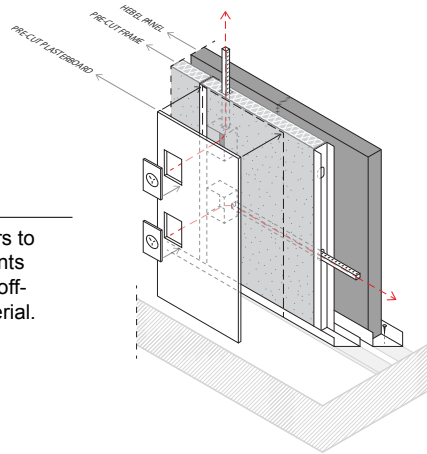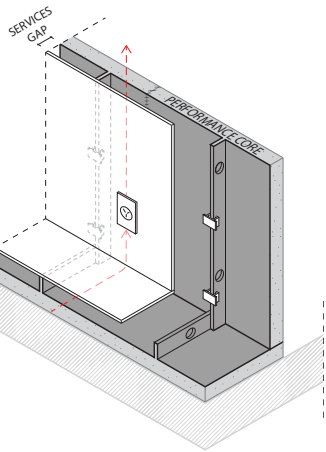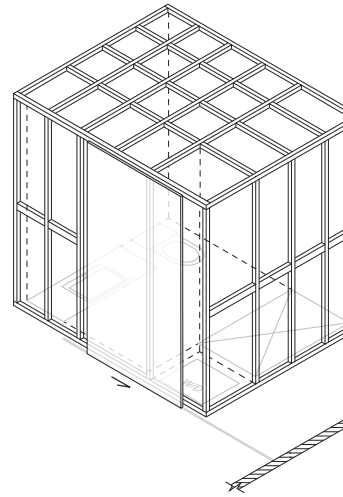**BAU**
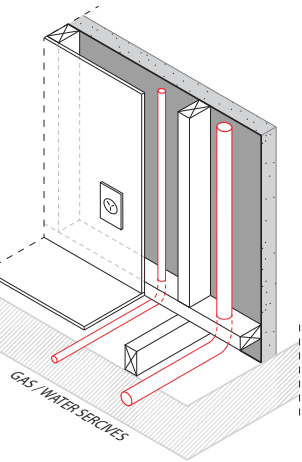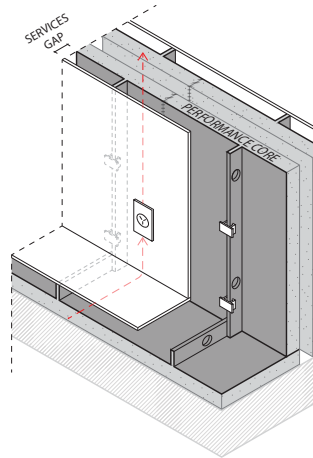Understand barriers to simple improvements initiatives such as off-site cutting of material.

NO WALLS
Eliminate walls by using pods & furniture for internal spatial divisions.
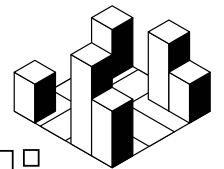
SLEEVE
Separation of performance from cladding.

PLUG-N-PLAY
Liberate partitions from wet services, maximise flexibility & minimise wall thickness.

building 4.0 crc

2022
ANNUAL REPORT

building4pointzero.org

BUILDING 4.0 CRC

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

2022 marks the second full year of operations for the Building 4.0 CRC. Together, we have continued our research to transform Australia's building and construction industries and deliver value for our partners.

As domestic and international travel restrictions eased, we took full advantage of opportunities to make the connections and build the relationships that are necessary for transformative change in the industry.

VISION

Our vision is an innovative, productive, efficient, sustainable building industry. This future building industry will be an ecosystem, facilitated by industrialisation and digitalisation. It will be underpinned by a platform business model that leads to a new building lifecycle.

MISSION

Our mission is to guide the industry to this future of building and develop next generation leaders. Working with research, industry and government partners, our R&D activities focus on industry-critical issues that will deliver transformative benefits.

OUR PARTNERS

COMMERCIAL INDUSTRY

lendlease   BlueScope   SUMITOMO FORESTRY   uTECTURE   DONOVAN GROUP   BENTLEY HOMES

salesforce   A.G.Coombs   Coresteel BUILDINGS   ultimate windows   HYNE TIMBER   MODULAR smart-affordable-sustainable

FLEETWOOD AUSTRALIA   aws   TARONGA VENTURES   schiavello   YNOMIA   ViRIDI

MASTER BUILDERS VICTORIA   Green Building Council Australia   MONASH University

VOCATIONAL EDUCATION AND TRAINING PARTNER

GOVERNMENT

VICTORIA State Government | Jobs, Precincts and Regions

prefabAUS   STANDARDS Australia   THE UNIVERSITY OF MELBOURNE   QUT

holmesglen

VBA VICTORIAN BUILDING AUTHORITY BUILDING CONFIDENCE

CONTENTS

EXECUTIVE SUMMARY

—

Since launching in July 2020, Building 4.0 CRC has initiated 46 projects during a global pandemic.

A Cooperative Research Centre is a unique way to bring together industry, research groups, vocational education, government, civil society and peak bodies to solve critical challenges. In our case, such a broad coalition is not just "nice to have", it is essential to transform Australia's building industry.

CHANGE MAKING // MAKING CHANGE was the theme of our inaugural annual conference. Our activities in 2022 demonstrated we are indeed making change: fostering collaboration, creating world-class research outcomes, and delivering value for our partners and the wider community.

For the first time in the CRC's history, we were able to meet in person. As the year progressed, we moved from virtual events to hybrid events, and now we regularly come together face to face. We've made the most of visiting government and partner organisations, exploring the pressing issues facing Australia's property and construction industries, and sharing ideas with groups in Australia and internationally.

We thank all our partners for their continued involvement in the CRC. The foundational work we've completed over the past 2.5 years has positioned us well to take our research and adoption activities to the next level in 2023.

"MAKING CHANGE in the building and construction industry has never been more important. Tackling the big global challenges we face – climate change, decarbonisation, housing supply and affordability – relies on us growing an innovation culture in our industry. Our role as a CRC is to create the platform for that innovation."

"The building industry is lacking a vision not only for what the future of building will look like, but also how we get there. The CRC has an important role to play in articulating this vision and also guiding the industry towards this future. In doing so, we are focused on creating a culture of innovation in building that can bring up all corners of the industry."

BUILDING 4.0 CRC MAJOR ACHIEVEMENTS

PROJECTS

A total of 46 projects have been initiated since 2020.

In 2022 we completed 27 projects and launched 13 new projects.
We currently have another 24 projects in the pipeline.

LIGHTHOUSE PROJECTS

7 Lighthouse Projects are in the planning stage.

They will deliver real buildings that demonstrate B4.0CRC research in action.

ADVISORY

We created a commissioned report for Austrade:

#47 Promoting Capabilities and Opportunities for Future Building Technologies and Solutions.

INDUSTRY PARTNERS

Viridi Group joined as a new partner and we have held discussions with many more prospective partners.

EVENTS & COLLABORATION

We held 11 public events and 24 workshops in 4 cities.

ANNUAL CONFERENCE

The inaugural Building 4.0 CRC Annual Conference attracted:

16 globe wide presenters
38 project posters
24 PhD posters
7 industry demonstrators
210 attendees.

ANNUAL SHOWCASE

The first Annual Showcase profiled 4 partners at a hybrid event across 3 states:

9 presenters
2 partner location tours
1 panel discussion
9 project posters
83 attendees.

INTERNATIONAL INVITATIONS

Professor Mathew Aitchison was invited to deliver a keynote address to the Industrialised Construction Forum at Stanford University.

PUBLICATIONS

We produced 68 publications, including:

15 project reports
9 conference papers
8 presentations
1 journal article
26 videos and 3 podcasts
3 newsletters
3 media releases

EDUCATION

171 Masters researchers worked with us, inlcuding:

140 at The University of Melbourne

31 at Monash University.

PHD STUDENTS

We awarded another 15 scholarships.

This brings our total number of PhD students to 31.

2 students submitted their PhD thesis for assessment.

SOCIALS

We more than doubled our followers on LinkedIn:

from 708 in 2021 to 1,620 in 2022.

RESEARCH

"Research activity is at the core of Building 4.0 CRC. It is fuelled by the intellectual curiosity, commercial imperatives and desire to innovate which is brought to the fore by our industry partners and actualised by the research expertise of our University research organisations." – Prof Chris Knapp, Research Director

BUILDING 4.0 CRC'S 4 KEY FOCUS AREAS

PEOPLE, PRACTICES & CULTURE

Supporting balanced, fair and customer-centric outcomes

Preparing the future leaders of the building industry

Refining governance, policy and regulation of the building industry

INDUSTRIALISATION

Improving building and construction processes

Introducing advanced manufacturing principles

Saving time and reducing costs

SUSTAINABILITY

Delivering buildings that operate efficiently

Minimising the impact on the environment

Considering the whole building lifecycle, from design to demolition

DIGITALISATION

Developing a faster, smarter, sustainable and responsive building industry

Applying technological advances, techniques and processes to building processes

RESEARCH REPORT - BY PROF. CHRIS KNAPP

Over the past 12 months, the research teams have focused on the quality of project design and outcomes. We are fine-tuning the 'project formula', finding that 2–4 collaborators on each project seems to be the optimal number. We are evaluating how '4.0' projects are, in terms of digital, industrial and other future-focused qualities. And, we are working on a research roadmap and capacity gap analysis.

We are developing 'utilisation plans' to extend and disseminate research impact demonstrations (e.g. papers, conferences, quality industry notes).

Via our 'Lighthouse Projects', we will deliver real buildings that demonstrate B40CRC research in action. This initiative pairs built or 'to-be-built' projects with research teams and market leading industry partners.
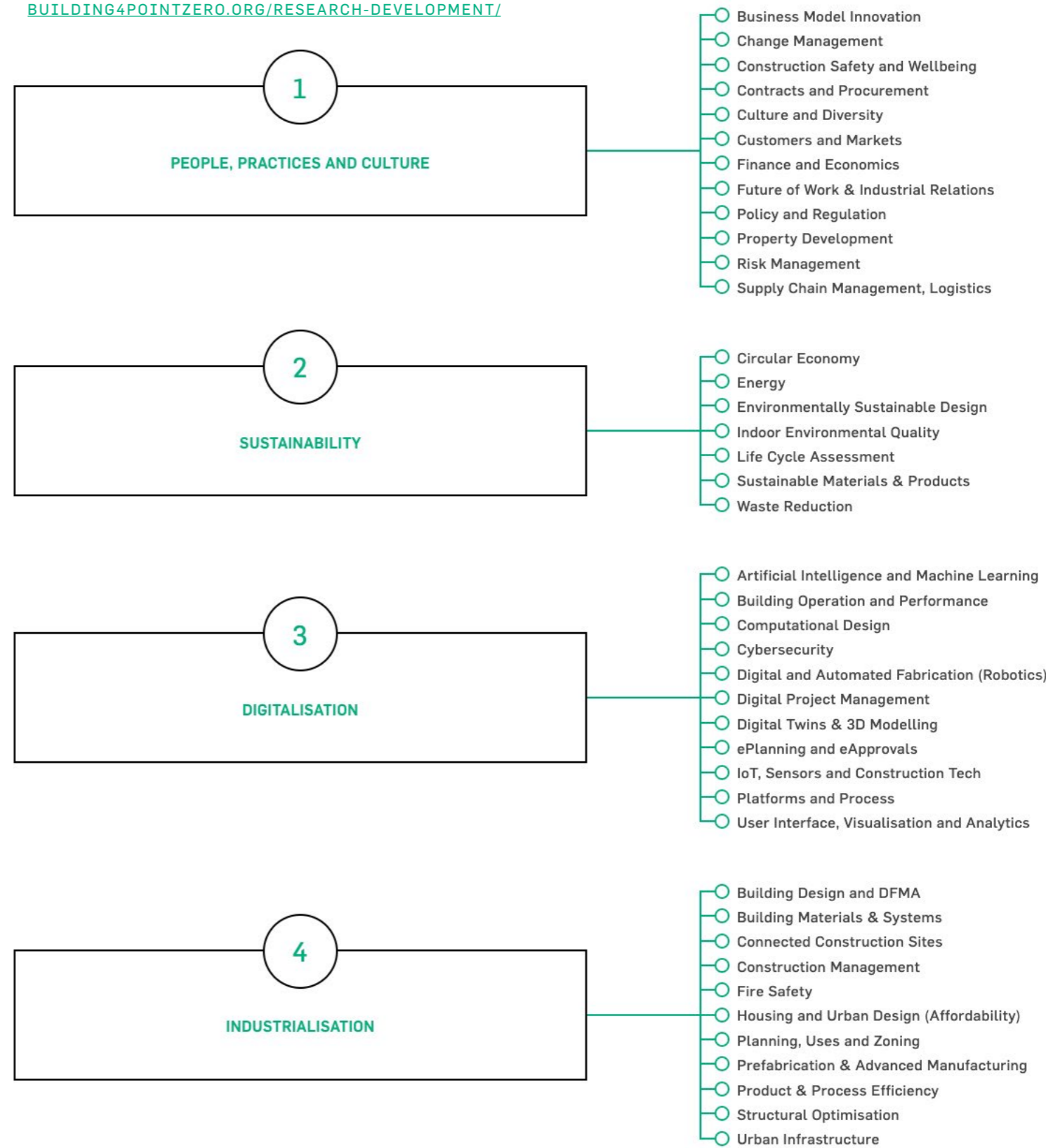
LIGHTHOUSE PROJECTS

We developed 7 prospective Lighthouse projects during 2022:

LHP #1 – Monash Smart Manufacturing Precinct

LHP #2 – Monash Retrofit KIT/NDIS

LHP #3 – National Centre for Healthy Aging/Monash/Peninsula Health

LHP #4 – Lendlease Queen Victoria Markets

LHP #5 – Lendlease Crane Optimisation/Verton

LHP #6 – Sumitomo Timber Prefabricated Housing

LHP #7 – Timber Development Association Fire Testing and Simulation.

RESEARCH THEMES

BUILDING4POINTZERO.ORG/RESEARCH-DEVELOPMENT/

1 — PEOPLE, PRACTICES AND CULTURE

- Business Model Innovation
- Change Management
- Construction Safety and Wellbeing
- Contracts and Procurement
- Culture and Diversity
- Customers and Markets
- Finance and Economics
- Future of Work & Industrial Relations
- Policy and Regulation
- Property Development
- Risk Management
- Supply Chain Management, Logistics

2 — SUSTAINABILITY

- Circular Economy
- Energy
- Environmentally Sustainable Design
- Indoor Environmental Quality
- Life Cycle Assessment
- Sustainable Materials & Products
- Waste Reduction

3 — DIGITALISATION

- Artificial Intelligence and Machine Learning
- Building Operation and Performance
- Computational Design
- Cybersecurity
- Digital and Automated Fabrication (Robotics)
- Digital Project Management
- Digital Twins & 3D Modelling
- ePlanning and eApprovals
- IoT, Sensors and Construction Tech
- Platforms and Process
- User Interface, Visualisation and Analytics

4 — INDUSTRIALISATION

- Building Design and DFMA
- Building Materials & Systems
- Connected Construction Sites
- Construction Management
- Fire Safety
- Housing and Urban Design (Affordability)
- Planning, Uses and Zoning
- Prefabrication & Advanced Manufacturing
- Product & Process Efficiency
- Structural Optimisation
- Urban Infrastructure

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
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

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, The University of Melbourne
59	Innovative Steel - Timber - Concrete Composite StongFloor	VIRIDI Group, The University of Melbourne
4	Computational Design and Optimisation Tools for Prefabricated Building Systems – Phase 1 Scoping Study	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

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
27	Environmental Decision-Support for Structures	BlueScope, Monash University, The University of Melbourne
36	Academic validation of performance gap research in energy rating systems	Green Building Council of Australia, Monash University
37	Australian Timber Fibre Insulation Scoping Study	Hyne & Son, The University of Melbourne, Ultimate Windows
45	Prefab Wall Integrated System – Phase 2	Bentley Homes, Ultimate Windows, The University of Melbourne
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

DIGITALISATION

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
46	Data analytics for structural fibre resources optimisation	Hyne & Son, Queensland University of Technology
57	Wind Comfort Simulation and New Engineering Design Process	Lendlease Digital, Monash University
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

CASE STUDY

PROJECT # 11:   THE ENVIRONMENTAL CREDENTIALS FOR BUILDING TECHNOLOGY PLATFORMS
PROJECT LEAD: Dr Victor Bunster, Future Building Initiative, Monash University
PROJECT PARTIES: utecture and Coresteel Buildings (part of Donovan Group), Monash University
LINK: building4pointzero.org/projects/environmental-credentials-for-building-technology-platforms/
DATE: March 2021, 18 months

OVERVIEW

Digital product platforms are a key enabler of B40CRC's vision of an efficient, connected and customer-centric construction industry. They give businesses visibility, certainty and control over the supply chain, while customers can participate in the project design. They can also help identify inefficiencies in the supply chain, reducing financial costs and enabling environmental savings. The outcome is a building that is more efficient, cost effective and environmentally sustainable.

However, ways to systematically assess the environmental impact of building platforms are not readily available. Monash University researchers are collaborating with industry partners utecture and the Donovan Group to explore opportunities to address this knowledge gap. In simple terms, Project #11 explores how platforms can provide key decision makers with support or insights during the development phases of a construction project.

Using platforms can enable a reduction in CO_2 emissions in excess of 10%. These savings are associated with design and sales efficiencies and material optimisation.

OUTCOMES

The project started with 3 main objectives:

- Define and test an environmental assessment framework for building technology platforms, to evaluate and communicate the environmental benefits of 2 digital products developed by the Donovan Group: utecture™ and Airbuildr™.

- Deliver a software implementation brief so the outcomes of the research can be incorporated on the utecture™ and Airbuildr™ product ecosystem.

- Uncover new commercialisation and development pathways, so the Donovan Group can leverage the environmental performance assessment framework outside its internal operation.

"The Project #11 outcomes demonstrate leadership in equipping the Australian construction sector with tools to positively contribute to sustainability and climate action. The folded box beam is an exemplar of innovating with building materials to find efficiencies. But it also underscores the importance of bringing industry players on to digital platforms that enable evidence-based decision making to achieve best practice."

PROFESSOR CHRIS KNAPP - RESEARCH DIRECTIOR BUILDING 4.0 CRC

The study found using TBB products can enable significant environmental savings - around 41% on average for the case studies evaluated in Australia. These savings are mainly associated with material savings (90%) but also with transporting material and manufactured components.

Project #11 was expanded to explore 2 practical applications:

PRACTICAL APPLICATION 1 –
Life Cycle Assessment of DonoBeam Tapered Box Beam (TBB)

Researchers used material quantities from the Airbuildr™/ Constructor platform to compare 3 structural design alternatives in various geographic regions:

- TBB using 350 Grade steel
- TBB using 450 Grade steel
- a traditional Universal Beam/Welded Beam (UB/WB) system.

4 areas for future research:

- Incorporate components such as foundations, paint or steel surface treatment, secondary structures and façade systems.
- Analyse relationships between design factors (e.g. layout geometry and span clearance) and other building typologies.
- Cover the complete life cycle of buildings, including use, end-of-life, and benefits and loads beyond the system

PRACTICAL APPLICATION 2 –
Pathways to net-zero

Researchers are working with utecture and the Donovan Group to identify pathways for both companies to become net-zero greenhouse gas (GHG) emissions companies. This work involves analysing the current environmental impacts of both companies' operational requirements, and then reviewing national and international certification schemes to identify the most appropriate support for business-to-business (B2B) and business-to-consumer (B2C) communication needs.

5 areas for future research:

- Net-zero certification
- Cost-effective mitigation initiatives
- Third-party verification of GHG reporting
- KPIs for ongoing emissions monitoring
- Introduction of circularity principles to business models.

CASE STUDY

PROJECT #28 : COMPONENTISED INTERNAL WALL SYSTEMS FOR MULTI-RESIDENTIAL APPLICATIONS
PROJECT LEADS: Dr Laura Harper and Dr Lee-Anne Khor
PROJECT PARTIES: Lendlease Digital, Monash University, The University of Melbourne, Monash University
LINK: building4pointzero.org/projects/componentised-internal-wall-systems-for-multi-residential-applications/
DATE: July 2021, 6 months

OVERVIEW

Internal wall systems in multi-residential applications continue to rely on labour intensive and wasteful on-site processing despite advances in prefabrication and other aspects of multi-residential construction. Described performance requirements for internal walls rely heavily on craftsmanship and supervision – when these fail, significant and costly legacy issues arise.

"It's incredible that focusing on something as prosaic and ubiquitous as a simple wall could reveal so much about buildings in general. Current practices in most buildings are wasting at least 18% of some materials, the vast majority of which ends up in landfill. This project shows there is a better way to build walls, and therefore a better way to build"

KARL-HEINZ WEISS , HEAD OF R&D LENDLEASE DIGITAL

Common challenges with business-as-usual (BAU) internal walls include:

• complex on-site assembly to meet performance requirements

• poor quality execution

• services integration/penetrations

• vulnerability of applied material properties (e.g. cracking, performance failures)

• significant waste production (e.g. 18% of plasterboard is wasted).

We need a different approach to design internal wall design that:

• considers modularity rather than customisation

• provides a model for costing legacy and lifetime value

• integrates services and performance-based criteria in a controlled, off-site environment

• addresses conflicting demands in building sequencing

• addresses market and industry expectations for BAU outcomes.

This project:

• reviewed existing wall construction to understand current wall partition approaches and the issues associated with them

• analysed barriers to adopting prefabrication in partition design

• established performance benchmarks and developed a framework to understand life cycle costs

• undertook case studies of innovative partitioning including bespoke architectural approaches, research-led innovation in academic institutions and existing innovation in prefabrication

• assessed a systems approach to internal walls through design and spatial testing to understand organisational, dimensional and aesthetic implications of componentised wall alternatives

• identified additional strategic partners and outlined research methods for future research.

OUTCOMES

The design research identified alternative strategies for improving internal wall systems, including:

• the optimisation of BAU construction

• separation of performance core and surface

• plug-n-play installation

• potential elimination of internal walls by using joinery, furniture and new technologies to achieve spatial separations.

The collaborative investigation method revealed key failure points within the complex choreography of current trades and on-site processing of typical internal wall systems, and the multi-scalar interrelationships with other (sometimes conflicting) building imperatives.

The costs of common failures can be measured against the costs of rectifying defects (including decanting). However, assessments of BAU and future alternatives must also consider redundancies/risks such as work health and safety processes, as well as opportunities for creating residual value.
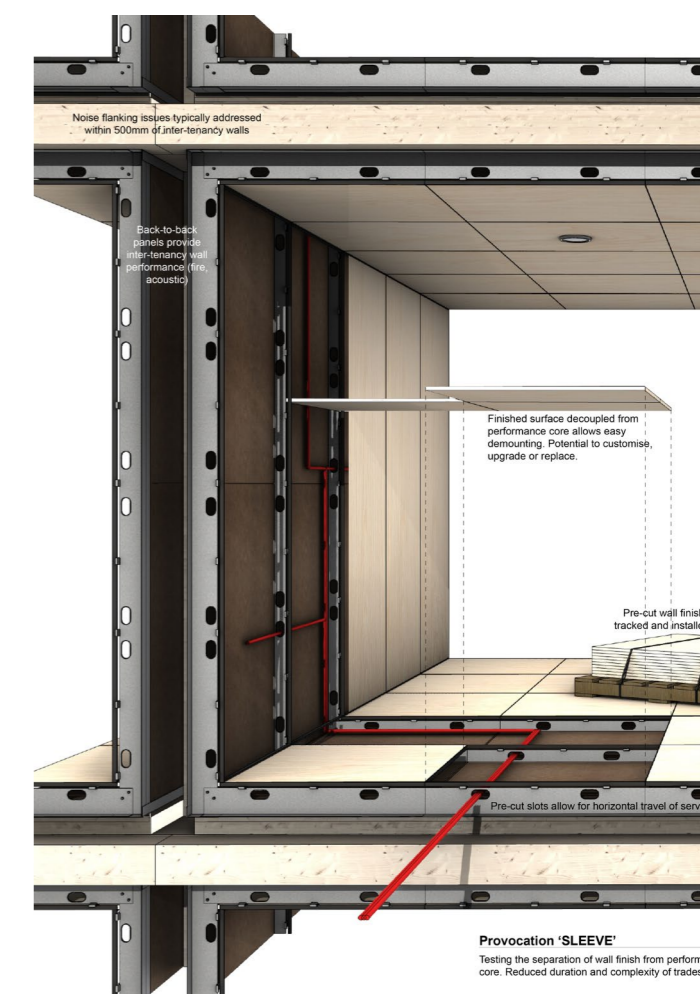
FUTURE PROJECT POTENTIAL

This design-led and collaborative scoping project provides a framework of design principles, inputs and processes required to further develop and test componentised and connected internal wall systems. A 2- to 3-year project will synthesise the framework into a tangible product pathway that industry partners can adopt.

Key issues and opportunities for further investigation include:

• optimising the complexity (assembly, performance) and waste (material, labour) associated with typical wall systems pointing to fundamental changes in wall design and services integration (e.g. separation of performance core and cladding)

• conflicting imperatives and/or lack of incentives to shift BAU supply, construction, building sequencing and waste reduction

• developing a holistic approach to circularity that involves reconsidering business/service models for internal walls, including research into future markets.

To date, the project focused on non-load bearing walls. However, the framework could be expanded to load-bearing inter-tenancy walls, introducing research opportunities that could impact on the dwelling arrangements and building typologies pursued by the housing industry.

Noise flanking issues typically addressed within 500mm of inter-tenancy walls

Back-to-back panels provide inter-tenancy wall performance (fire, acoustic)

Finished surface decoupled from performance core allows easy demounting. Potential to customise, upgrade or replace.

Pre-cut wall finish del tracked and installed 'in

Pre-cut slots allow for horizontal travel of services

Provocation 'SLEEVE'
Testing the separation of wall finish from performance core. Reduced duration and complexity of trades on

CASE STUDY

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OVERVIEW

Growth in demand to produce high-grade structural timber products cannot be met if current practices continue.

On the one hand, the sector is being squeezed by increasing consumer demand. On the other hand, irreversible changes to the raw material, due to unforeseen climatic events and change in resources management, is challenging supply.

This project aims to find ways of using more of the tree to benefit all participants in the supply chain, from growers and millers to builders and end users. Using the whole tree more effectively is not only about being good global citizens using finite natural resources in ways that align with the global effort to reduce greenhouse gas emissions. It is also about adding value to the built environment in ways that grow profitability across the supply chain.

Using data analytics, this scoping study aims to find promising avenues that will optimise the use of the timber resource and better meet the future needs of the building industry.

Sensors (scanners and testing equipment) in modern large sawmills generate a huge volume of data. This information is used to maintain competitiveness, but is often insufficiently used to optimise the production process. The main reasons for this are:

- complex and heterogeneous data structures that lack transparency

- limited data access

- missing product tracing information.

This project examines how to use and extend an existing database containing historical information on feedstock and sawn timber products. It uses advanced analytical techniques to uncover new, useful and understandable information from this data, and identify additional data to be collected.

OUTCOMES

This research will analyse data about Hyne Timber's processes to summarise historical production trends and the key factors affecting production levels, including time, location and species.

The first stage involves linking data between different stages of the process to enable initial tracing of sawn boards.

Later work involves developing a random forest machine learning model to predict distribution of log acoustic wave velocity.

"The past few years have shown that the industry needs to do everything we can to improve yield of structural timber sourced from our plantation timber resource if we are to keep up with demand. Using the latest computational analytics, this project demonstrated that we can make gains in our industry that will flow through to the rest of the construction sector and the end user."

STEFAN GERBER, ENGINEERING AND SALES MANAGER GLT,

FUTURE PROJECT POTENTIAL

Future research could include the following options:

- Expand the machine learning model to different stages of sawmilling process – Manufacturers could predict different variables (e.g. board grade) based on factors such as properties of the stems and logs (e.g. location and geometry, species) at earlier stages.

- Improve data linking, and extend it across further stages of the sawmilling process – Manufacturers could track the origins of sawn boards, such as what tree they were sawn from etc.

- Develop an analytics tool for Hyne – This would improve the uptake/useability of this research.

- Incorporate market demand, constraints and economic factors that can influence manufacturing – This research considered only raw production data; it did not consider any additional factors that may drive decisions on what products to manufacture. Linking raw production data with information on external requirements may provide additional opportunities for improvement.
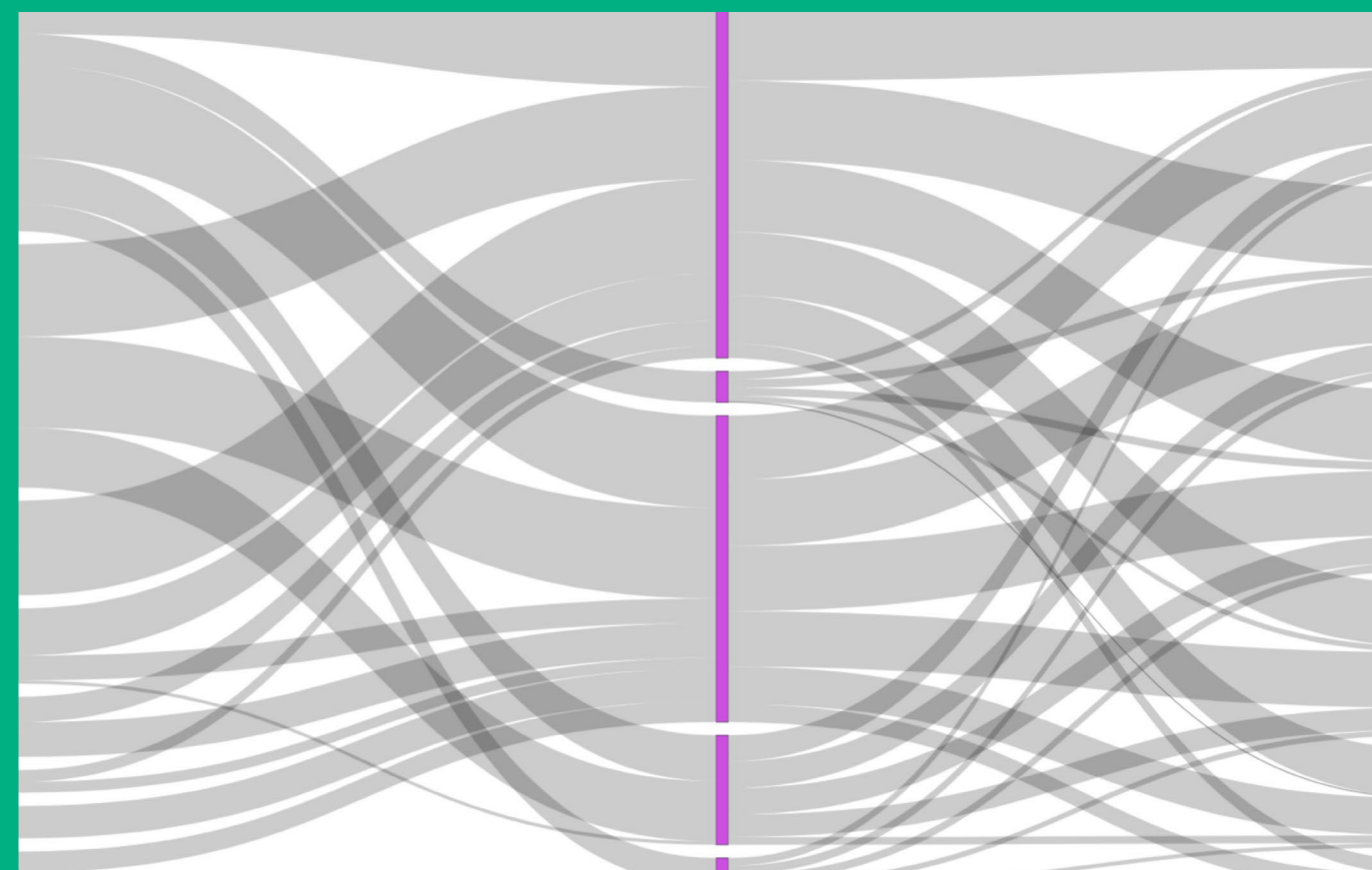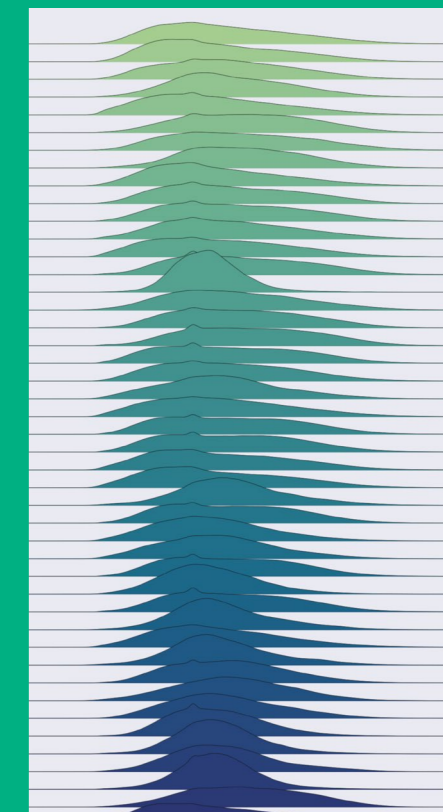
COLLABORATION

We currently have 28 industry partners who are deeply engaged. With the emergence from the pandemic, we look forward to deepening our engagement with existing and new partners.

Industry engagement increased significantly as Covid-19 border restrictions eased:

- We welcomed new partner VIRIDI Group.

- We are developing numerous conversations with prospective partners who may join the CRC in the coming months.

- We delivered a project-based commission from Austrade – #47 Promoting Capabilities and Opportunities for Future Building Technologies and Solutions.

- We also collaborated with industry partners across Victoria, New South Wales and Queensland on workshops, networking events and discussion groups (see Events at a Glance).

- We introduced 'Melbourne Weeks', bringing together executive staff, located across 3 states – Queensland, New South Wales and Victoria – for a concentrated time together. During these weeks, we also deliver project workshops and milestone meetings for researchers and industry partners.

Siemens' Roundtable

Building 4.0 CRC Chair, Dr Bronwyn Evans AM and CEO, Professor Mathew Aitchison attended a round table "Thought Leaders Series: The race to adaptable, flexible and resilient cities and infrastructure" at Siemens Australia by Matthias Rebellius (Global CEO of Siemens Smart Infrastructure), Peter Halliday (CEO Siemens Australia) and Keith Ritchie (Head of Communication and Government Affairs Siemens Australia).

Study Tour to Germany & Denmark

Dr Bronwyn Evans AM and Professor Mathew Aitchison conducted a study tour of building industrialisation and digitalisation sites in Germany and Denmark, including the Tegel Projekt (Berlin), Fraunhofer Institute for Production Systems and Design Technology (Berlin), Bloxhub (Copenhagen) and the Royal Danish Academy of Fine Arts (Copenhagen).

Urban Redevelopment Connections

Gudrun Sack, CEO of the Tegel Projekt in Berlin, met with government and industry representatives from 3 of Australia's most high-profile urban redevelopment sites in Sydney, Brisbane and Melbourne to discuss the ambitions of Berlin's largest urban redevelopment project and the opportunities such projects offer for building innovation.

Lendlease Showcase

The CRC Executive team and researchers outlined the structure, format, relevant content, and delivery approach for each identified project for the 'Lendlease Showcase'. The audience was Lendlease senior executives and senior managers, managers, and individuals from various Group Functions (Procurement, EH&S, Assurance, Sustainability) and Business Units (Development, Construction).

Singapore Tour

Professor Mathew Aitchison met with industry and government representatives in Singapore to explore opportunities for new partnerships and collaboration.

Better Buildings and Better Bottom Lines

We are collaborating with prefabAus and the Advanced Manufacturing Growth Centre to deliver 4 one-day workshops on "Business Model Innovation in the Building Industry: Better Buildings and Better Bottom Lines". These workshops will explore how industrialisation and digitalisation – particularly prefabrication and offsite construction – will affect building industry business models. We held the first workshop in Adelaide in November 2022. The remaining workshops will run in 2023.

EVENTS AT A GLANCE - 2022

We made the most of easing travel restrictions to engage face to face with partners, researchers, government and community representatives in Australia and internationally.
Link to events: building4pointzero.org/events/

MARCH: ANNUAL & PARLIMENTARY SHOWCASES

We showcased 9 of our projects at a hybrid simultaneous event across 3 states: Hyne Timber in Queensland (pictured), Lendlease in New South Wales, and Holmesglen and A.G. Coombs in Victoria.

Parliamentary Showcase – We also showcased our projects and Research at Parliament House, Canberra.

APRIL: DRIVING THE ADOPTION OF TECHNOLOGY

Led by CRC Industry Lead Isaac Coonan, at the University of Melbourne, Victoria we launched our Austrade Project promoting the capabilities and opportunities for future building technology solutions in Australia.

AUGUST - ANNUAL CONFERENCE

The highlight of 2022 was our inaugural annual conference, Wednesday 31 August at Monash College City Campus in Melbourne.

With the theme CHANGE MAKING // MAKING CHANGE, research and industry experts gathered to explore the pressing questions facing Australia's property and construction industries:

- What are the most urgent areas for change?
- How can we remove barriers to change?
- What does 'change' look like in building?
- What are the effects of making change that the industry needs to consider?

As well as hearing from national and international experts, the 200+ participants enjoyed a range of other activities that encouraged questions and connections:

- the lunchtime Mixing Chamber, which was an opportunity to hear from Partners and SME demonstrators, who presented about their experiences as innovators and disruptors
- the PhD poster exhibition, where participants could meet and talk with the next generation of research and industry leaders
- the networking drinks at the end of the day.

OCTOBER: SUSTAINABLE SOLUTIONS TO THE HOUSING CRISIS

Sustainable Solutions to the Housing Crisis (Queensland University of Technology, Queensland) – Led by CRC Program Lead, Dr Tanja Tyvimaa, panellists explored options to address the severe housing crisis faced in Brisbane and elsewhere, including ways to restructure the housing market.

MAY: CIRCULAR ECONOMY

Loops, lattices, systems: circular economy for the building industry (Monash University, Victoria) – Led by CRC Research Director, Professor Chris Knapp, at Monash College Docklands, panellists discussed the technical, material, financial and cultural implications of circular economy concepts for the building industry.

JUNE: CONSTRUCTION PLATFORMS

Construction platforms: potentials and pitfalls from product to ecosystem (Monash University, Victoria) – Led by CRC Program Lead, Dr Duncan Maxwell, panellists discussed how platforms are emerging in construction – from product platforms in manufacturing to digital platforms that leverage developments in the technology sector.

NOVEMBER ENERGY EFFICIENCY & MBAV YOUR

Tour of MBAV Building Leadership Simulation Centre, followed by panel discussion: Energy Efficiency for Future Buildings: Challenges, Solutions and Opportunities (Master Builders Association Victoria, Victoria) – Led by CRC Program Lead, Professor Tuan Ngo, panellists explored the key changes and practicalities involved in meeting the new National Construction Code energy efficiency requirements.

EDUCATION & TRAINING

Holmesglen Tour

Holmesglen Tour of Victorian Tunnelling Centre – PhD students and partners came together to tour the training centre in Chadstone.

PhD Students

We completed our Round 2 intake of PhD students in 2022, awarding another 15 scholarships. This brings our total number of PhD students to 31. They are already beginning to realise their potential. Two of our Round 1 students submitted their PhDs in 2022.

Many of our Round 1 and 2 students have begun deepening their understanding and bringing new perspectives to the following projects:

#4 Computational Design and Optimisation Tools for Prefabricated Building Systems – Phase 1 Scoping Study

#6 Field Data Collation to Support Real-time Operational Management

#9 Implementing DfMA and Lean in Construction: Best Practice Guidelines through a Study of Building Services and Structure

#11 Environmental Credentials for Building Technology Platforms

#15 Using the Whole Tree for Future Timber-Based Construction – Scoping Study

#17 The Implication of Industry 4.0 for the Construction Industry: Towards Smart Prefab

#18 Long-span Low-Carbon Floor Systems (Scoping Study)

#20 Robustness of Light Gauge Steel Buildings

#24 Next Generation of Robust and Fire-resilient Light Gauge Steel Systems for Mid-Rise Buildings (Umbrella Project)

#27 Environmental Decision-Support for Structures

#30 Critical Path IMPACT through Productization

#31 Demystifying Volumetric Construction: A Study of the Bathroom Pod Project

#33 Evaluation of Emerging Technologies for Remote (Virtual) Inspections of Building Work

#42 Workflow Automation Tools for Home Designs – Phase 1 Scoping Study

#62 Digital Building Approval

Lighthouse Project #6 Sumitomo Timber Prefabricated Housing.

Third round of PhD recruitment now open

We expect to award up to 14 new PhD scholarships in 2023.

Masters students

171 Masters level researchers worked with Building 4.0 CRC during 2021-22: 140 at The University of Melbourne; 31 at Monash University: 13 students were enrolled at The Future Building Initiative summer intensive studio, while 18 students were involved in Project #28 (Componentised Internal Wall Systems for Multi-residential Applications).

Skills and training

Reviews of several completed projects identified 3 key themes for future research on training for building and construction workers and para-professionals:
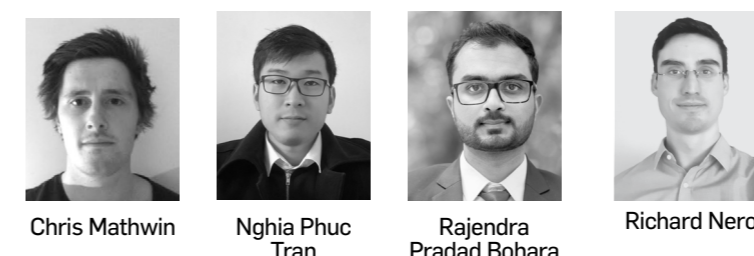
1. Prefabrication of buildings, building components, and building fitouts, specifically the skills and knowledge required by workers undertaking these projects, how these skills and knowledge should be packaged, and what impact this will have on existing qualifications.

2. Industrial relations (award structure and demarcation) and contractor (trades) payments in the Building 4.0 circular economy.

3. Application of new learning technologies in the education and training of trades people and para-professionals in the building and construction sector.

ROUND TWO PHD STUDENTS BELOW:

Monash University

Cheng Zhang | Dilshi Dharmarathna | Fucai Ke | Mohammad Aslanpour | Razeih Karimi | Shahed Khan | The Son Kieu

University of Melbourne

Chris Mathwin | Nghia Phuc Tran | Rajendra Pradad Bohara | Richard Nero

Queensland University of Technology

Ali Pakdel | Haider Hamad Ghayeb

Meet...

PhD student Dilshi Dharmarathna

Q: What inspired you to become a Researcher?

A: My passion for continuous learning and application of knowledge to do my part in transforming the building and construction industry for the better.

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

A: I was encouraged to apply for the scholarship by my supervisor, as it was a unique learning opportunity to study my PhD and be a part of many incredible industry led projects focusing on shaping an efficient and sustainable Australian building and construction industry.

Q: What do you intend to research in your PhD project:

A: My research explores how to mainstream sustainable building and construction in the age of Industry 4.0. I look forward to exploring several aspects of building performance related to dynamic life cycle assessment and novel digital technologies such as digital twins.

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

A: My research aligns with several CRC research targets which aim to integrate innovative digital technologies to deliver energy efficient, sustainable, and better buildings to reduce life cycle costs and carbon emissions.

Q: What are the major changes you would like to see in the construction industry?

A: To benefit from Industry 4.0 and integrate digital technologies within the construction industry to overcome the barriers and enable the drivers of sustainable building, so that achieving decarbonisation targets can be a possibility.

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.

Recognised for Excellence

Building 4.0 CRC Program Leader Tuan Ngo and Board Director Ivan Marusic have been recognised by The Australian as being in the top 250 leading Australian researchers in "Composite Materials" & "Fluid Mechanics" respectively. Tuan has also been recognised as a "Highly Commended Researcher of Excellence in Research Impacting a Sustainable Future" in this year's "The Australia & New Zealand Scopus Researcher Awards". We are so fortunate to have your expertise as part of the CRC team!

The Team

The Executive Team, led by Professor Mathew Aitchison, manages B4.0CRC's day-to-day operations. We welcomed new members to the Executive Team in 2022:

Professor Chris Knapp as Research Director

Clare Blizzard as Executive Assistant and Events Manager

Assoc. Professor Dane Miller, Lighthouse Projects Manager

Daniel Rex as Partnerships Director

Jenny Flynn as Communications Manager

Samantha Lemons as Research Portfolio Manager

Dr Sarah Breen Lovett as Education and Engagement Leader.

We also welcomed Claire O'Leary and Priya Das, who provided invaluable operations support. Claire provides special project support and Priya is our social media officer.

building4pointzero.org/people-partners/

We farewelled the following people, and thank them for their contribution: Dr Angela Solarte Castaneda, Education Leader; Isaac Coonan, Industry Lead; Megan King, Projects Officer; Michelle O'Grady, Executive Assistant and Events Assistant; Pascale Twikler-Green, Executive Assistant; Paul Stroud, Projects Portfolio Manager; and Susan Waterer, Communications Manager.

The Board

Professor Ivan Marusic (The University of Melbourne) joined the Board as the rotating Tier 1 Board Director for 2022, replacing Shane Murray from Monash University. We thank Ivan for his valuable contribution throughout the year. The Tier 1 Board Director for 2023 is George Konstandakos from Sumitomo Forestry.

Board L-R, Dr Bronwyn Evans AM, Prof. Mathew Aitchison,

Bill Ruh, Steve Gower, Theodora Elia-Adams,

Jan Bingley, Ivan Marusic & George Kostandakos

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Congratulations Bronwyn Evans AM

Chair of our Board, and Engineers Australia CEO Dr Bronwyn Evans AM was honoured in a ceremony in April 2022, to accept her 2021 Women in Industry Excellence in Engineering, and Woman of the Year award.

Bronwyn was acknowledged as an outstanding engineer and trailblazer in her field – she was the first woman to graduate from electrical engineering at Wollongong University and her career has taken her from industry and academia to the boardroom.

Communications & Media

15 project reports
9 conference papers
8 presentations
1 journal article
27 videos
3 podcasts
3 newsletters
3 media releases
21 media mentions.

Website
13,0274 web users
12,969 new visitors
58,744 pages visited
2.67 pages visited per user (with each user staying for 2:30 minutes).

LinkedIn
1,620 followers

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

FINANCIAL OVERVIEW

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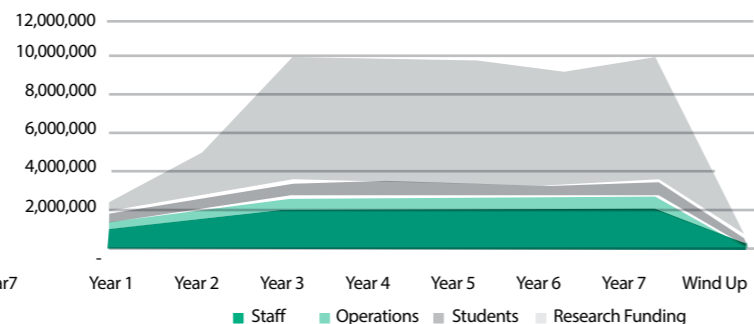We have now completed our second full year of operational activities.

Income over 7 years

Partners' cash and in-kind contributions leveraging $28m in Commonwealth funding over 7 years.
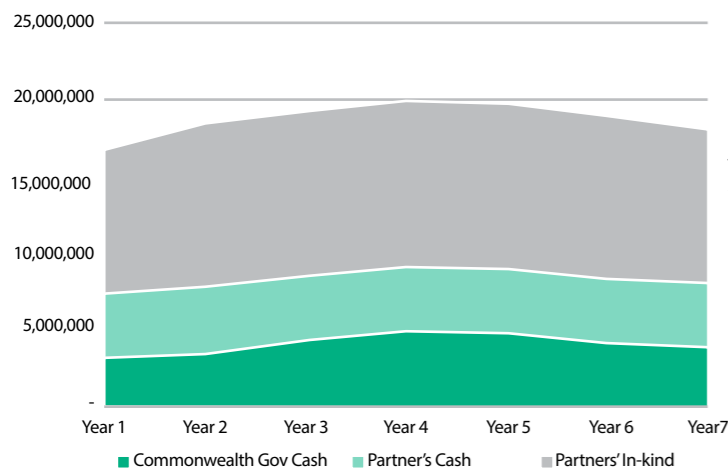
Expenditure over 7 years

The low flat fixed administrative costs and high investment in research over 7 years.

Income over 7 years chart — y-axis from - to 25,000,000; x-axis Year 1 to Year 7. Legend: Commonwealth Gov Cash, Partner's Cash, Partners' In-kind.

Expenditure over 7 years chart — y-axis from - to 12,000,000; x-axis Year 1 to Wind Up. Legend: Staff, Operations, Students, Research Funding.

FUTURE PLANS

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Building 4.0 CRC is planning to continue its in-person events initiative, within its 2023 Engagement and Events Strategy.

In 2023 we will deliver a CRC Partner Showcase (March 2023), an Annual Conference (September 2023), and ongoing workshops, panel sessions, topical events, and sessions that will involve partners and those stakeholders within the broader building industry.

These events will continue to be supported by our media and communications channels, including internal and external newsletters, our website, and our LinkedIn feed. In addition to our Podcast, we've set up a YouTube channel, which will feature key content for our engagement and events initiative.

Finally, we look forward to continuing to grow our core business: initiating, developing and running collaborative research projects. We will also continue to train more students, welcome new partners, and seek new innovations, as we strive to lead the building industry into the future.

Visit our YouTube channel:

If you are interested in being a part of Building 4.0 CRC's future, please contact our Industry Partnerships Director, Daniel Rex : d.rex@building40crc.org.

Image Credit: Front & Back cover image by Project 28 - Daniella Tinios, Laura Harper and Lee-Anne Khor.

Case Study Images by Project Team & Partners.

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