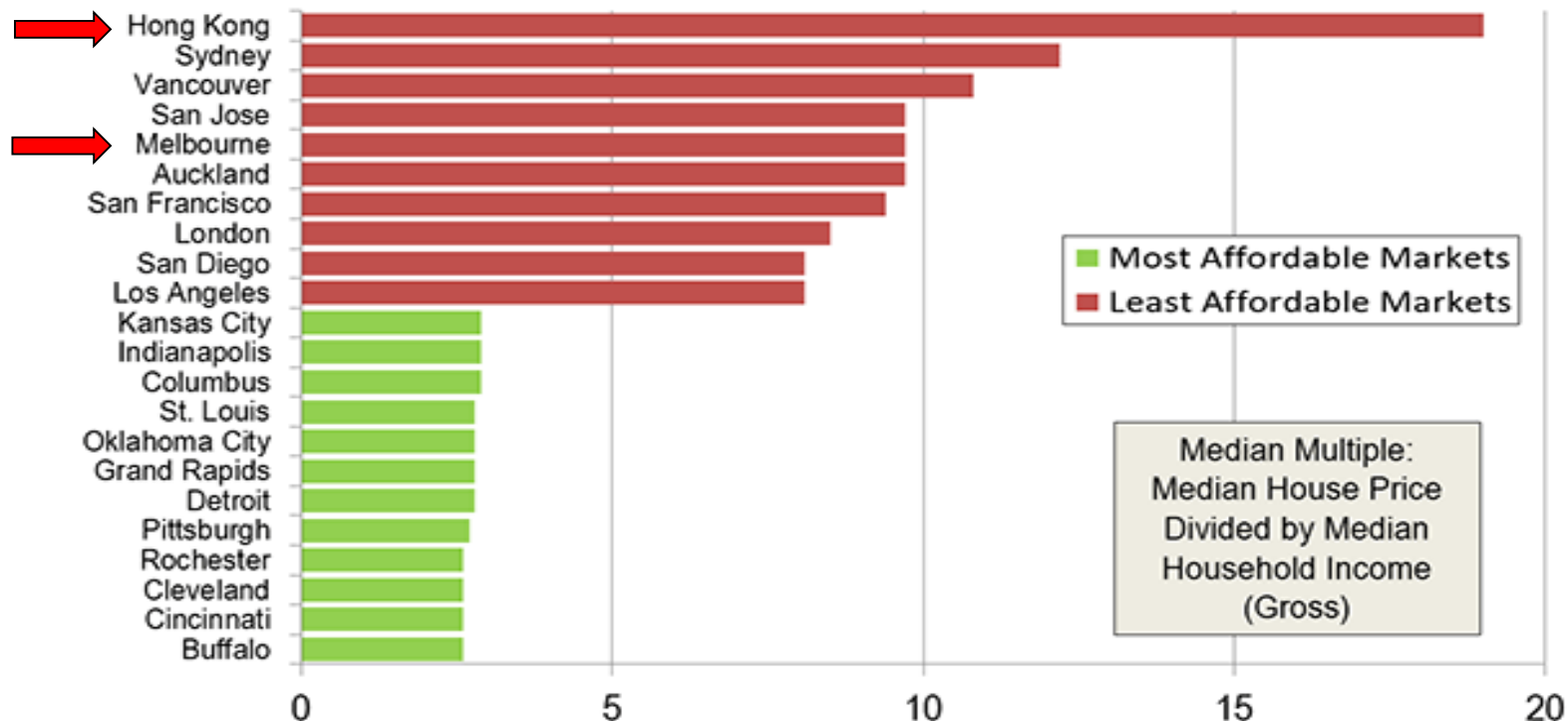
Prof Tuan Ngo,

Research Director - ARC Centre for Advanced Manufacturing of Prefabricated Housing
The University of Melbourne, Australia



Most & Least Affordable Major Markets

DEMOGRAPHIA HOUSING AFFORDABILITY SURVEY





By 2050, Melbourne's population will double to more than 8 million
Extra 700,000 homes will need to be built over the next 15 years

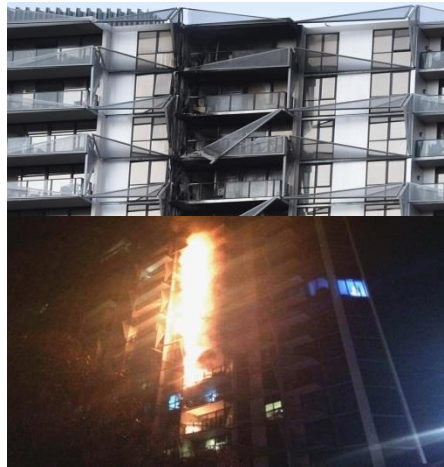
Key problems

1. Project Delays & Cost Overrun



- One in three projects experienced delay and cost overrun by up to 50%
- Governments lost \$28 billion over the last 15 years on cost overruns in infrastructure projects

2. Non-conforming Materials & Building Products



- More than 50% of tall buildings in Melbourne use non compliant cladding materials

3. Quality Issue & Reduced Workplace Productivity



- 40% projects reported having quality issues
- Cost \$2 billion a year for re-work
- Productivity hasn't changed over the last 20 years

4. Safety on Site & Skilled Labour Shortages



- Over 5 years 2008-2013
 - 182 workers killed
 - 63230 serious injuries
- 20% tradespeople above 55 yr

Productivity challenge, how can we solve it?

Challenges: How do we build faster, cheaper, high quality and more sustainable buildings & infrastructure?



McKinsey & Company, 2017, Reinventing construction through a productivity revolution

5–10X productivity boost

possible for some parts of the industry by moving to a manufacturing-style production system



DIGITAL TECHNOLOGY, NEW MATERIALS, AND ADVANCED AUTOMATION

Lower costs

33%

reduction in the initial cost of construction and the whole life cost of built assets

Faster delivery

50%

reduction in the overall time, from inception to completion, for newbuild and refurbished assets

Lower emissions

50%

reduction in greenhouse gas emissions in the built environment

Improvement in exports

50%

reduction in the trade gap between total exports and total imports for construction products and materials

Resilient, Affordable and Sustainable Buildings



Markets for Modular Prefab Construction

Residential



\$40B (Aus)
+\$500B (Asia)

Education



\$150M (Vic), 100 schools
\$2B (NSW),

Healthcare



**\$6B/pa on upgrade
& ext.**

Hotels



\$15B market

Infrastructure



\$70B next 5 years

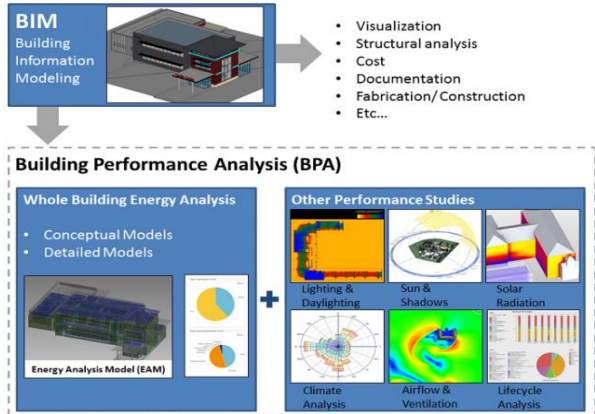
VISION

To create a global **research hub** that enables rapid growth of the emerging prefab manufacturing industry to deliver **affordable and high-quality housing** through innovation and streamlining of the supply-chain.

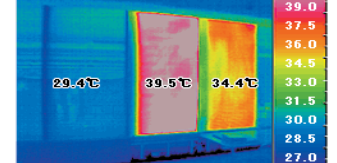
\$4 million Australian Research Council funding and matching funding from industry



One-stop-shop: Digital design, prototyping, materials & components, testing and certification, manufacturing/automation, process optimisation, monitoring

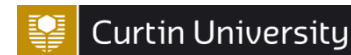


Fire
Acoustic
Structural
Thermal
Durability
IAQ
Energy
Wind
Flood
Earthquakes



Comparison of the temperature of the interior surface by window system



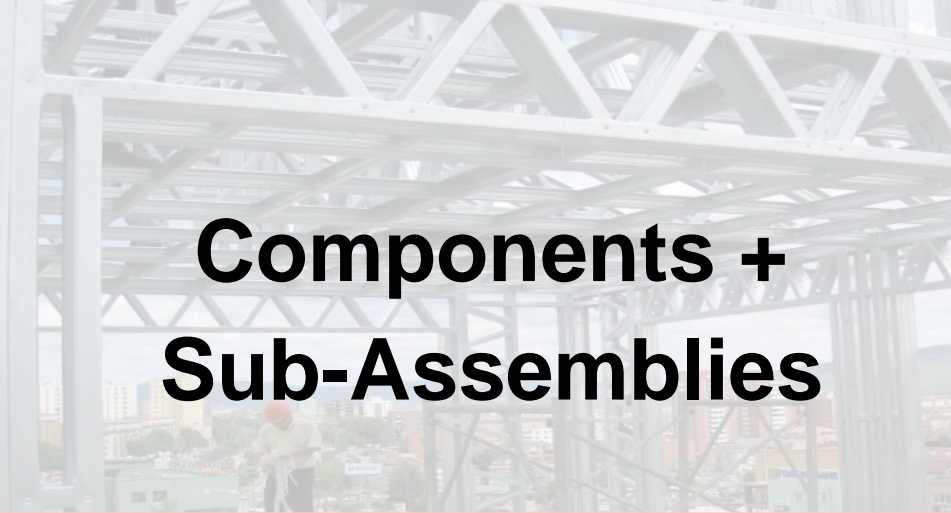


Transform the Australian construction industry through:

- New materials, systems, techniques, and processes
- New financing and supply-chain models
- Achieve a step-change in productivity
- Realise significant cost reduction
- Up-skill existing workforce
- Develop high-value manufacturing capabilities





A close-up view of a complex steel truss structure, likely part of a bridge or a large industrial building, with a city skyline visible in the background.

Components + Sub-Assemblies

A large yellow crane is lifting a flat, rectangular panel into the air. The panel is suspended by cables. In the background, a modern building with a yellow facade is visible under a blue sky.

Panels

A view of a modern building with large glass windows and doors. The building has a multi-level design with a mix of glass and concrete. The sky is blue with some clouds.

Modules

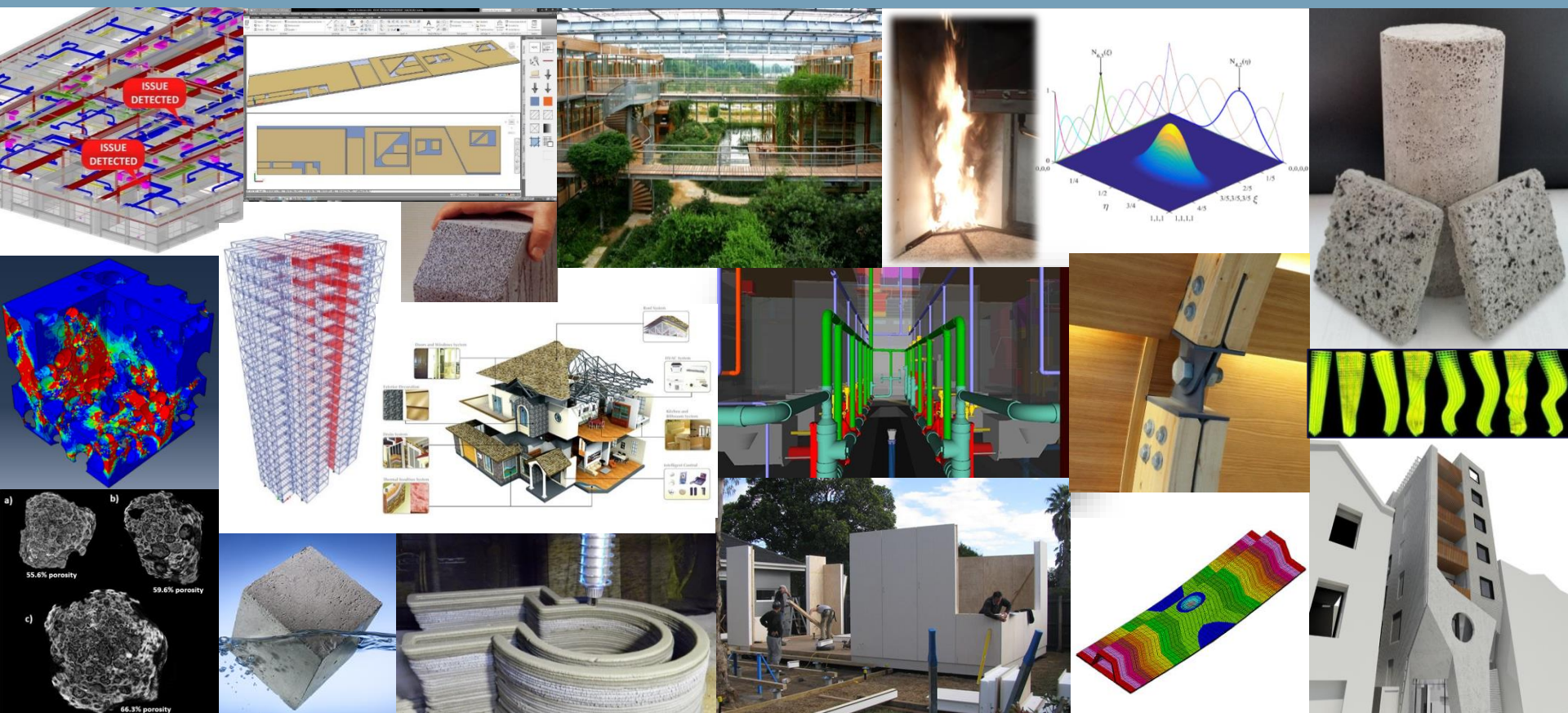
A modern, single-story building with a flat roof and large glass windows. The building is surrounded by greenery and trees. The sky is blue with some clouds.

Whole Buildings

From Panelised to Volumetric Systems

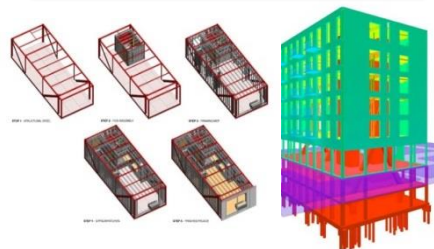


Enabling technologies - Our R&D projects



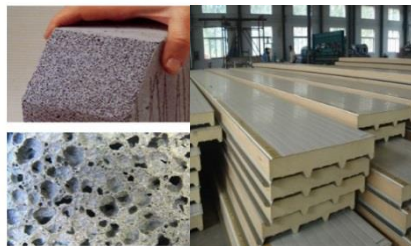
Key Programs

1. Digital Technologies for Design, Simulation, DfMA



Improved Productivity & Safer Construction

2. Novel Material Development & Testing



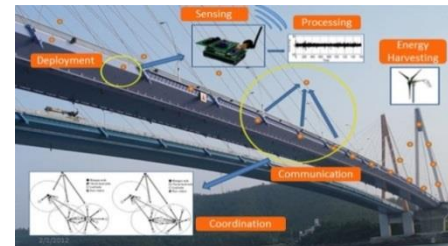
Cost Effective, Energy Efficient, Less Waste

3. Innovative Construction & Infrastructure Systems



Better Quality & More Affordable Housing

4. Financing, Risk & Supply Chain Management



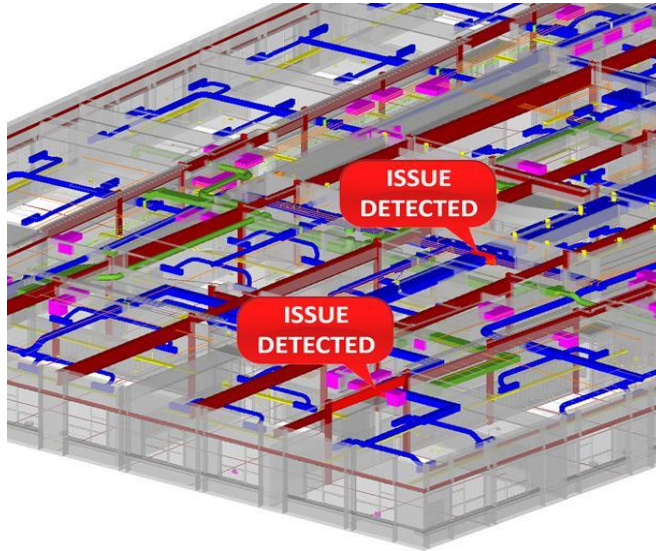
Export Opportunities, Global Market

More Resilient, Lower Life Cycle Cost

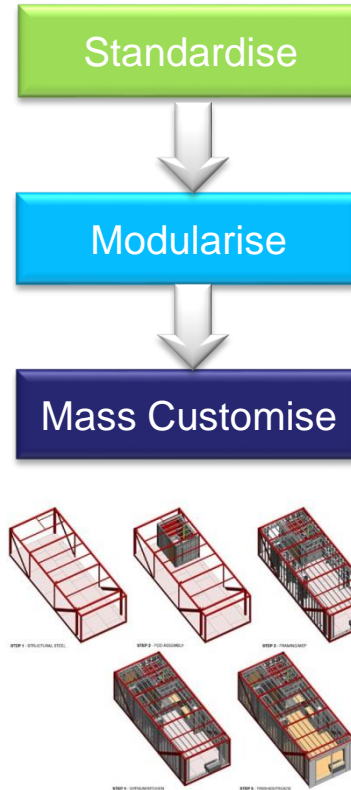
Industry Outcomes

- 60% faster construction
- 50% reduction in life cycle costs
- 90% reduction in waste
- 50% reduction in GHG emission
- 70% reduction in labour & transport

1. Innovation in Design for Manufacturing and Assembly

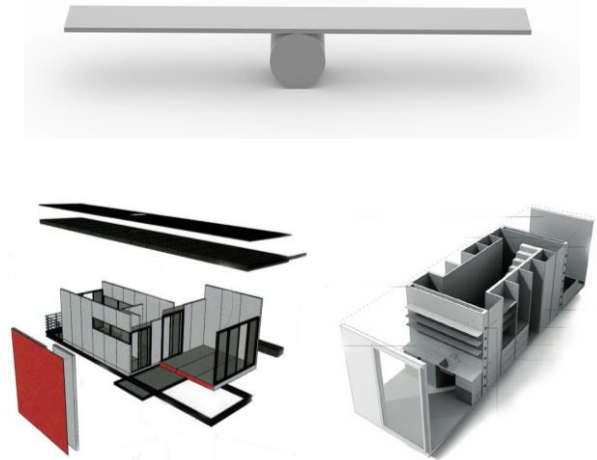


- Design for Manufacturing and Assembly (DfMA)
- BIM Platform for Modular Prefab
- Design for Transportation

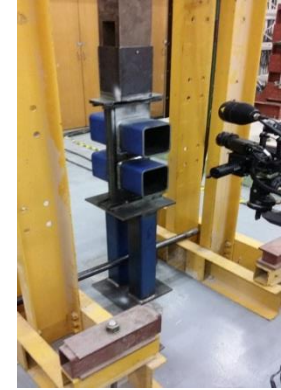
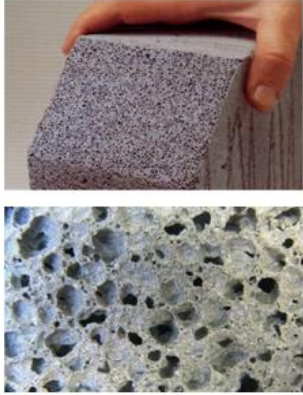


VOLUME

CHOICE



2. High performance materials



Lightweight

Fire resistant

Affordable



High Strength

Durable

Environmental friendly

3. Advanced building systems and assembly techniques



Lightweight Floor Systems
Framing Systems
Panelised Systems
Smart Pods
Connections





Challenges

- Australian banks risk averse in lending to modular
- Risk of traditional modular industry being disrupted by imported modular industry if finance isn't solved.
- Supply chain inefficiency

Program 4: Supply chain and financing innovation

- New risk profiling tools and procurement frameworks for prefab housing.
- Logistic optimisation
- Assist industry to develop a more efficient supply chain and new financing models.

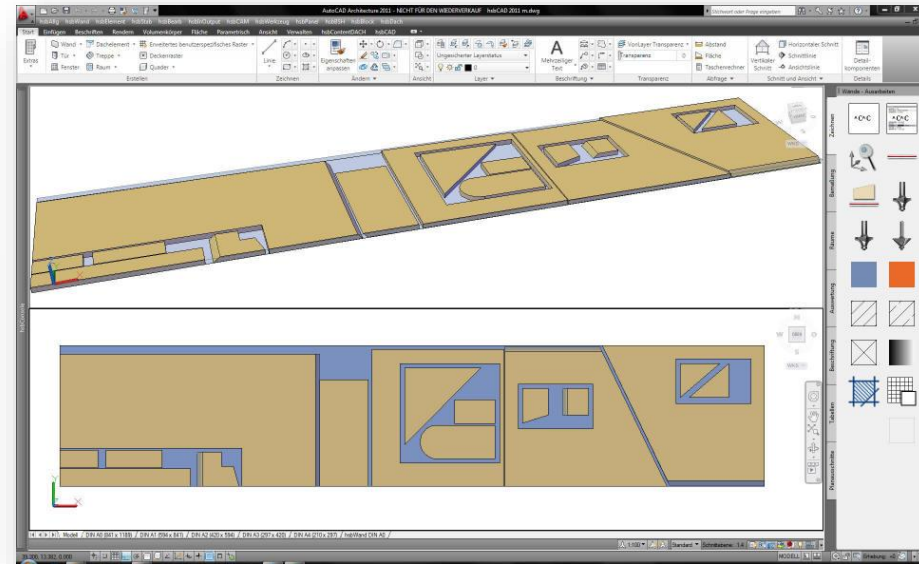


Modular Panelised Systems





- Engineered timber post-tensioned panelised system
- Experimental and numerical validation of structural performance
 - Lifting system
 - Panel system
 - Timber floor system



Timber Building Systems

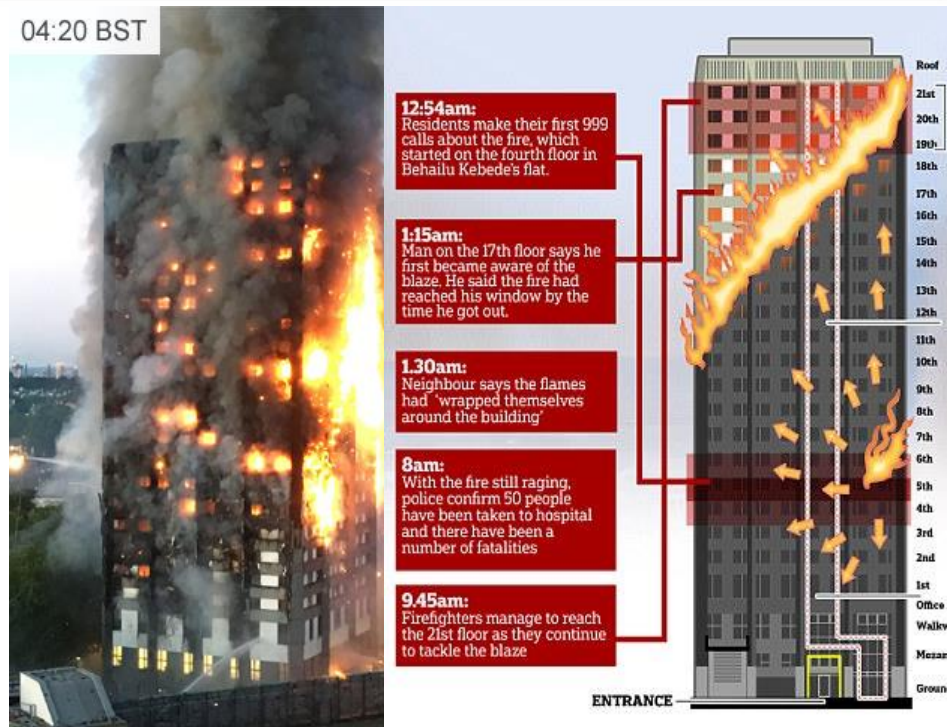
Non-compliant Building Products – A Global Issue



**Lacrosse Tower
Melbourne, 2014**



**The Address Hotel
Dubai, 2015**



**Grenfell Tower,
London, 2017**



HUGE COST TO OWNERS

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“Since the fire, **312** apartment owners in the 23 storey Lacrosse Tower have been ordered to rip off and replace the noncompliant material within the next 12 months and will be forced to **bear the estimated \$40 million cost themselves.**”

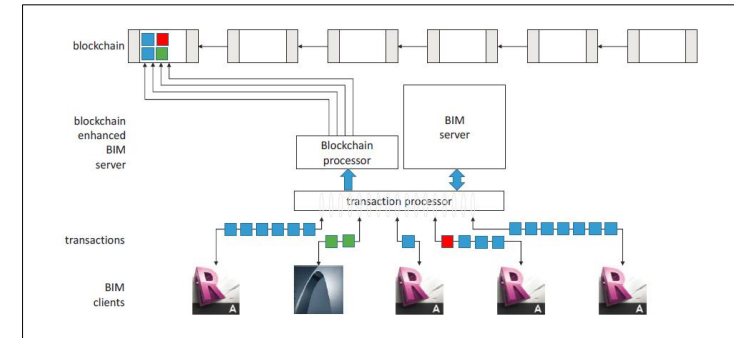
The Australian, 18 February 2016

That equates to a cost of approximately
\$128 000/per apartment



More than 50% of high-rise buildings in Melbourne use similar non-compliant cladding materials

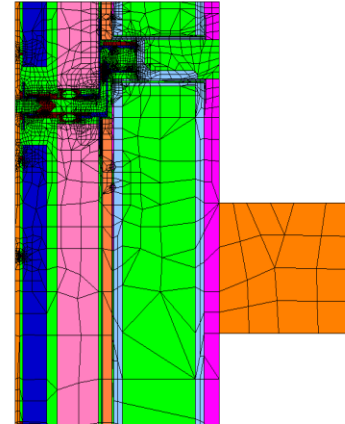
- The main challenge of the traditional supply chain is the shortage of an open and trustworthy information resource across the supply chain. Every link in the supply chain is a bottleneck for information sharing and trust erosion.
- The Blockchain technology has the potential to tackle these challenges. Information on each product can be indelibly recorded in the product's Blockchain. This capability can be extended to provide some supporting evidence of any claim made about products or services provided.
- All of these records are available to the supply chain participants and can enable any audits on quality issues faced in the downstream supply chain. Since the information input to the Blockchain system is authenticated, the reliability of the information is significantly higher than in traditional building projects.





Australian Government
Department of Industry,
Innovation and Science

CRC-P on Advanced Manufacturing of High Performance Building Facade Systems



Inclose Façade System



ANU Student Accommodation Project



Project details:

- Production to commence in April 2018
- Installation to commence in May 2018
- Façade installation complete in August 2018



SOUTHMOOR PRIMARY SCHOOL

CLIENT:

DET/ Victorian School
Building Authority (VSBA)

PROJECT TEAM:

Grove Aust Pty Ltd
K20 Architects
BHA Project Management

TIMELINE:

Award: 5 October 2017
Design: 12 November 2017
Delivery: 9 January 2018
Handover: 26 January 2018

BUDGET

Design= \$120,000
Construction= \$2,100,000
Civil works= \$420,000

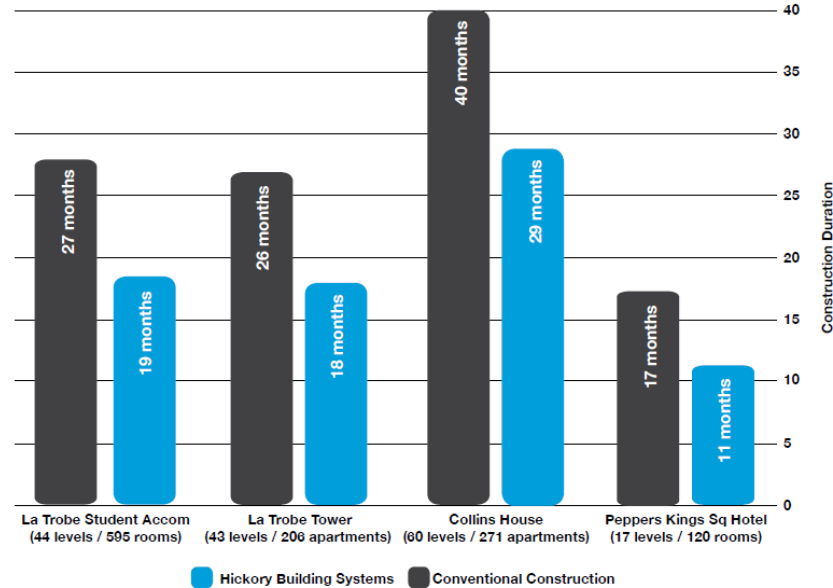
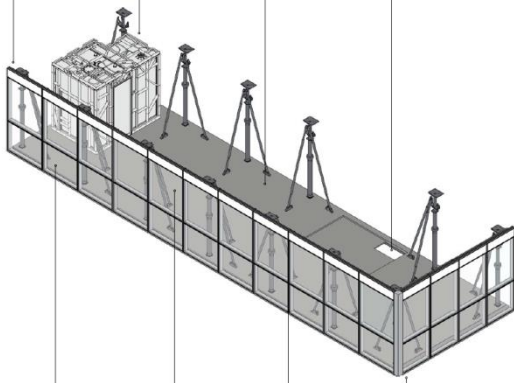


77 apartments.

6 levels.

Assembled on site in just 10 days.

La Trobe Tower - Australia's tallest prefabricated building





Thank you



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