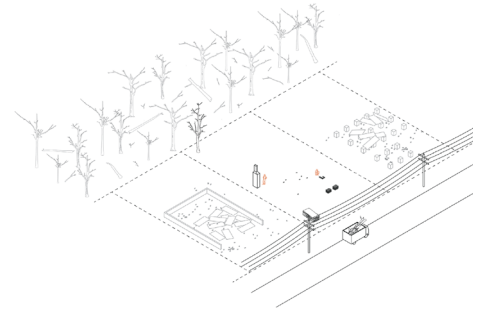**01 POST FIRE**
immediately post disaster

site clearing

material collection
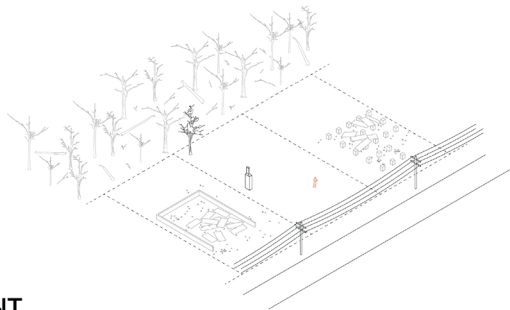
02 CLEAN UP
site made safe

site assessment
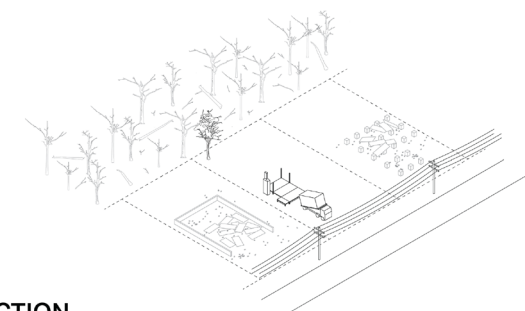
client decisions

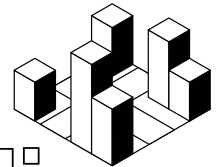**03 ASSESSMENT**
siting decisions

pod journey

05 CONSTRUCTION
delivery to site

building
4.O crc

2023

ANNUAL REPORT

building4pointzero.org

EXECUTIVE SUMMARY

Building 4.0 CRC has now completed its third year of a seven-year tenure, and our work has never been more critical.

2023 brought into sharp focus the many issues the building industry currently faces – housing affordability and supply, building company insolvencies, meeting sustainability and other environmental requirements. These problems can be traced back to the lack of innovation and the fragmented nature of the wider building sector.

Now is the time for the sector to come together to expand existing solutions and try new ideas: a forum that Building 4.0 CRC can help provide.

Our vision is an innovative, productive, efficient and sustainable building industry. In this future, the building industry will be an ecosystem facilitated by industrialisation and digitalisation. It will be underpinned by new flows of value in the industry that lead to a new building lifecycle.

Our mission is to guide the industry to this future of building and develop next generation researchers and professionals. The CRC is ideally poised to bring together the critical ingredients for change

to create a national pathway for innovation in the building industry.

Over the past 12 months, our activities have started moving from desktop research to more applied research to works on the ground. We have launched five Light House Projects – real buildings that demonstrate our research in action. These projects pair built or to-be-built projects with an R&D agenda. We currently have over 20 Light House Projects in the development pipeline.

We also launched our first Shared Interest Projects (SIP) – a scoping study to create a circular economy roadmap for Australia's property and construction industry. As the name suggests, Shared Interest Projects cover topics that affect all aspects of the building supply chain – from design to construction to disposal.

By facilitating collaboration between industry, government and research partners, and with world-leading expertise, we seek not only to develop new ideas but also to grow awareness and adoption of innovation in building.

We thank all our partners for their continued involvement in the CRC. Together, we will continue to deliver our ambitious plan to transform Australia's building industry.

CONTENTS

OUR PARTNERS

COMMERCIAL INDUSTRY

lendlease · BLUESCOPE · SUMITOMO FORESTRY · uTECTURE · DONOVANGROUP · salesforce

A.G.Coombs · Coresteel BUILDINGS · ultimatewindows · HYNE TIMBER · FLEETWOOD AUSTRALIA

aws · TARONGA VENTURES · YNOMIA · ViRIDI · VERTON

PROJECT PARTNERS

AMGC ADVANCED MANUFACTURING GROWTH CENTRE LTD · NASH · Nexans ELECTRIFY THE FUTURE · POPULOUS · Stockland

PEAK BODIES
MASTER BUILDERS VICTORIA · Green Building Council Australia · prefabAUS · STANDARDS Australia

UNIVERSITIES
MONASH University · THE UNIVERSITY OF MELBOURNE · QUT

VOCATIONAL EDUCATION AND TRAINING
holmesglen

GOVERNMENT
VICTORIA State Government | Jobs, Precincts and Regions · VBA VICTORIAN BUILDING AUTHORITY BUILDING CONFIDENCE

MAJOR

ACHIEVEMENTS

Building 4.0 CRC is an industry-led research and development consortium funded by the Australian Government.

Our aim is to develop an internationally competitive, dynamic and thriving Australian advanced manufacturing sector, delivering better buildings at lower cost and the human capacity to lead the future industry.

"The main thing that drives productivity of labour is giving workers better processes and solutions to work with – that's innovation. Productivity improvements also come from investing in human capital – that's training and education. These are exactly the areas Building 4.0 CRC has focused on since we started. And it's what we will continue to focus on looking ahead."

"After three years, we have approved 55 projects. At this level of maturity, we are now thinking more about the impact of the research. Not just doing the research, but asking how we can improve our impact and how can we accelerate it?"

Building 4.0 CRC major achievements

IMPACT MATRIX

We developed an impact matrix tool to track and measure the impact of all CRC projects for partners and research.

INTERNATIONAL STUDY TOUR

We led our first group tour to Europe, to see international innovation in action. Taking 20 people to 3 countries, attendees included industry, research, not-for-profit and government representatives.

IMPACT ON INDUSTRY

Building 4.0 CRC Annual Showcase 2023

Double 2022 attendees

Presentations and demonstrations from industry partners and researchers

Project exhibitions

PhD posters

CULTURE OF INNOVATION

Building 4.0 CRC Annual Conference 2023

Attracted record attendance

Broad range of attendees from industry, peak bodies, government and research

International keynote speakers from 4 countries

Esteemed industry panellists

Industry exhibitors

Partner-led roundtable discussions

Record media engagement

INDUSTRY LEADERS

Prof. Mathew Aitchison was a finalist in the Industry Leader of the Year at the Inside Construction Foundation Awards.

NEW COLLABORATIONS WITH INDUSTRY

Finding Infinity, Fologram, LTCM, Nash, Nexans, Populous, Stockland, Verton Cranes & VMIA.

BUILDING AWARENESS

Prof. Mathew Aitchison gave a keynote address at the Industrialized Construction Forum at Stanford University. He also presented at the Greater Cities Commission, the National Innovation Policy Forum 2023 and the Property Council Breakfast on Alternative Housing Solutions.

INTERNATIONAL WOMEN'S DAY

We held our first International Women's Day event, where Dr Bronwyn Evans AM (Chair) shared her reflections on career highlights and some powerful insights into what it takes to become a leader.

RESEARCH EXCELLENCE

Our program leader from Monash University, Dr Duncan Maxwell, was nominated for the VC award for Research Excellence. He also presented at a knowledge exchange at ETH Zürich.

Our Skills & Training Leader, Dr Ross Digby, won a fellowship from the Victorian Skills Authority in partnership with the International Specialised Skills Institute.

SUSTAINABLE BUILDING SPECIALIST

Our program leader from University of Melbourne, Prof. Tuan Ngo, was named a fellow of the Australian Academy of Technological Sciences & Engineering, as a sustainable building specialist.

IN THE MEDIA

We featured on national media channels such as: ABC news, ABC Radio, SBS News & SBS Radio, as well as multiple platforms following our article on the housing crisis in The Conversation.

ENGAGEMENT

We substantially increased our engagement with government and external peak bodies to build awareness of the changes that the building industry needs.
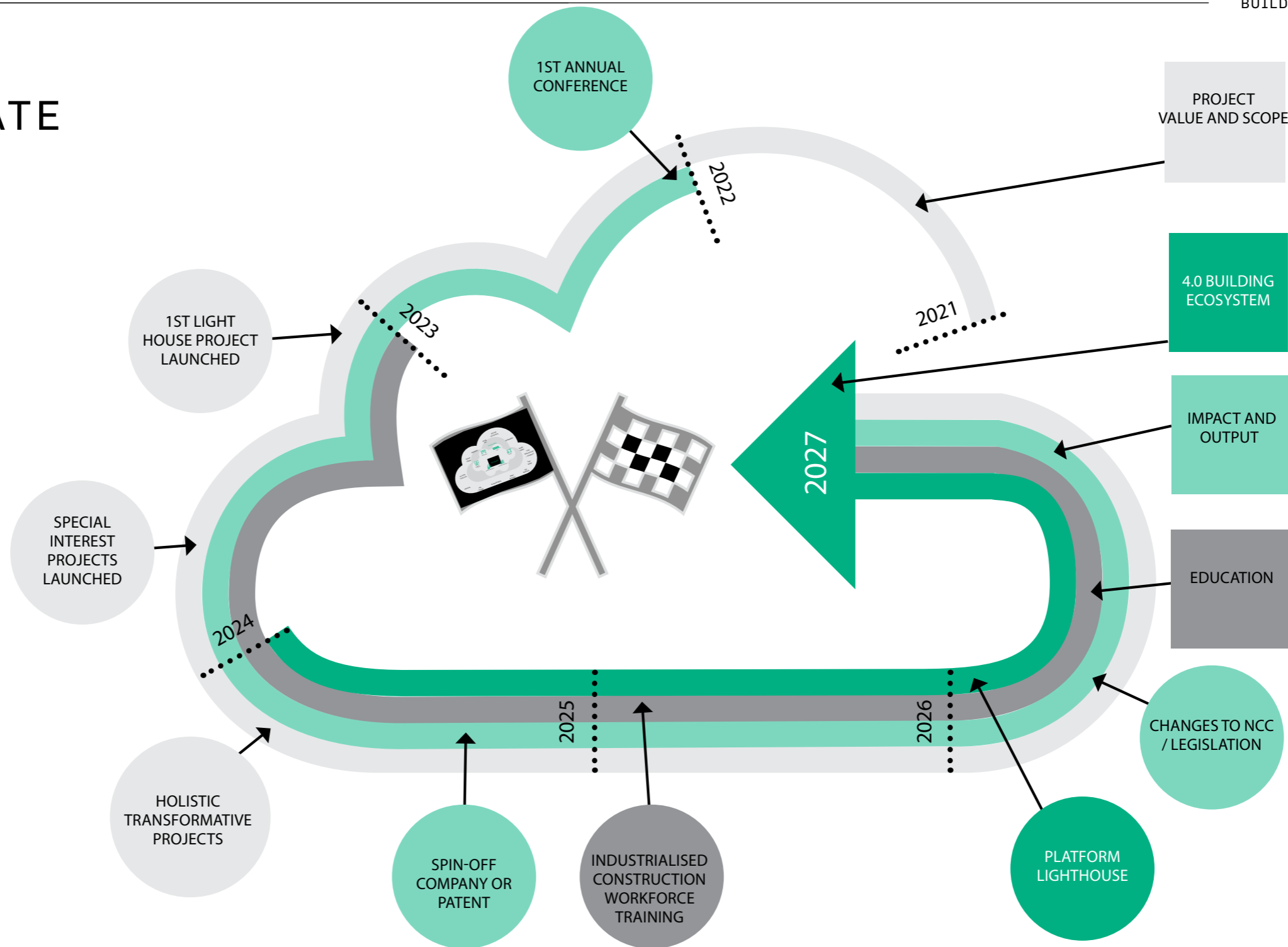
RESEARCH UPDATE

—

"As we mature and refine our approach to the research, we are exploring how we can get the most out of every project." –

Prof. Chris Knapp, Research Director

Nearing the half way mark in our seven-year term, we are moving from generating new knowledge, ideas and technologies, to applying them to works on ground, to understand how they can work in practice.

Diagram labels: 1ST ANNUAL CONFERENCE · PROJECT VALUE AND SCOPE · 4.0 BUILDING ECOSYSTEM · 1ST LIGHT HOUSE PROJECT LAUNCHED · IMPACT AND OUTPUT · SPECIAL INTEREST PROJECTS LAUNCHED · EDUCATION · CHANGES TO NCC / LEGISLATION · HOLISTIC TRANSFORMATIVE PROJECTS · SPIN-OFF COMPANY OR PATENT · INDUSTRIALISED CONSTRUCTION WORKFORCE TRAINING · PLATFORM LIGHTHOUSE · 2021 · 2022 · 2023 · 2024 · 2025 · 2026 · 2027

Work began on five Light House Projects:

Light House Project #1 – Monash Smart Manufacturing Hub (mSMH) – A Digital Twin Living Lab: Aims to address the challenges associated with creating digital twins, which digitise the operation and maintenance of physical assets.

Light House Project #3 – NCHA Independent Living Lab: Will design and construct the NCHA Independent Living Lab, which will test and demonstrate care models for healthy living and ageing.

Light House Project #6 – Malvern East Apartment Development: Involves redesigning a three-level apartment building from traditional in situ concrete to prefabricated timber, and then benchmarking performance across various parameters.

Light House Project #7 – Platform Delivery of Affordable Housing: Aims to demonstrate sustainability improvements, validate digital construction processes and quantify value gains using an offsite platform approach to construct affordable housing.

Light House Project #13 – Mixed Reality Carpentry Demonstration: Investigates how augmented reality and virtual reality can enhance prefabricated component assembly in carpentry and construction, drawing on real-time assembly of a complex timber pavilion at the Building 4.0 CRC Annual Conference 2023.

The first Shared Interest Project (#48) Building the Future – Circular Economy began – a scoping study to create a circular economy roadmap for Australia's property and construction industry.

As the name suggests, these projects cover topics that affect all aspects of the construction supply chain – from design to construction to disposal.

We also launched a Research Expression of Interest (EOI) process, asking members of the CRC community propose new research projects. Proposals supported by industry partners receive priority. To date we have received 23 proposals and endorsed 10 projects for further development.

PROJECTS

The CRC had approved 55 projects by the end of 2023:

•17 projects started in 2020-21, 19 projects started in 2021-22, 15 started in 2022-23, and 4 started in the first half of 2023-24.

Another 60 projects are in the pipeline:

• 36 research projects, 23 Light House Projects and 1 Shared Interest Project.

The complete list of active and completed projects is listed overpage.

PROJECTS BUILDING4POINTZERO.ORG/PROJECTS/

BLACK TEXT = ACTIVE

GREY TEXT = COMPLETED

PEOPLE, PLACES & CULTURE

3	Projects to Platforms: Investigating New Forms of Collaboration – Scoping Study	A.G. Coombs, BlueScope, Hyne & Son, Lendlease Digital, Monash University, Sumitomo Forestry, The University of Melbourne
21	Regulatory Reform for Industrialised Building	A.G Coombs, Fleetwood Australia, Lendlease Digital, Queensland University of Technology. Standards Australia, Sumitomo Forestry Australia, Master Builders Association Victoria, Victorian Building Authority
40	Business Model Innovation in the Building Industry: Better Buildings and Better Bottom Lines	AMGC, PrefabAUS, Monash University, University of Melbourne.
7	New Technologies, the Future of Work, Skills and Industrial Relations (IR)	AG Coombs, Holmesglen Institute, Master Builders Assoc, Lendlease Digital Delivery, Monash University, Queensland University of Technology, The Master Builders Assoc. The University of Melbourne.
17	The Implications and Opportunities from Industry 4.0 for the Building Industry: towards smart prefab	AMGC and Prefab Innovation Hub (Funding body), Various Building 4.0 CRC Industry Partners, Monash University, The University of Melbourne, Queensland University of Technology
23	When prefab hits the ground: Barriers and opportunities in the Australian housing market	Fleetwood, Sumitomo Forestry, Monash University, Queensland University of Technology
30	Critical Path IMPACT through Productisation	Lendlease Digital, Monash University, The University of Melbourne
35	Prefab Housing Solutions for Bushfire & Disaster Relief	AMGC and Prefab Innovation Hub (Funding body), University of Melbourne, Monash University, Queensland University of Technology
47	Promoting Capabilities and Opportunities for Future Building Technologies & Solutions	Austrade

SUSTAINABILITY

11	Environmental Credentials for Building Technology Platforms	utecture, Coresteel, Monash University
15	Using the Whole Tree for Future Timber-Based Construction – Scoping Study	Hyne & Son, Sumitomo Forestry, University of Melbourne
36	Academic validation of performance gap research in energy rating systems	Green Building Council of Australia, Monash University
45	Prefab Wall Integrated System – Phase 2	Bentley Homes, Ultimate Windows, The University of Melbourne
48	Scoping Study for Building the Future – Circular Economy	Shared Interest Project - All Building 4.0 CRC Partners
60	Mass Timber Wellness	VIRIDI Group, Sumitomo Forestry, Monash University Queensland University of Technology
5	Automatic compliance and energy rating system	uTecture, Green Building Council of Australia, The University of Melbourne, Monash University, Queensland University of Technology
18	Long-Span Low-Carbon Floor Systems	Lendlease Digital, Sumitomo Forestry, Monash University, The University of Melbourne
26	New materials for windows of the future	Ultimate Windows, Monash University
27	Environmental Decision-Support for Structures	BlueScope, Monash University, The University of Melbourne
37	Australian Timber Fibre Insulation Scoping Study	Hyne & Son, The University of Melbourne, Ultimate Windows

INDUSTRIALISATION

24	Next Generation of Robust and Fire-resilient Light Gauge Steel Systems for Mid-Rise Buildings (Umbrella Project)	BlueScope Steel Limited , Queensland University of Technology, The University of Melbourne
32	Acoustic flanking performance of mid-rise light gauge steel (LGS) structures	BlueScope, Monash University & University of Melbourne
41	Advanced Windows - Phase 2 Development of Novel Hard Coat for Plastic Double Glazed Windows	The University of Melbourne, Ultimate Windows
59	Innovative Steel - Timber - Concrete Composite StongFloor	VIRIDI Group, The University of Melbourne
LHP3	Independent Living Lab	Fleetwood Australia, Monash University: Urban Lab, Future Building Initiative, Design Health Collab School of Primary Allied Health Care (RAIL Lab), Monash University Buildings and Property Division, Peninsula Health Allied Health Team
LHP6	Malvern East Apartment Development	Monash University, Sumitomo Forestry, The University of Melbourne
LHP 7	Platform Delivery of Affordable Housing	BlueScope, Nexans, The University of Melbourne, LTCM
4	Computational Design and Optimisation Tools for Prefabricated Building Systems – Phase 1	M-Modular, The University of Melbourne, Queensland University of Technology
8	Prefab, Integrated Wall Systems - Scoping Study	Bentley Homes, Ultimate Windows, The University of Melbourne, Monash University
9	Implementing DfMA and Lean in Construction: Best Practice Guidelines through a Study of Building Services and Structure	A.G. Coombs, Lendlease Digital, Monash University, The University of Melbourne
10	Product Platform for Volumetric Building (Scoping Study)	Fleetwood, Monash University
19	Hybrid Timber Steel Structural Systems for Mid to High Rise Buildings – Phase 1 Scoping Study	BlueScope, Hyne & Son, Monash University, The University of Melbourne, Queensland University of Technology
20	Systems and methods for robustness of mid-rise light gauge steel (LGS) buildings – Phase 1 Scoping Study	BlueScope, The University of Melbourne, Monash University
22	Generative design and BIM-based Design Automation methods for Steel Framed Buildings – Phase 1 Scoping Study	BlueScope, The University of Melbourne, Queensland University of Technology
25	Operational Excellence framework of steel fabrication and processing in the OSM and prefabrication sector (Phase 1)	BlueScope, Fleetwood, Monash University, The University of Melbourne, Ynomia
28	Componentised Internal Wall Systems for Multi-residential Applications	Lendlease Digital, Monash University, The University of Melbourne
34	Acoustic flanking performance of mid-rise Light Gauge Steel (LGS) structures – Phase 1 Scoping Study	BlueScope, Monash University, The University of Melbourne
42	Workflow Automation Tools for Home Designs Phase 1 Scoping Study	Bentley Homes, M-Modular, The University of Melbourne, Queensland University of Technology

DIGITALISATION

29	Real-time EH&S Intervention to Improve Site Safety (Scoping Study)	Lendlease Digital Australia, Monash University, The University of Melbourne
33	Evaluation of Emerging Technologies for Remote (virtual) Inspections of Building Work	Victorian Building Authority, Victorian Managed Insurance Authority (VIMA), Salesforce, Sumitomo Forestry Australia, Monash University, The University of Melbourne
38	Victorian Government Digital Build - Translating Theory into Practice	A.G. Coombs, BlueScope, Fleetwood, Coresteel Australia, Donovan Group, Victoria State Government Department of Jobs, Precincts and Regions, Lendlease Digital, Monash University, SFDC Australia, Salesforce.com, Sumitomo Forestry Australia, The Master Builders Association of Victoria, The University of Melbourne, Ynomia
44	Generative Architectural Design Engine	Lendlease Digital Australia, Monash University
50	Development of Artificial Neural Network and Automated Life Cycle Assessments for Cloud Based Residential Energy Estimations	Monash University, The University of Melbourne, uTecture
53	Process Engineering, and Design and Estimating Automation of Fleetwood's Product Platform	Fleetwood, Monash University, The University of Melbourne
57	Wind Comfort Simulation and New Engineering Design Process	Lendlease Digital Australia, Monash University
61	Building Productvity: Product Proecess People	Lendlease Digital Australia, Monash University
LHP1	Monash Smart Manufacturing Hub (mSMH) – A Digital Twin Living Lab	AWS, Monash University
LHP13	Mixed Reality Carperntry Demonstration	Ynomia, Holmesglen Intitute, Monash University & Fologram
1	ePlanning and eApprovals – Scoping Study	Lendlease Digital, uTecture, Sumitomo Forestry, A.G.Coombs Group, salesforce.com, Inc., Master Builders Association of Victoria, Victorian Building Authority, Victorian Government, Department of Environment, Land, Water and Planning, Monash University, The University of Melbourne
2	Automated tracking of construction materials for improved supply chain logistics and provenance – Phase 1 Scoping Study	BlueScope, Holmesglen Institute, Lendlease Digital, Monash University, Queensland University of Technology, Salesforce.com, Inc., Sumitomo Forestry, Master Builders Association of Victoria, The University of Melbourne, Victorian Building Authority, Ynomia
6	Field data collation to support real-time operational management	Lendlease, Ynomia, Standards Australia, Monash University, University of Melbourne, Queensland University of Technology
12	VR/AR Technologies in Vocational Education and Training (Scoping Study)	Holmesglen Institute, Master Builders Association of Victoria, Monash University, Queensland University of Technology
31	Demystifying Volumetric Construction: A Study of the Bathroom Pod	Lendlease Digital, Monash University, Queensland University of Technology, The University of Melbourne
46	Data analytics for structural fibre resources optimisation	Hyne & Son Pty, Queensland University of Technology

CASE STUDY

PROJECT # 17: THE IMPLICATIONS OF INDUSTRY 4.0 FOR THE BUILDING INDUSTRY – TOWARDS A ROADMAP

PROJECT LEAD: Dr Philip Christopher, University of Melbourne

PROJECT PARTIES: Advanced Manufacturing Growth Centre, The University of Melbourne, Monash University, Queensland University of Technology, Bentley Homes, Bluescope, Exergenics, Fleetwood Australia, Hyne Timber, Lendlease Digital, prefab AUS, Space Platform, Xlam Australia, Ynomia

LINK: https://building4pointzero.org/projects/the-implication-of-industry-4-0-for-the-construction-industry-towards-smart-prefab/

START DATE: April 2021, 28 months

THE INDUSTRY PROBLEM

Industry 4.0, characterised by the integration of advanced technologies and digitalisation, is reshaping the global business landscape across many industries. These technologies – which include the Internet of Things (IoT), cloud computing, artificial intelligence (AI), robotics and automation – promise to improve sustainability, efficiency, productivity and project timelines. They can also enhance safety practices and risk management through real-time monitoring and data analysis.

To date, the building industry has lagged behind manufacturing industries and has failed to realise the key benefits of Industry 4.0. This project identified five key barriers:

- the complexity of building projects, marked by numerous interconnected processes, diverse participants and varied locations
- the unique, time-limited and site-specific nature of each building project, which creates unpredictability due to incomplete process specifications and a lack of uniformity in design, materials, work and teams
- the highly fragmented supply chain, characterised by numerous small and medium enterprises providing undifferentiated products and services with limited capacities for technology investment
- loosely connected permanent networks yet tightly coupled project structures that promote short-term thinking and inhibit long-term learning and innovation
- aversion to change and usually being the third or fourth adopter.

"The significance of understanding and integrating Industry 4.0 into the building industry cannot be understanded. By exploring the benefits and barriers of Industry 4.0, this research articulates steps government and industry can take NOW to accelerate adoption. A proactive approach, informed by best practice and backed by strategic investments, can usher the Australian building sector into a future of efficiency, innovation and growth."

PROFESSOR CHRIS KNAPP, RESEARCH DIRECTOR BUILDING 4.0 CRC

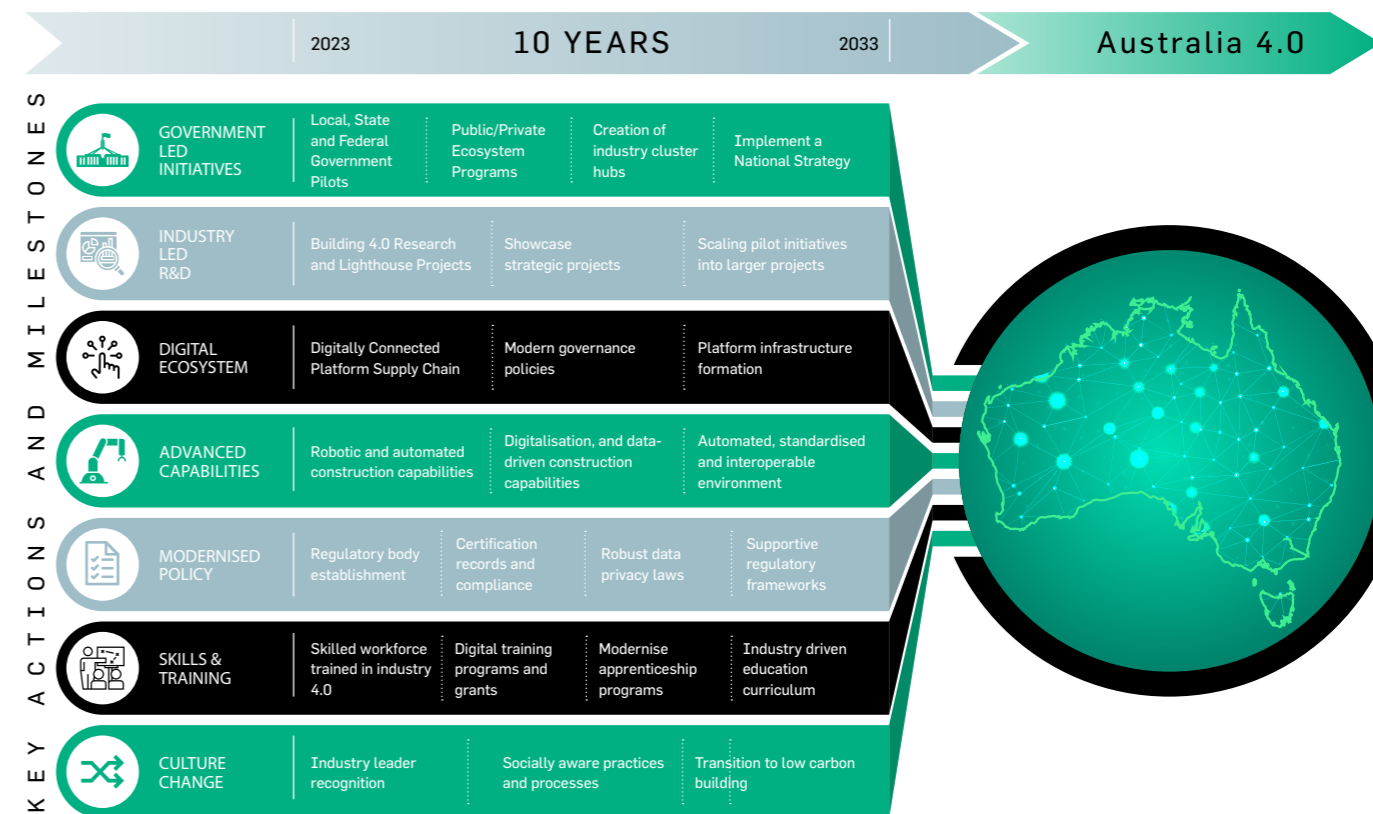Figure 1: Roadmap to Industrialised Constuction.

THE SOLUTION

The project team developed a roadmap to accelerate the adoption of Industry 4.0 by the building industry, identifying actions government and industry can take (figure 1):

Actions for government

- Improve skills development and education policies, particularly digital capabilities and the capabilities of those new to the workforce.
- Develop a national strategy that encourages building companies to adopt new technologies.
- Provide financial support (e.g. grants, subsidies and tax incentives) for building companies to invest in new technologies.
- Nurture collaboration and knowledge sharing among industry stakeholders.
- Establish supportive regulatory frameworks that promote adoption of Industry 4.0 technologies in the building industry.
- Invest in research and development on Industry 4.0 technologies that can be applied in the building industry.

Actions for industry

- Encourage collaboration within the industry, and with government and research institutions.
- Embrace operating models that consider the entire lifecycle of assets.
- Digitise and automate the design, manufacture and assembly stages of building.
- Develop building-specific Industry 4.0 processes that address building's dynamic nature.
- Embrace technologies such as smart cities, cloud computing, AI, machine learning and GIS-enabled mapping.
- Adopt digital tools and platforms that enable faster and accurate predictive building modelling.
- Integrate data that provides valuable insights, supports informed decision making and drives improvements across the industry.

CASE STUDY

PROJECT LHP#6:	MALVERN EAST APARTMENT DEVELOPMENT
PROJECT LEAD:	Dr Sahar Soltani, Monash University
PROJECT PARTIES:	Monash University, Sumitomo Forestry Australia, The University of Melbourne
LINK:	https://building4pointzero.org/projects/light-house-project-6-malvern-east-apartment-development/
START DATE:	December 2022, 24 months

THE INDUSTRY PROBLEM

Offsite construction poses several challenges, despite its potential for efficiency and sustainability. In particular, the industry grapples with fragmented processes, unclear ways to measure benefits, and loss of knowledge from one project to another.

THE SOLUTION

LHP#6 project aims to tackle these issues through comprehensive research using a live pilot project by Sumitomo Forestry Australia. Set to construct a three-level apartment building in Malvern East (Nurture), the project has been re-designed from traditional in situ concrete to prefabricated timber (figure 2). This creates an opportunity for benchmarking and comparative study across various parameters.

"LHP#6 highlights the challenges in implementing offsite construction methods through an industry geared towards traditional in situ approaches. This research will enable the industry to adopt a new approach that considers offsite construction methods during the early design phase of a project."

GEORGE KONSTANDAKOS, SUMITOMO FORESTRY AUSTRALIA

The research is segmented into five streams:

• Stream A: Integrated Design – Develop a preliminary design process guideline integrating industrialised building principles. This serves as a template for future projects and offers a benchmark for comparing traditional and offsite methods.

• Stream B: Lifecycle Analysis (LCA) and Carbon Analysis – Establish a detailed log of analysis methods and required data. Additionally, a pilot LCA establishes a demonstration baseline that can guide subsequent studies, adding clarity and objectivity to the research process.

• Stream C: Building Performance – Procure necessary equipment for vibration and noise measurements, paving the way for accurate, real-world data collection during the 'as-built' and post-occupancy studies.

• Stream D: Market Perception – Identify analogous suburbs and projects to inform market perception analysis. Develop a comprehensive end-user engagement approach, complete with a data collection plan like survey designs and multi-layered analyses focusing on the target market.

• Stream E: Digital Project Management – Formulate a multi-staged integration strategy anchored by a process matrix and introduce a customised maturity matrix for the adoption of industrialised building techniques.

These streams are interwoven to form an integrated decision support framework that will provide metrics, tools and knowledge storage for future projects.

THE IMPACT

This project will create a well-documented, quantitative assessment of the benefits and costs of offsite construction methods. It will inform designers, architects and developers on the effective implementation of offsite construction technologies, making a more compelling case for their broader adoption. The project will also generate reusable knowledge that can be applied to future projects, reducing the chances of reinventing the wheel and thereby saving time and resources. An agile research approach will foster the development of flexible, adaptable tools that can accommodate diverse project objectives.

WHAT'S NEXT

Following the successful completion of LHP#6, the next step is wider application of the research findings across various construction projects. A multi-project perspective will provide better insights into the economies of scale and verify if the integrated approach is indeed beneficial across different settings. There's considerable potential for developing a versatile product platform that caters to different market segments.
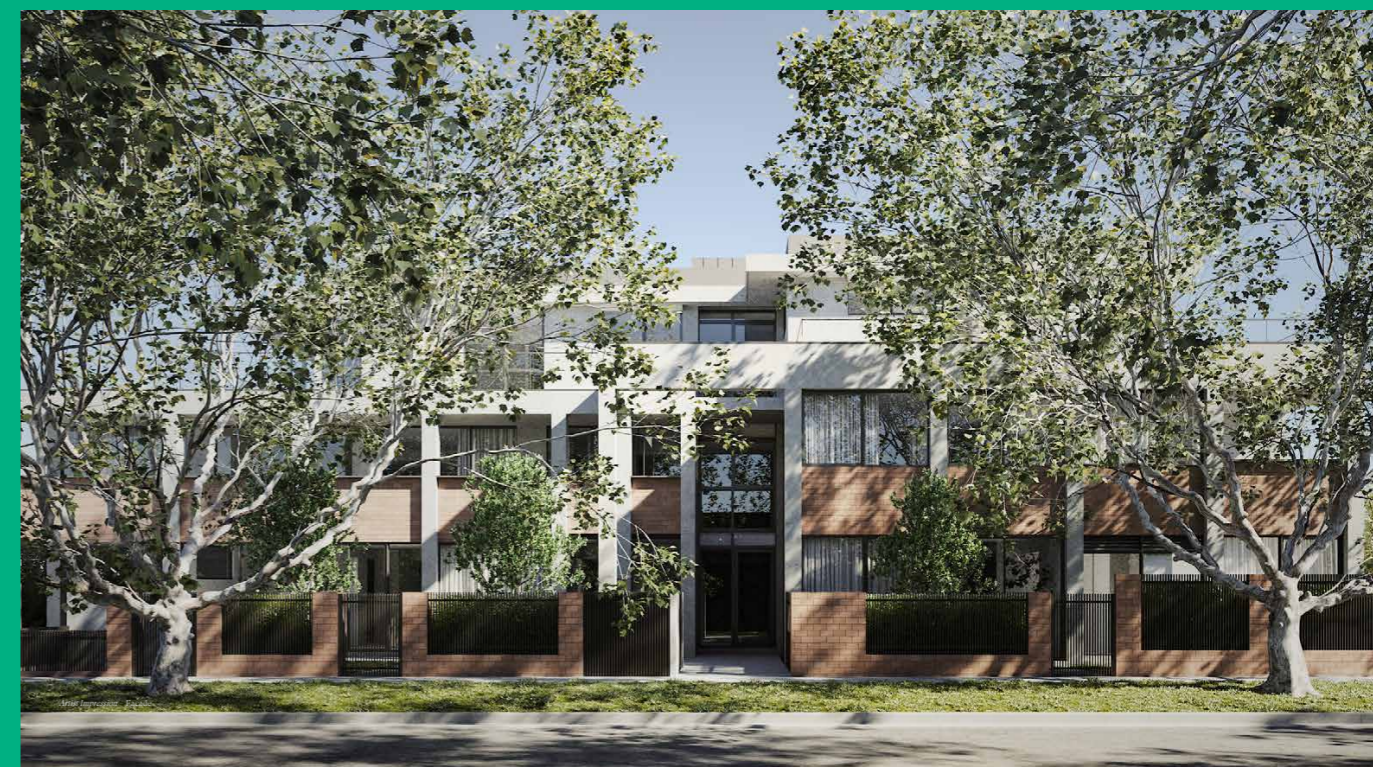

Figure 2: Architect's render of Nurture development, Malvern East. (Image credit: CK Architecture)

CASE STUDY

PROJECT #35:	PREFAB HOUSING SOLUTIONS FOR BUSHFIRE AND DISASTER RELIEF
PROJECT LEAD:	Professor Melanie Dodd, Monash University
PROJECT PARTIES:	Monash University, The University of Melbourne
LINK:	https://building4pointzero.org/projects/prefab-housing-solutions-for-bushfire-disaster-relief/
START DATE:	July 2021, 15 months

THE INDUSTRY PROBLEM

Suitable temporary accommodation options and timely reconstruction are crucial to helping communities recover and thrive from disasters such as bushfire and floods.

Unfortunately, the traditional model of rebuilding can be extremely slow and complex. For example, one year after the Black Saturday fires in Victoria (in 2009), around only 100 homes had been rebuilt. Estimates show only 23% of homes had been rebuilt after two years and only 44% after three years.

A collaborative research project funded by the Advanced Manufacturing Growth Centre (AMGC) Prefab Innovation Hub and Building 4.0 CRC aims to address this problem. Project #35 is a collaborative investigated using prefabricated housing solutions that:

- comply with fire safety requirements
- are resilient to natural hazards
- are low cost and sustainable
- provide both temporary and long-term accommodation.

THE SOLUTION

Researchers highlighted the complexities involved in designing, manufacturing and installing prefabricated modular homes and units in bushfire affected regions around Australia. And then set about finding ways to manage them.

Framework of objectives for prefab housing

Complex settings are at play when providing housing after a disaster. The design and technical performance advantages of prefabricated housing solutions must be weighed against other factors such as cost, flexibility and giving people the opportunity to participate in design and construction.

Project #35 developed a framework (figure 3) that combines the objectives of a prefabricated housing solution (e.g. cost, customisation, design appearance, construction method), as well as broader community objectives (e.g. building regulations, recovery stage, neighbourhood character, access to finance).

"Research shows slow reconstruction after a disaster prolongs trauma and hinders recovery. The 'kit of parts' approach developed in this project supports an incremental approach to addressing the primary stressor for people affected by a disaster – where they are going to live now and where they will live long term."

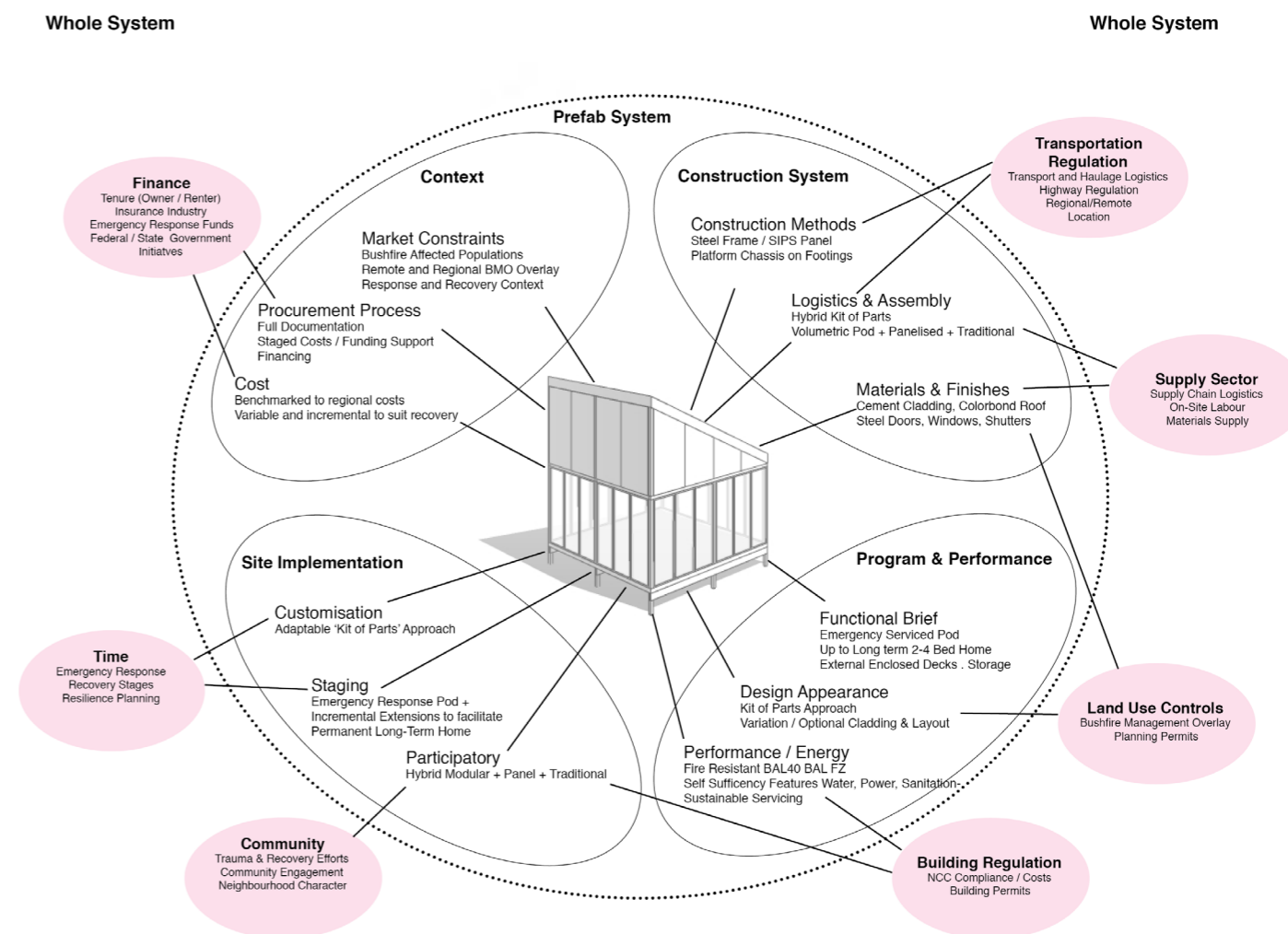PROFESSOR MEL DODD, MONASH UNIVERSITY

Figure 3: Objectives for a Prefabricated Housing Solution for Bushfire and Disaster.

Design template

The design template or 'kit of parts' considers four aspects of a housing solution:

- the construction system e.g. modular, flatpack, self-build
- program and performance e.g. building orientation, spatial design, bedrooms, outdoor spaces
- context e.g. access to infrastructure, neighbourhood character, affordability, compliance with housing regulations or codes
- site implementation e.g. immediate response, longer-term house, permanent house, social engagement in design and construction.

The 'kit of parts' supports an incremental approach to reconstruction. It can be used to provide accommodation immediately after a disaster, and can then be incrementally expanded to create a permanent home.

WHAT'S NEXT

The proposed next stage for the project is for researchers to engage with industry, government and community partners to prototype and test the design template.

This stage is critical to understand the factors that influence local context, such as building regulation, land use control, availability of finance, time and community preferences.

COLLABORATION & ENGAGEMENT

The CRC's collaboration and engagement activities maximise opportunities to influence practices, behaviour and culture in all parts of the construction and property industry.

As with our research activities, the CRC's collaboration and engagement activities focused on addressing the critical issues affecting Australia's building industry.

The Executive Team has been building relationships with government agencies around the country, identifying opportunities for projects that address issues such as housing affordability, building sector productivity and sustainability requirements.

Doing Better Bolder Panel Discussion

The Doing Bolder Better panel at the Building 4.0 CRC Annual Conference 2023 invited Australian industry leaders – Mike Zorbas (Property Council of Australia), Cameron Bruhn (Australian Institute of Architects), Selina Short (EY), Helen Bell (Green Building Council Australia and World GBC) and Prof. Mathew Aitchison (Building 4.0 CRC) – to discuss ways to improve the industry:

- using technologies to overcome fragmentation in the supply chain and nurture relationships up and down the chain
- considering how to include biodiversity in the built environment
- designing buildings that can be retrofitted and repurposed, instead of knocking them down
- investing in new technologies and upskilling the workforce.

We have also broadened opportunities for organisations to become involved in CRC activities. For example, we welcomed third party industry partners who are contributing to specific projects, such as:

Advanced Manufacturing Growth Centre – #17 (The implication of Industry 4.0 for the construction industry: towards smart prefab), #35 (Prefab housing solutions for bushfire and disaster relief) and #40 (Business model innovation: the platform ecosystem)

LTCM and Nexans– LHP#7 (Platform delivery of affordable housing)

Nash – #24 (Next generation of robust and fire-resilient light gauge steel systems for mid-rise buildings) and #32 (Acoustic flanking performance of mid-rise light gauge steel structures)

Populous and Stockland – #48 (Scoping study for building the future – Circular economy shared interest project).

Elevator Initiative

Another new activity is the Elevator Initiative, which invites businesses looking to advance their technology in the building industry to join the Building 4.0 CRC. Members have opportunities to collaborate with the CRC's industry partners, get access to leading research and data, and take an active role in shaping the industry's future innovations and products. Currently, we have nine members: Design Confidence, Immersiv, Domus AU, Fologram, inndox, Sitedata, Cognian, Trendspek and Veyor.

Contact Industry Lead Claire O'leary if you are interested in joining the Elevator Initiative. c.oleary@building40crc.org

European tour

We hosted a very successful European industry tour, attracting 20 delegates from industry, government, not-for-profit and research. The group toured building industrialisation and digitalisation sites in Germany, Denmark and Sweden, offering a glimpse into the future of building with Europe's biggest urban development projects.

A key message was that partnerships and collaboration are essential for success: between SMEs, start-ups, medium and large corporations, between the public and private sectors, between business and science, as well as internally between organisation leaders and workers.

This tour was also an opportunity to establish links with Australian Government agencies overseas. Read more about the tour on the report.

Building on the success of the European tour, the first US tour is planned for February 2024.

Japanese tour

Dr Evans and Prof. Aitchison visited Japan in September 2023 to gain insights into research and collaboration in the Japanese context. They met with representatives from Sumitomo Forestry, Tsukuba Research Institute (Sumitomo's research institute for trees), Obayashi Corporation (one of Japan's five major construction companies) and the Australian Embassy and Austrade.

What's Next in Building Innovation

Following the Annual Conference, Building 4.0 CRC took David Flynn (KOPE.ai), Philipp Erler (Gropyus) and Wayne Larsen (PT Blink) to meet with government and industry representatives in Sydney and Brisbane. Participants discussed the latest ideas gripping the building industry from around the world and in Australia and how they can help us build more resilient and efficient buildings faster and cheaper.

ANNUAL SHOWCASE 2023

The Annual Showcase (Wednesday 22 March 2023, Melbourne Connect, Melbourne) profiled projects that can transform Australian building industry.

This year's theme – IMPACT ON INDUSTRY – challenged stakeholders to look at things differently.
It was a mix of presentations, demonstrations and exhibitions that covered all aspects of building and construction:

- Ensuring industry has the capability and capacity

- Establishing an authorising environment

- Getting down to the nitty gritty and demonstrating how we can move beyond business as usual

- Making building and construction more sustainable.

As well as delivering the latest information, the day created informal settings for people to get to know one another better, discuss new innovation and ideas, and see how they can help each other achieve our collective vision of transforming building and construction.

BY THE NUMBERS

150 attendees - increase by 50%

49 projects exhibited

28 PhD posters exhibited

WATCH VIDEOS FROM THE SHOWCASE AND CONFERENCE ON OUR YOUTUBE CHANNEL
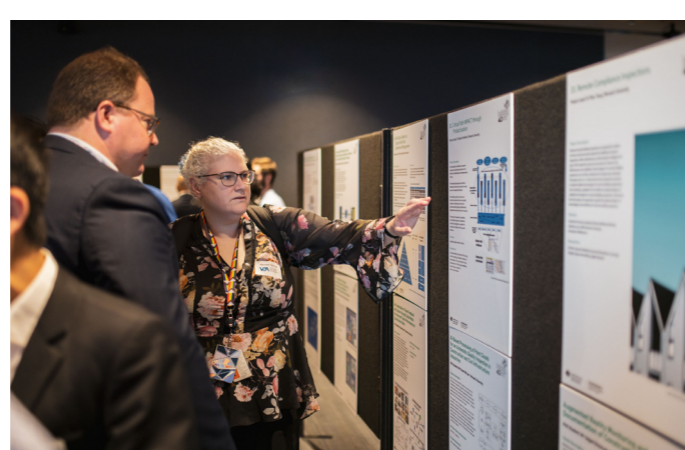
ANNUAL CONFERENCE 2023

At our second Annual Conference (Wednesday 11 October 2023, Monash College, Melbourne), we explored the ingredients needed to create the CULTURE OF INNOVATION to address the problems facing the building industry – housing affordability and supply, building company insolvencies, and meeting sustainability and other environmental requirements.

A key message from the ~230 attendees is that innovators – both here and overseas – are already working on solutions to the problems we face. International keynote speakers, Australian industry leaders, building industry entrepreneurs and innovators, and CRC partners and researchers discussed the changes to policy, regulation, education, skills and training and practice on ground needed to transform our building industry.

BY THE NUMBERS

230 attendees - 10% increase on previous year

52 projects & 44 PhD research projects exhibited

12 roundtable discussions led by industry partners

10 exhibitors

9 guest speakers, including 4 international speakers

4 Elevator Initiative presentations

LOOKING FORWARD

THE 2024 Showcase and Conference will build upon the success from 2023 - featuring more ground breaking projects, prototypes, presentations and discussions. We will continue to create platforms and projects to shift the dial on important issues in the building industry.

EDUCATION & TRAINING

Annual Conference

Above: Holmesglen Students installing Prototype at Annual Conference.

Below: CRC PhD students at Conference exhibition.

PhD students

At the end of 2023, we have 46 PhD students enrolled:

- 16 Round 1 students
- 12 Round 2 students
- 18 Round 3 students.

Two students graduated during 2023 – Thais Gonclaves Sartori (QUT) and Son Tung Vy (QUT). Another eight students submitted their thesis this year: Brandon Johns (Monash University), Fereshteh Banakar (QUT), Kaveh Mirzaei (Monash University), Marko Radanovic (University of Melbourne), Rajendra Prasad Bohara (University of Melbourne), Sara Rashidian (QUT), Hamidreza Rafizadeh (QUT) and Mohammad Aslanpour (Monash University).

PhD students presentations to external conferences and events in 2023

OCEANIA
FMA National Summit: Digital Transformation in FM (Australia)
Circularity 2023 (Australia)
23rd World Congress on Safety and Health at Work (Australia)
3 Minute Thesis Competition (Australia)
International Association for Shell and Spatial Structures Annual Symposium 2023 (Australia)
Australasian Conference on the Mechanics of Structures and Materials (NZ)

ASIA
ZEMECH Zero Energy Mass Custom Home Mission (Japan)
Tsukuba Research Institute, Sumitomo Forestry (Japan)
IEA Annex 87 Expert Meeting (Japan)
Maintenance Resilience Tokyo 2023 (Japan)
30th IEEE International Conference on Image Processing 2023 (Malaysia)
ACADIA Task and Motion Planning for Robotic Assembly (Hong Kong)

AFRICA
ISPRS Geospatial Week 2023 (Egypt)

EUROPE
23rd International Conference on Construction Applications of Virtual Reality (CONVR 2023) (Italy)
2023 PhD Grand Challenges Interdisciplinary Mobility Workshop (Italy)
16th European Architectural Envisioning Conference (Denmark)
CIB W070 Conference 2023: Facility Management and Maintenance (Norway)
3D GeoInfo 2023 (Germany)
10th ACM International Conference on Systems for Energy Efficient Buildings, Cities and Transportation (BuildSys 2023) (Turkey)

NORTH AMERICA
International Conference on Protective Structures (United States)

Masters students

166 Masters level researchers worked with Building 4.0 CRC during FY22-23:

- 125 at University of Melbourne
- 37 at Monash University, including 18 students who were enrolled in Project #28
- 4 at QUT.

This brings the total number of Masters students involved with CRC activities to 661. .

Skills and training

Building 4.0 CRC PhD students are working with Holmesglen Institute and other industry partners on research projects focusing on methods and technologies to improve construction site safety and productivity, and identify the skills and knowledge needed for the future building industry.

Industry partners are confirmed for a new project with Holmesglen Institute (Project #66 – The Future of Construction Education).

We are also reviewing national required training packages to identify how and where CRC research can apply to skills and training.

ROUND THREE PHD STUDENTS:

Meet...

PhD student Peyman Jafary, University of Melbourne

Q: What inspired you to become a researcher?

A: I have a constant passion for using research capabilities to address real-life challenges. I am particularly interested in tackling complex problems relevant to geospatial technology.

Q: How did you become aware of Building 4.0 CRC and what led you to apply for a scholarship?

A: My supervisor, Dr Davood Shojaei, made me aware of the CRC. I was truly inspired by its mission to advance construction through technology and innovation, fostering collaboration between academia and industry.

Q: What is your PhD research project about?

A: My PhD aims to develop an integrated property valuation method leveraging Building Information Modelling (BIM) potentials in different phases of the valuation procedure while considering various physical, geographical, environmental, socioeconomic and legal factors affecting the value of properties.

Q: How will your research make a difference to the CRC and contribute towards the consortium's goals?

A: My PhD program integrates cutting-edge Machine Learning techniques with BIM to enhance existing property valuation methods. It contributes to Building 4.0 CRC's goal of positioning Australia at the forefront of global advancements in the construction industry.

Q: What are the major changes you'd like to see in the building industry?

A: Amid global concerns about urbanisation's impact on sustainability, I aim to facilitate informed decisions by real estate market participants. This, in turn, can optimise resource allocation and reduce market inefficiencies, contributing to the resilience of property and construction industries.

Monash University

Aidan White | Abdurrahman Beg | Darcy Zelenko

University of Melbourne

Duc Minh Le | Ester Liana | Hafedh Al-Mashgari

Queensland University of Technology

Fatheen Hisham | Gihan Ranasinghe | Hamidreza Rafizadeh

Miyami Dasandara | Tanghan Jiang | Yimin Li | Hesong Jin | Kiran Tattukolla | Lalita Lama | Mahdi Valitabar | Sara Rashidian | Shabnam Lotfian

GOVERNANCE

Building 4.0 CRC is committed to excellence and inclusivity in all that we do. We're set up as a diverse international research centre, enabling us to draw on vast cultural knowledge and global industry insights to achieve the most innovative building outcomes. It is this collaboration of brilliant minds, and our broad stakeholder network, that sets the CRC apart.

The Board

Building 4.0 is governed by a board of directors, chaired by Dr Bronwyn Evans AM.

Prof. Shane Murray (Monash University) joined the Board as the Largest Contributor Nominee Director, replacing Bill Ruh from Lendlease. We thank Bill for his valuable contribution during his time on the Board.
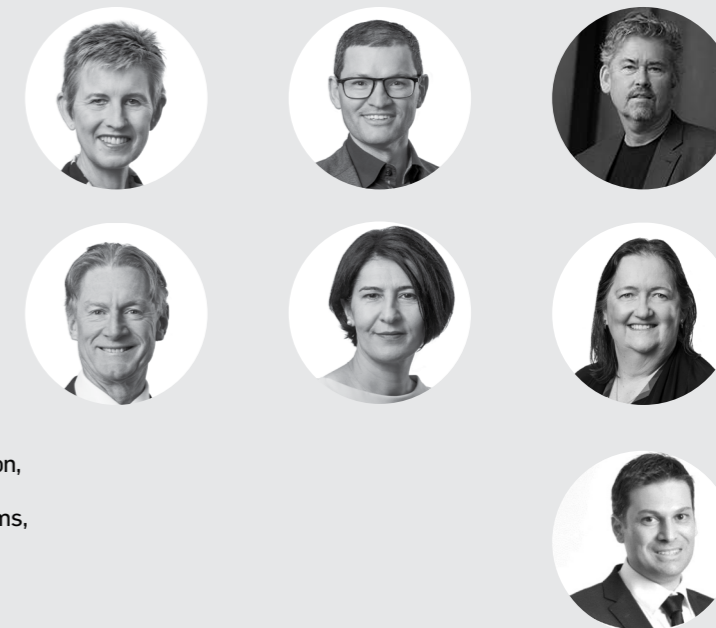
Board L-R, Dr Bronwyn Evans AM, Prof. Mathew Aitchison,

Prof. Shane Murray, Dr Steve Gower, Theodora Elia-Adams,

Jan Bingley & George Kostandakos

building4pointzero.org/people-partners/

The Team

The Executive Team, led by Prof. Mathew Aitchison, manages the CRC's day-to-day operations. We welcomed the following new faces to the Executive Team:

Dr Sara Omrani (QUT Program Leader)

Dr Chris Landorf (Project Milestone and Reporting Manager)

Kathy MacDemott (Engagement Advisor)

Fraser Paxton (Research Development Manager)

Nicklaus Mahony (Senior Research Administrator).

We farewelled the following people, and thank them for their contribution:

Daniel Rex (Partnerships Director)

Samantha Lemons (Research Portfolio Manager)

Verity McDonald (Operations Manager)

Dr Tanja Tyvimaa (QUT Program Leader).

building4pointzero.org/people-partners/

Communications & Media

15 project reports
5 conference papers
14 journal article
10 videos
3 podcasts
4 newsletters
9 media releases
1 corporate report

58 media mentions

Website
15,481 new visitors
65,206 pages views

Presentations
11 internal events,
25 external events and
18 conferences

LinkedIn
2,803 followers (up from 1,620 in 2022)

We have a Youtube Channel and our podcast is available on Apple Podcasts, Google Podcasts and Spotify.

FINANCIAL OVERVIEW

## We have now completed our third full year of operational activities.

Income over 7 years

Partners' cash and in-kind contributions leveraging $28m in Commonwealth funding over seven years.

■ Commonwealth Gov Cash   ■ Partner's Cash   ■ Partners' In-kind
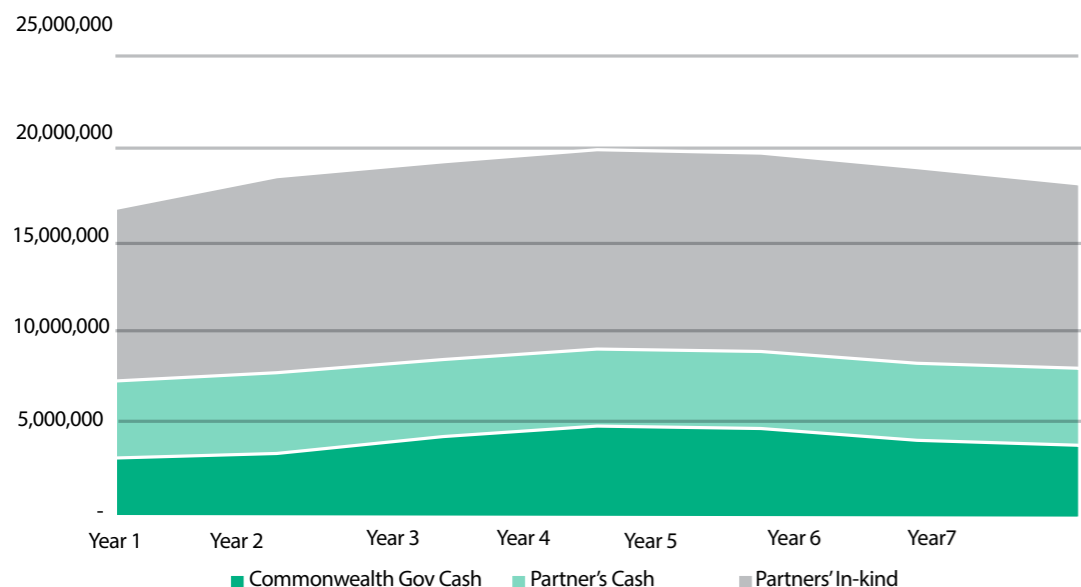
Expenditure over 7 years

The low flat fixed administrative costs and high investment in research over seven years.

■ Staff   ■ Operations   ■ Students   ■ Research Funding

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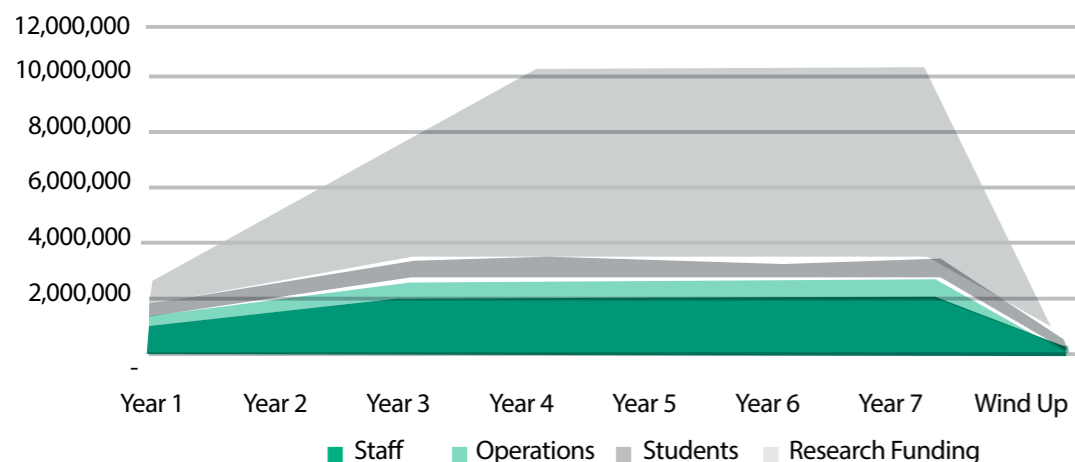
FUTURE PLANS

Building 4.0 CRC will further grow our core business: initiating, developing and running collaborative research projects. We will also continue to train students, welcome new partners and seek new innovations, as we strive to lead the building industry into the future.

In addition to following our research roadmap as outlined on page 4, Building 4.0 CRC will build upon our in-person events initiative as part of our 2024 Engagement and Events Strategy.

In 2024, we will deliver the Annual Showcase (Melbourne, May 2024) and the Annual Conference (Melbourne, September 2024), as well as workshops, panel sessions, topical events and sessions that involve partners and other stakeholders in the building industry.

These events will be supported by our media and communications channels, including newsletters, the website, LinkedIn, podcasts and videos.

Watch our YouTube channel.

Listen to our Podcasts.

Keep up to date with our events.

> If you are interested in being a part of Building 4.0 CRC's future, please contact our Industry Lead, Claire O'Leary: c.oleary@building40crc.org.

Image Credit: Front & Back cover image by Project 35 -Prof. Mel Dodd Monash University.
Case Study Images by Project Team & Partners.
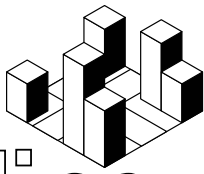
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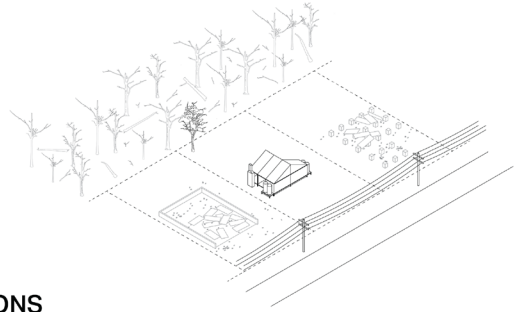
05b POD OPTIONS
single, couple or shared housing
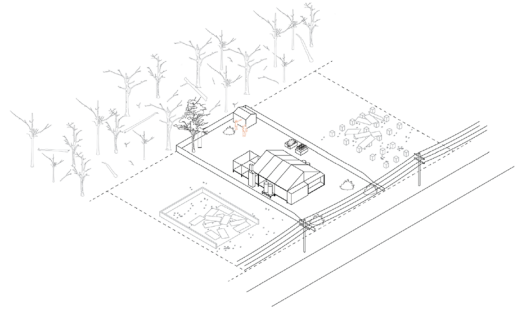
06 ADDITIONS
owner builder changes
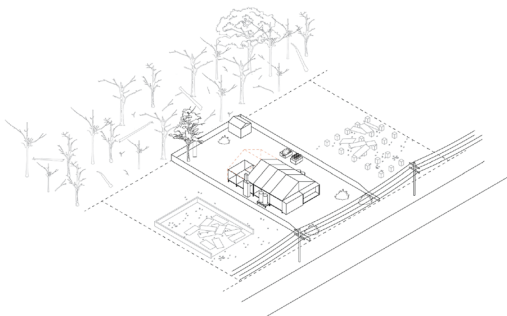
07 PLANNING
short to long term transition

08 CONSTRUCTION
prefabricated or traditional addition