arch_ manu

ARC Centre for Next-Gen
Architectural Manufacturing

research symposium 2026

16-17 September



Australian Government
Australian Research Council

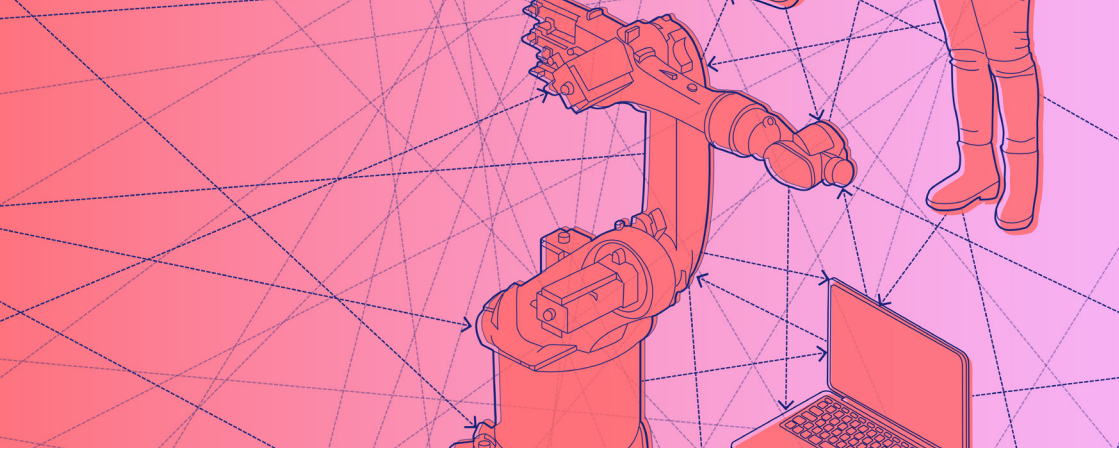
Copyright © Arch_Manu 2026

Contents

Introduction 2
Symposium Schedule 3
Postdoctoral Research Showcase 7
PhD and MPhil Showcase 13

- Design-to-Making Fabrication Workflows 13
- AI and Computational Tools in Architectural Practice 17
- Organisational Digital Implementation in AEC 21
- Lifecycle Data for Material Recovery 27
- Early-Stage Design Decision Support 31
- Standards-Based Building Assessment 37
- Learning and Knowledge in Architectural Practice 41

Projects not Presented at Symposium 47
Arch_Manu 2026 CPD Offering 54
Arch_Manu Partners 56

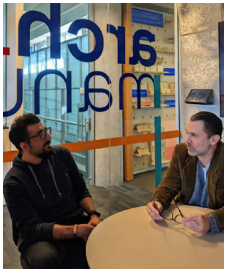



arch_
manu
The Theory
Thinking ab
work in the


circular intelligence
MINA


CAADRIA2026
26 April - 2 May
Hsinchu, Taiwan
Humanistic Computation & Intelligence
The 31st International Conference on
Computer-Aided Architectural
Design Research in Asia








circular intelligence
Masterclasses

Introduction

ARC Centre for Next-Gen Architectural Manufacturing

As the ARC Centre for Next-Gen Architectural Manufacturing (Arch_Manu) moves into the second half of its five-year program, our focus is increasingly on turning ambitious ideas into meaningful change for Australia's Architecture, Design and Engineering (ADE) sector.

Established in February 2024 with Australian Research Council funding, Arch_Manu brings together researchers, industry partners, peak bodies and graduate researchers to address the twin challenges shaping the built environment: improving productivity while reducing environmental impact. Our work is guided by six priorities—to reduce material consumption, waste and carbon emissions, while ensuring that projects are delivered on time, within budget and for the benefit of the wider community.

At the heart of the Centre is a belief that digital transformation and sustainability must advance together. We are exploring how new technologies, data and manufacturing approaches can help reshape how buildings are designed, delivered and maintained, while creating a sector that is more resource-efficient, resilient and responsive to community needs.

Over the past year, Arch_Manu has continued to strengthen the connections between research and practice that are central to our model. Through partner engagement projects, industry case studies, hackathons, and built projects, we are creating opportunities for ideas to be tested in real-world settings and for knowledge to circulate across the profession. Our growing community of PhD and MPhil candidates, postdoctoral researchers, affiliated scholars, and industry collaborators is contributing new perspectives to some of the sector's most pressing questions.

The Arch_Manu Continuing Professional Development offerings remain an important part of this exchange, creating a forum for practitioners, researchers and students to engage with emerging challenges and opportunities. These activities reflect our commitment not only to generating new knowledge, but to sharing it in accessible and useful ways that support professional practice.

This year's Annual Research Symposium offers a snapshot of that work in progress. The projects presented across the following pages demonstrate the breadth of inquiry underway across the Centre—from material innovation and circularity to digital workflows, artificial intelligence, automation, industry capability, and new approaches to collaboration.

More than a showcase of individual projects, this catalogue captures a community learning together: testing ideas, building partnerships and asking how research can help deliver a more capable, sustainable and equitable built environment. We invite you to explore the work, meet the people behind it and join the conversation about the future of architectural manufacturing in Australia.

Symposium Schedule

DAY 1

Wednesday
16 September

			pg. #
8.30am - 9.00am	Registrations open		
9.00am - 9.15am	Welcome and Introduction		
9.15am - 10.45am	Design-to-Making Fabrication Workflows		
	Designing with Earth: An Integrated Design-to-Fabrication Framework for 3D-Printed Earthen Walls	Mohamed Aboeloyoon	14
	Design and Fabrication of Freeform Earth-Based Structures Using Adjustable Mould System	Hamidreza Malekian	15
	Chippie and the Circular Robotic Housing Chassis: A Digital Vernacular for Reversible Timber Automation & Construction	Luis Rivero Torres	16
10.45am - 11.00am	Break		
11.00am - 12.30pm	AI and Computational Tools in Architectural Practice		
	Turning AI Foresight into Business Model Innovation in Architecture	Anthony Lockhart	18
	Understanding how Generative Design Tools can be Leveraged within Early Design Workflows to Improve Design Efficiency in Large-Scale Architectural Projects	Thao Pham	19
	AI as a Collaborator in Architectural Design: Cognitive, Neurophysiological and Creativity Impacts	Guanlin He	20
12.30pm - 1.00pm	Postdoctoral Research Showcase: Dr Lisa LuBowden		
	The Future of Architectural Expertise: Scenarios, Legitimacy, and Competency Standards		8
1.00pm - 2.00pm	Lunch		
2.00pm - 3.30pm	Organisational Digital Implementation in AEC		
	Communication and Collaboration Strategies for Implementing Integral-Circular Practices Enhancing Resourceful Fabrication	Alexander Jung	22
	Digital Sustainability & Sustainable Digitalisation: Towards Convergent Transformation	Chloe Nguyen	23
	Digital Sustainability in the Architecture, Engineering, and Construction (AEC) Sector	Jumana Hamdani	25
	Data Circularity in the AEC Sector: Implementing Circular Thinking into a Data Driven Process to Enhance Early Design Decisions	Jorge Castillo	26
3.30pm - 3.45pm	Break		
3.45pm - 5.15pm	Lifecycle Data for Material Recovery		
	Linking Building Records to Structural Components: A BIM-Based Information Framework for Reuse Screening	Zhengnan Liu	28
	Managing End-of-Life Solar Photovoltaics in Achieving Circularity through Blockchain	Wimarshi Jayathilaka	29
	Mapping Future Material Stocks: A Digital Spatial Approach to Circular Management of Wind Energy Infrastructure	Qiaoqiao Yong	30
5.15pm - 5.45pm	Break		
5.45pm - 7.00pm	Keynote: Prof Pamela Bell (Victoria University of Wellington)		
	Spotting the Gap: How Curiosity, Collaboration + Connecting Across Architectural Academia, Industry + Government Creates Impactful Change in the Built Environment Sector		6

DAY 2

Thursday
17 September

			pg. #
9.00am - 9.15am	Registrations open		
9.15am - 10.45am	**Early-Stage Design Decision Support**		
	Investigating Machine Learning (ML) Supported Structural Form-Finding for Early-Stage Architectural Design	Alireza Abdolmaleki	32
	Designing an LLM-Supported Iterative Building Material Selection Framework with Knowledge Taxonomy and Decision Memory	Kaiyu Zhou	33
	Redefining Architectural Design Process through Human Experience Data in Micro-Living Spaces	Shiva Ghaznavi	34
	AI-Powered Solutions for Decarbonising AEC, with focus on Façade Systems	Shahdad Fard	36
10.45am - 11.00am	Break		
11.00am - 12.30pm	**Standards-Based Building Assessment**		
	Space Automation Using Generative AI for Enhancing Circulation in Public Buildings	Nihal Morsi	38
	Developing an Automated Code Compliance Tool for Modular Construction Projects in Australia	Hirusheekesan Selvanesan	39
	Simplifying Envelope Retrofit for Australian Detached Dwellings: a Decision Support System for Deciding with Uncertainty	Sasanka Gallage	40
12.30pm - 1.00pm	**Postdoctoral Research Showcase: Dr Christopher Bamborough**		
	Material Flux: Climate Adaptability and the Built Environment		12
1.00pm - 2.00pm	Lunch		
2.00pm - 3.30pm	**Learning and Knowledge in Architectural Practice**		
	Reimagining Professional Development in a Digital Age: Integrating Human and Technical Learning Capabilities	Sandra Meng	42
	Educating Future Architects: Investigating Cultures of Collaboration in Architectural Design Studios	Annette Joseph	43
	Investigating Reverse Mentoring to Support Digital Transformation in the Australian Architecture Profession	Michael Lewarne	44
	Project Knowledge Capture for Architectural Design: Towards Organisational Insights and Learning	Houssame Hsain	45
3.30pm - 4.00pm	**Postdoctoral Research Showcase: Dr Geoff Kimm**		
	Action, Abstraction, AI		10
4.00pm - 4.15pm	Break		
4.15pm - 5.30pm	**Industry Partner Showcase: Architectus, Cox, Tzannes, ACA**		
	Presentations by Arch_Manu industry partners about research initiatives		
5.30pm - 6.30pm	**The Impact of AI on Copyright, Liability and Fees in Australian Architectural Practice**		6
	Panel discussion moderated by Prof Christiane Herr (Southern University of Science and Technology), featuring Ivana Simkovic (ARCH), Helen Kuo (FK), John Ferendinos (COX Architecture), and Prof M. Hank Haeusler (UNSW / Arch_Manu)		
6.30pm	Afterparty		

Keynote_16 September 2026

Spotting the Gap: How Curiosity, Collaboration + Connecting Across Architectural Academia, Industry + Government Greates Impactful Change in the Built Environment Sector

Prof Pamela Bell

Professor of Advanced Construction at Te Herenga Waka | Victoria University of Wellington

This keynote explores how curiosity, collaboration, and cross-sector connections between architectural academia, industry, and government can turn research into real-world impact in the built environment sector. It draws on projects in prefabrication, mass timber, and post-disaster housing, as well as architectural design competitions for universal bathroom pods (UNIpod) and 'a home in my backyard' (SNUG). Lived examples contrast 'sole trader' and research models with collaborative, socially driven networked approaches to bringing architecture and innovative solutions closer together. It examines why some built environment industry partnerships succeed while others stall, and how design-led technological innovation gains uptake. Finally, it proposes a BE-ST Scotland style model for uniting regional economic development, commercialisation grants, and multi-university input to rethink architecture and construction education alongside industry relationships for long-term sustainability and Indigenous outcomes.

Panel Discussion_17 September 2026

The Impact of AI on Copyright, Liability and Fees in Australian Architectural Practice

Panel Moderator

Prof Christiane M. Herr
SUSTech School of Design

Panel Members

Ivana Simkovic, ARCH
Helen Kuo, FK
John Ferendinos, COX Architecture
Prof M. Hank Haeusler, UNSW / Arch_Manu

Artificial intelligence is already reshaping how Australian architects design, document and deliver, while the rules underpinning the profession were written for a world where a human held the pen. This panel brings together academics and practitioners from across Australia to work through what AI adoption means for three foundations of architectural practice: copyright and authorship, liability, and fees. Who owns an AI-assisted design? Australian copyright requires a human author, which raises the question whether AI-generated work is protected at all, and what architects should do to secure their rights.

Who is liable when something goes wrong? The registered, insured architect remains accountable for what they issue, even for outputs they cannot fully check, while the AI provider is often overseas and beyond easy reach. And who captures the value? As AI tools compresses conventional tasks, should the productivity gain flow to the practice or the client, and how should firms should price their work in response? Australia currently governs AI through existing laws rather than a dedicated AI Act, even as that landscape begins to shift. Join us to explore where the profession is exposed, where it has room to move, and how architects can prepare. This panel brings together academics and practitioners from across Australia to examine how AI adoption is changing three foundations of Australian architectural practice: copyright and authorship, liability, and fees. With Australia currently governing AI through existing technology-neutral laws and sector regulators rather than a dedicated AI Act, this panel will collect forward-looking perspectives on how and who captures AI's value and who bears its risk.





Postdoctoral Research Showcase →



The Future of Architectural Expertise: Scenarios, Legitimacy, and Competency Standards

Postdoctoral Researcher

Dr Lisa LuBowden
UNSW Business School

Project Description

Architecture is operating within a period of considerable change. Artificial intelligence (AI), automation, changing regulation, environmental pressures, and shifting expectations of professional services are altering not only how architectural work is done, but also what expertise is valued and how it is recognised. This research program examines how these changes may reshape architectural practice, professional authority, and the capabilities required of future architects.

One stream examines plausible futures for the Australian architecture, design, and engineering (ADE) industry. Across three interactive workshops using a human-led, AI-supported scenario analysis process, senior practitioners identified trends and uncertainties likely to shape the industry over the coming decade and developed plausible future scenarios. Rather than predicting which future will occur, the research identifies four strategic tensions that recur across different futures: regulatory coherence and liability, AI-enabled augmentation vs commoditisation, professional jurisdiction, and legitimacy and trust. These raise questions already confronting stakeholders in the industry, including whether AI increases the value of professional expertise or makes aspects of the work increasingly reproducible; where responsibility sits as digital systems become embedded in project delivery; and how architects maintain legitimacy as professional roles and boundaries shift.

A related stream examines how AI and increasingly sophisticated digital technologies may affect professional legitimacy. Because clients and the public often cannot always directly assess the quality of professional services, they rely on signals such as credentials, titles, and reputation to infer expertise. In seeking to remain relevant,

A conceptual depiction of divergent future scenarios for architecture, emerging from shared underlying tensions

professions are actively developing and adopting technologies that reproduce capabilities previously embedded in professional expertise. For architects, this includes elements of design judgment. These actions make core professional work easier for others to access, reducing the scarcity of the capabilities that make professional expertise credible. We observe and develop the concept of jurisdictional self-erosion: a gradual self-hollowing-out of the profession in which actions intended to preserve relevance instead weaken the foundations on which professional authority has historically rested. Formal jurisdiction may remain intact, yet professional legitimacy becomes increasingly fragile as technology both reproduces expert capability and changes what clients and the public can do for themselves.

The third stream examines the competency standards that define what architects are trained on, expected to know, and be able to do. This project triangulates three sources of evidence: comparative analysis of competency frameworks across Australia, the United Kingdom, United States, and Canada; a scenario-analysis workshop with a sample of internationally-based architects and design researchers to identify emerging capabilities; and analysis of Australian disciplinary registers, tribunal/court cases, and professional indemnity claims to examine where failures in practice occur. Together, these streams of evidence allow the project to consider both future capability requirements and demonstrated areas of professional risk, and to ask how competency standards can operate more as adaptive systems responsive to emerging evidence, technological development, and changing practice.

Across these projects, the central concern is not simply how architecture responds to AI or new technology, but how the profession can adapt to profound change while retaining the expertise, accountability, and legitimacy that justifies its professional role.



Action, Abstraction, AI

Postdoctoral Researcher

Dr Geoff Kimm
Swinburne University of Technology
School of Design and Architecture

Project summary

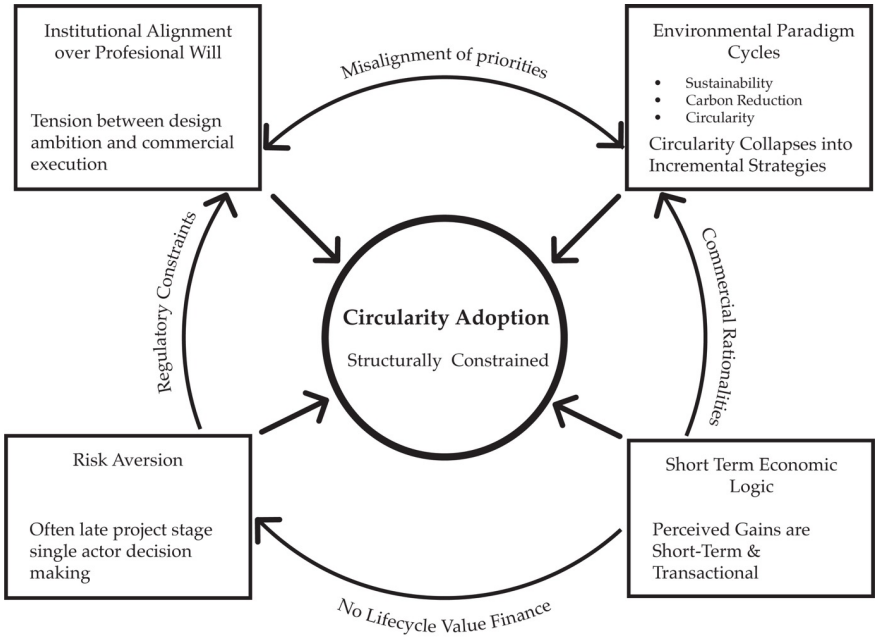
My research, since joining Arch_Manu this year, has focused broadly on how actions and relationships are represented and abstracted within computational systems. Each interface and process boundary within a system controls what is passed between components, what connections can be found, and what may flow from users to the system and back again. What may be exposed or filtered is a decision, whether deliberately or, implicitly, through inaction. Through such abstraction, complexity is made more manageable by the suppression of detail. This suppression is both a productive method and a subjective evaluation of what matters. Representation and abstraction can obscure possibilities that a practitioner may wish to pursue. These processes may also fix a computational representation of a problem in the moment of creation, while circumstances change and the problem develops through attempts to solve it. Computational systems therefore embody a persistent tension: openness supports free interpretation and user discretion, while curated restriction facilitates directed, efficient work. Agentic AI muddles this division. The locus of abstraction changes, as the AI system can make its own tools or perform actions. Some constraints and connections may then be determined in operation rather than directly by a workflow designer. I consider these broader issues through the lens of my background in software development, architectural training, and design research.

This concern runs through several of my activities within Arch_Manu. A PhD dashboard prototype investigates how semi-structured accounts of candidate research can be translated into interpretable views that reveal themes. Its analysis views indicate research

Empirical analysis of augmented LLM design decisions in the Simplified Analysis Augmented Generation (SAAG) workflow

projects' relevance to external questions and where those projects connect with or diverge from one another. A complementary tool proposes thematic research groupings to assist human creation of conference schedules. The work aids understanding of which targeted tools can provide a basis for conversational and agentic AI workflows for interpreting and organising information about activities. I also presented research in Taiwan on a Simplified Analysis Augmented Generation (SAAG) pattern for LLM use in early-stage design. The study showed how simple analysis tools, rapidly authored with AI, can supply spatial hints that improve the perceived quality of LLM design recommendations. A Sketch-to-Script prototype developed collaboratively at the Arch_Manu April Hackathon tested a guided interaction through which a non-technical designer's intentions could be translated into a working parametric script.

Related writing examines the concepts through which computational activity is understood. A current book chapter follows a 2022 one on classes of AI in urban design and planning. It redirects analytical attention from individual tools and language models to the workflows through which they are put to use. Other work in progress applies software-engineering concepts to AI-enabled design, asking what computational interfaces suppress and whether the conditions beneath them remain open to investigation. A related paper in development examines cross-disciplinary borrowing itself and asks which checks on a concept's correct use fail to travel with it into design computing. My aim across all these projects is to retain the productive roles of representation and abstraction while making their consequences more inspectable and their boundaries open to deliberate revision.



Material Flux: Climate Adaptability and the Built Environment

Postdoctoral Researcher

Dr Christopher Bamborough
UNSW School of Built Environment

Project Description

Over the past year, my research has examined circularity efforts, barriers, and opportunities in the architecture, design, and engineering (ADE) industry. This work culminated in the journal article "Towards Circularity: A Qualitative Study of Circularity Adoption in Australian Architectural Practice," published in Architecture and co-authored with M. Hank Haeusler, Michael J. Ostwald, Mohammad Kafaei, Yasmine A. Y. Thaher, Daniel Oteng, Jane Burry, Mark Burry, and Tim Schork.

Based on qualitative focus groups, the study identified a persistent gap between the ambitions of the circular economy and the realities of architectural production. Although circularity is increasingly promoted as a way to reduce waste and extend building lifecycles, architectural decisions remain constrained by fragmented supply chains, incomplete material information, short project timeframes, and professional norms shaped by linear construction.

Building on this work, my research examined digital capability around circularity more closely and the potential for a "circular intelligence" in architectural practice. The conference paper "Digital Circularity: An Empirical Study into the Tool-Based Progression of Circular Intelligence in Architectural Practice" asks how tool-based workflows can help designers understand, evaluate, and act on material circularity throughout the design process, and was accepted for presentation at the 7th International Conference on Computational Design and Robotic Fabrication.

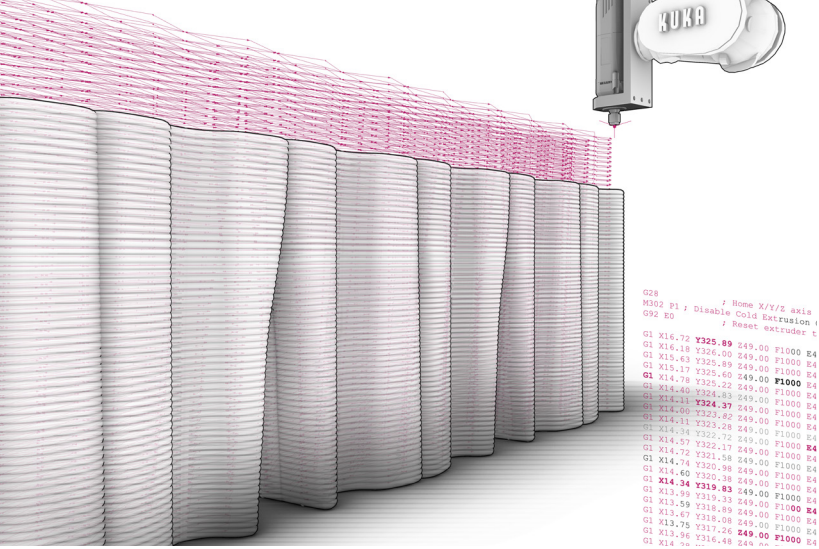
The research informed public and professional engagement through "Shattered Topography: A Monument to Waste", an installation using discarded plasterboard to construct a 30-metre-long, low-lying wall in Martin Place, in collaboration with Prevalent and ScaleRule.

Design-to-Making → Fabrication Workflows

(Bamborough et al, 2026, p16)

By placing construction waste in a highly visible public setting, the project exposed the material consequences of architectural expectations and invited broader conversations about reuse, circularity, and low-waste design. The installation also tested whether circular principles could operate within the current regulatory system. Across briefing, design, procurement, construction, use, adaptation, and disassembly, the live project tracked reuse decisions and examined the evidence, expertise, and digital support needed to make material recovery, reuse, and accountability routine.

The next stage of the research will focus on the specific challenges that could unlock circularity in practice. In July, I conducted a circularity workshop with industry partners to identify high-impact research problems. I am now analysing the results, which will inform a project designed to help these partners, and the wider architectural community, achieve more effective circular outcomes.



3D printing with earth-based material using a custom Gh script (generated by author)

Designing with Earth: An Integrated Design-to-Fabrication Framework for 3D-Printed Earthen Walls

PhD candidate

Mohamed Aboeloyoon, Synthesis Lab
Adelaide University School of Civil Engineering and Construction Management

Supervisors

Prof Jane Burry
A/Prof David Kroll

Project summary

The urgent need to reduce emissions and material waste in the construction industry has renewed interest in pairing digital fabrication with low-carbon materials. Earth-based materials, among the oldest building materials globally, are increasingly revisited as low-carbon, locally sourced alternatives with significant architectural potential. However, the scalability of extrusion-based earthen construction remains fundamentally constrained by wet-state instability, which limits maximum continuous printable height and undermines fabrication reliability. Existing research addresses this primarily through material composition, often undermining the material's inherent sustainability, or through fabrication timeline adjustments such as process pausing, multi-session printing, or forced drying, which increase fabrication overhead. This research proposes an alternative fabrication-integrated framework that enhances wet-state stability without altering material formulation. Two complementary strategies are investigated: Periodic Toolpath Modulation (PTM), which introduces coordinated geometric variation to redistribute stresses during deposition, and In-Process Reinforcement Integration (IPRI), which embeds temporary discrete elements to provide localised bracing during consolidation. Through multi-scale experimentation progressing from small-scale prototyping to full-scale robotic fabrication, the research establishes validated design-to-fabrication guidelines for improving buildability, geometric reliability, and fabrication continuity in earthen additive manufacturing, positioning fabrication logic as an alternative to material alteration. In doing so, this work lays the groundwork for wider integration of low-carbon, earth-based materials into mainstream digital construction practice.

Design and Fabrication of Freeform Earth-Based Structures Using Adjustable Mould System

PhD candidate

Hamidreza Malekian, Affiliated PhD
Swinburne University of Technology
School of Design and Architecture

Supervisors

Dr Mohamed Gomaa
A/Prof Mehrnoush Latifi

Project summary

The construction industry is under growing pressure to lower its environmental impact, making decarbonisation a critical priority. At the same time, architects are increasingly using digital tools to design more complex forms, while construction methods have not kept pace. Addressing this gap requires new approaches to material selection, fabrication, and construction processes. In fabrication, digitisation; particularly through automation, offers a pathway toward more efficient construction practices. But integrating digital technologies into contemporary construction raises new challenges, particularly around the properties of sustainable materials and their compatibility with automated fabrication processes.

Bio-composites are eco-friendly materials used in the construction industry, offering biodegradability, affordability, low energy requirements, and a reduced environmental impact. Earth is a particularly strong candidate as a base material for such composites due to its low cost, minimal processing, availability, and reusability. This study investigates earth-based composites as a sustainable alternative within automated construction, responding to architecture's growing demand for fabricating freeform complex forms. It proposes a method for fabricating freeform earthen construction using locally sourced material.

Freeform earthen panels can be fabricated manually, but this process has several issues due to the use of sacrificial moulds. Existing mould-based fabrication typically requires geometry-specific formwork, meaning each shape needs its own mould, which makes the construction labour-intensive and can result in significant formwork waste. A reusable and reconfigurable mould offers an alternative. One mould that can be adjusted to produce multiple geometries, reducing the need to produce and discard new formwork for each new curvature.

The research began by examining earth-based bio-composites, since material properties are the primary driver behind the design of the adaptive mould system. Initial work focused on the mix composition, fibre content, density, rigidity, shrinkage, and compressive behaviour. This material investigation provides the basis for next stage of the study, which is currently in progress: developing and refining and adaptive moulding system for customised earthen panels. The aim is a mould that can be adjusted to produced multiple geometries on construction site, reducing single-use formwork and supporting more sustainable approach to freeform earthen construction.



This image was generated and edited using OpenAI's ChatGPT image-generation tool, based on the author's design concept and instructions.

Freeform earth panels, shaped by an adjustable mould system and made from locally sourced soil, point toward a sustainable building future for rural Australia

Chippie and the Circular Robotic Housing Chassis: A Digital Vernacular for Reversible Timber Automation & Construction

PhD candidate

Jorge Luis Rivero Torres, Synthesis Lab
Swinburne University of Technology
School of Design and Architecture

Supervisors

Prof Blair Kuys
A/Prof Mehrnoush Latifi
Dr Geoff Kimm

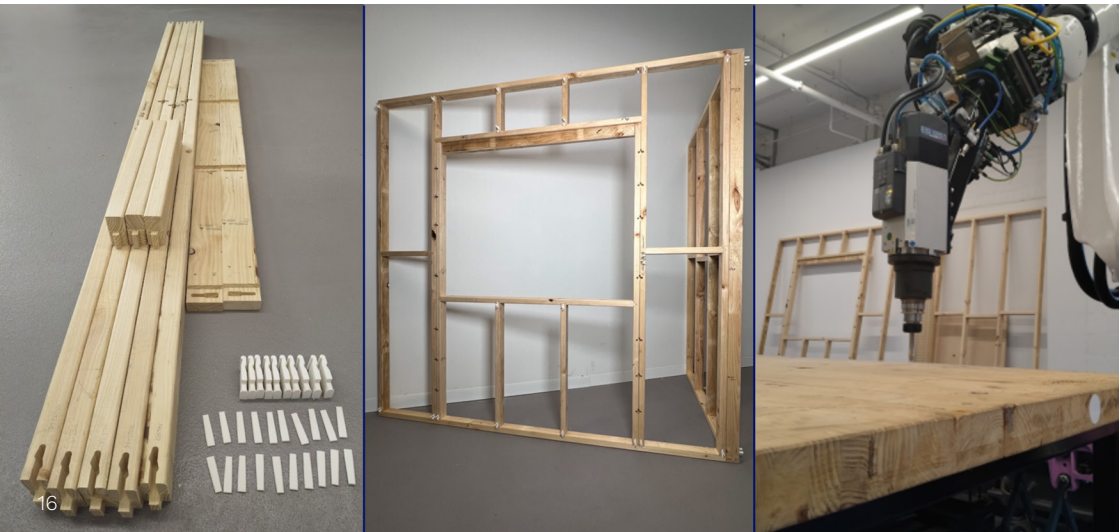
Project summary

Australia faces a dual construction crisis: among the least productive sectors in the national economy, and a projected shortfall of over 200,000 dwellings by 2029, while conventional building methods send most end-of-life materials to landfill. This research proposes an alternative: the Circular Robotic Housing Chassis, a stick-based structural timber platform designed from the outset for Manufacture, Assembly, and Disassembly (DfMAD).

The project develops a “Digital Vernacular”, a taxonomy of traditional friction-fit joinery, drawn principally from Asian and Western European carpentry, reinterpreted through the precision of 6-axis robotic fabrication. Where contemporary prefabrication depends on steel fasteners and adhesives that bypass material recovery, these joints hold through geometry alone. The same kinematic property that permits a robot to fabricate a joint, and a human to snap-fit it on site without specialist training, later enables non-destructive disassembly, returning structural members to circulation at full material value.

At the core of the workflow is Chippie, a three-tier algorithmic auditing engine that certifies joints computationally, across geometry and kinematics, force and friction, and material limit states, before a single cut is made. Developed within a custom Grasshopper environment and validated through robotic prototyping at Swinburne’s ProtoLab (KUKA KR 120), the system treats craft knowledge as computable design intelligence: tacit knowledge, made explicit through data.

The thesis contributes to UN SDGs 9, 11, and 12, positioning housing components as recoverable material banks rather than demolition waste, and asking how automation might preserve, rather than displace, the knowledge embedded in vernacular craft.



AI and Computational Tools in Architectural Practice

Full-size corner assembly comprising a common wall and a window wall panel (2355 x 2330mm) with a 1350mm window opening, lintel, and lintel-supporting studs (700 x 350 mm). Assembled by non-specialist participants with no prior experience in carpentry, construction, or wall framing in 25 minutes, using only a mallet, no additional measurements or squaring were required. The exercise also documented the complete action sequence for assembly and disassembly (Author's own image)



Conceptual illustration of architecture firm partners exploring business model responses to AI (Image generated using OpenAI's ChatGPT)

Turning AI Foresight into Business Model Innovation in Architecture

PhD candidate

Anthony Lockhart, Affiliated PhD
UNSW School of Management and Governance

Supervisors

Prof George Shinkle
Prof Markus Höllerer
Dr Christian Criado-Perez

Project summary

Artificial intelligence is rapidly reshaping architectural practice, both disrupting established ways of working and enabling new ways for firms to design, work with clients, deliver projects, and generate value from their expertise. Many architecture leaders can already see these changes coming. The harder challenge is deciding how their firms should respond – and turning that foresight into viable business model innovation: changes to the system of interdependent activities through which the firm creates, delivers, and captures value.

This research examines why some AI-related strategic initiatives gain traction inside architecture firms while others stall, despite an apparently strong commercial or operational case. As part of a broader UNSW research program across professional service firms, it investigates how strategic foresight translates into business model innovation – from recognising emerging technological change, through designing a response, to putting that response into practice. In doing so, it explores how organisational capabilities, internal dynamics, and external pressures combine to shape that process.

Architecture provides a particularly revealing setting. AI is reshaping the expert work at the heart of the profession, while professional standards, partnership structures, client relationships, and liability exposure can all influence which changes firms pursue and how they implement them. Within this broader process, the research is especially interested in how partners, staff, clients, peers, and regulators react to proposed changes (measured as organisational/managerial expectations) – and how those reactions shape progress.

The project will draw on interviews with architecture professionals, followed by a cross-firm survey. Participating firms will contribute to a broader evidence base and receive practical insights drawn from anonymised cross-firm findings on where and why initiatives gain or lose momentum, and what distinguishes those that progress from those that stall. These insights are intended to help leaders understand what they can do to turn strategic foresight into viable business model innovation.

Understanding how Generative Design Tools can be Leveraged within Early Design Workflows to Improve Design Efficiency in Large-Scale Architectural Projects

PhD candidate

Thao Morgan Pham, Analytics Lab
Swinburne University of Technology
School of Design and Architecture

Supervisors

A/Prof Charlie Ranscombe
Dr Sascha Bohnenberger-Fehr

Project summary

The architecture, engineering and construction (AEC) industry has long faced challenges related to productivity, efficiency, and the adoption of emerging technologies. While technologies such as digital fabrication, augmented and virtual reality, and machine learning have introduced new opportunities for the sector, their implementation can be constrained by barriers including cost, training requirements, technical expertise, and usability. Generative Design (GD) software tools represent an emerging approach with the potential to support early-stage architectural design by automating computationally and labour-intensive tasks while enabling designers to explore and evaluate multiple design alternatives. Compared with advanced technologies such as digital fabrication, machine learning, AR, and VR, the increasing accessibility of GD tools, including reduced requirements for specialised expertise and computational infrastructure, may lower some barriers to adoption. However, despite their increasing availability and accessibility, their practical application within architectural workflows remains limited, and questions remain regarding how their capabilities can be appropriately aligned with designers' needs and professional practices to ultimately achieve the efficiency they promise.

This thesis investigates how Generative Design software tools can be effectively integrated into early-stage architectural design workflows. It addresses a gap in knowledge concerning the practical implementation and use of GD tools in architectural practice, complementing existing research that has predominantly focused on their technical capabilities, computational methods, and theoretical potential. The research aims to develop an implementation guide that



Model generated by practitioners during the trial of GD tools in Case Study 1

identifies appropriate GD functionalities, levels of automation, conditions of use, and designer requirements for the effective integration of these tools into early-stage design workflows.

The anticipated contribution of this research is a practice-oriented guide for understanding and implementing GD tools in early-stage architectural design. The guide is intended to support practitioners in identifying where and how GD can provide value within design workflows, assist researchers in evaluating GD tools against practice-oriented criteria, and inform developers about the functionalities, levels of automation, and workflow conditions that should be considered when developing future GD tools for architectural practice.

and validation against real-world data, underexplored MR benefits, adoption gap with existing workflows, limited integration with EBD and UCD, and inconsistent validation of VR's measurable design value.

To address the gap, this research aims to design an interactive, practice-based framework integrating UCD, EBD, and immersive technologies. The framework supports early occupant feedback loops, improves communication, and ensures design decisions. One outcome will be a validated iterative design process model, adaptable for existing workflows of architectural firms. Another outcome will be revisions to AEC guidelines, enhancing stakeholder engagement and prioritising human experience. Ultimately, the framework's effectiveness will be tested through real-world case studies with industry partners, ensuring practical impact on architectural practice.

AI as a Collaborator in Architectural Design: Cognitive, Neurophysiological and Creativity Impacts

PhD candidate

Guanlin He, Analytics Lab
UNSW School of Built Environment

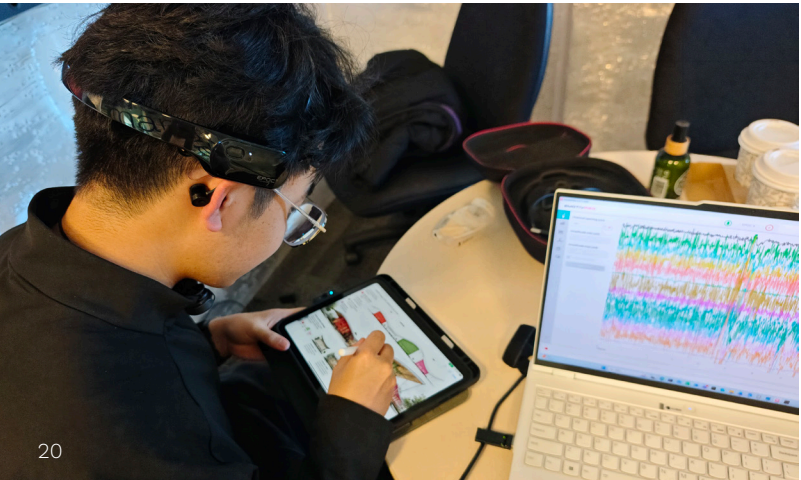
Supervisors

Scientia Prof Michael J. Ostwald
A/Prof JuHyun Lee

Project summary

Collaboration between architectural designers and artificial intelligence (AI) is reshaping creative design processes, particularly during conceptual design, by supporting efficiency and ideation.

AI's impact in the sector, especially on the creative processes used in architectural



Pilot experiment setup for the human-AI collaborative design study. A participant wearing an EEG headset while sketching and communicating with a large language model on a tablet. Real-time brain signals are recorded on the laptop for subsequent cognitive process analysic (Author's own image)

design, is poorly understood (Atwa & Saleh, 2023). Furthermore, the role of AI in shaping or engaging creativity and improving efficiency remains a subject of controversy. On the one hand, research and practices with generative AI present a potential for enhancing creativity with 'unexpected' generations (Dall'Asta & Di Marco, 2024). On the other hand, there are concerns about the ways AI models may limit human involvement or engagement in design (Fleischmann, 2024; Parente et al., 2023) or even result in a decrease in creativity (Kosmyna et al. 2025) and a loss of efficiency (Becker et al. 2025:8).

This study aims to understand how architects can effectively collaborate with AI in the design process, striking a balance between creative thinking and mechanical generation within established workflows. However, existing research on Human–AI Collaborative (HAIC) design primarily relies on interviews, researcher-coded behavioural observations, self-report surveys, and expert evaluation questionnaires. These approaches are inherently subjective and largely depend on participants' perceptions or researchers' interpretations, resulting in limited objective evidence to empirically explain designers' cognitive processes during collaboration with AI.

To achieve this aim and partially overcome these limitations, the research employs electroencephalogram (EEG) equipment to capture human designers' creativity and cognitive performance across HAIC-assisted architectural design processes.

This research contributes to cognition and neurophysiological studies of Human-AI collaboration and creativity in the architectural design field, including: (i) developing a multimodal assessment system for evaluating creative thinking patterns, (ii) comparing human-to-human collaboration and human-to-AI collaboration processes, (iii) investigating the influence of AI collaboration on creativity in architectural design.

Organisational → Digital Implementation in AEC

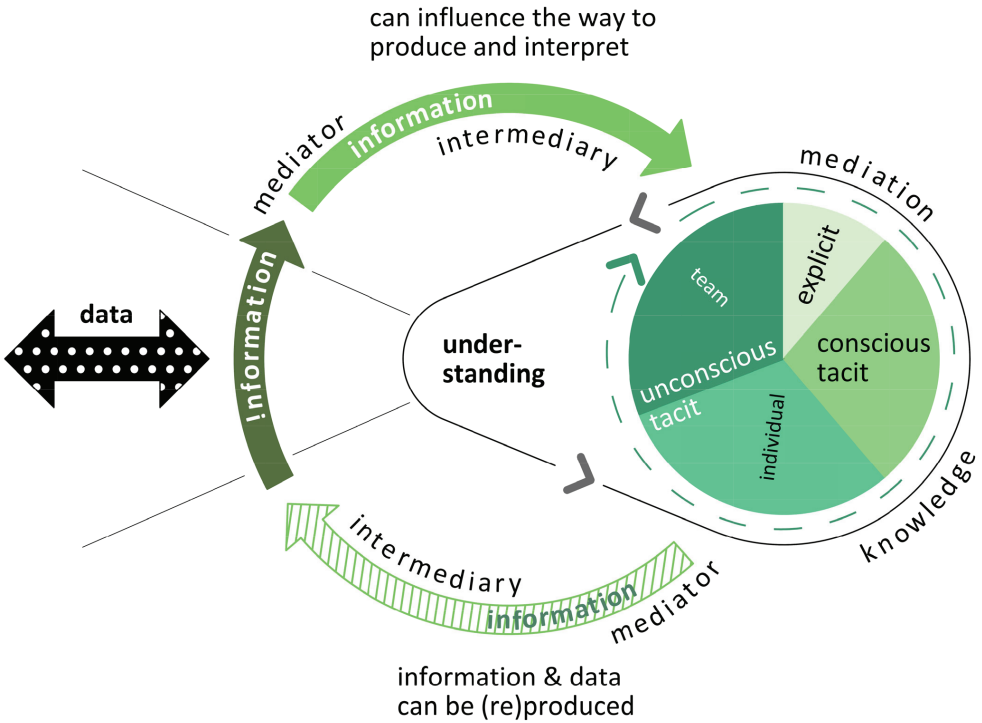


Fig. 1: DIKU Diagram_Data-Information-Knowledge-Understanding, (Author, based on Bektaş, 2013)

Communication and Collaboration Strategies for Implementing Integral-Circular Practices Enhancing Resourceful Fabrication

PhD candidate

Alexander Jung, Synthesis Lab
UNSW School of Built Environment

Supervisors

Prof M. Hank Haeusler
Dr Christopher Bamborough

Project summary

The AEC sector struggles to translate digital innovation into scalable, circular solutions. BIM, immersive technologies, blockchain, and AI-driven planning offer potential, but adoption is constrained by legislative, organisational, social, cultural, and epistemic barriers. Despite two decades of digitalisation, AEC remains the least productive sector. Industry 4.0 has reshaped design and delivery, yet communication and collaboration challenges persist (McKinsey, 2024).

This gap was identified through a Systematic Literature Review examining digital communication tools, collaboration strategies, and organisational structures for interdisciplinary project delivery and

integral-circular practices towards climate action. Using the CSCW framework (Greif, 1988) and PRISMA, the review applies three lenses: people, process, and technology, to analyse communication in Large-Complex Building Projects, revealing siloed practices, fragmentation, weak collaboration skills, interoperability issues, and limited socio-technical attention.

The methodology combines realist and constructivist perspectives utilising three philosophical lenses: Schulz von Thun's Communication Square, Habermas's Communicative Action Theory, and Actor-Network Theory, analysing 19 semi-structured interviews at micro, macro, and a-scale (network) levels via Reflexive Thematic Analysis (Braun & Clarke, 2022b), producing five themes.

A preliminary finding shows that effective collaboration requires treating communication as a tool (Fig. 1) needing flexible interpretation to exchange implicit and explicit knowledge. Data transfer alone is not communication unless meaning is transformed for the receiver. Latour's (2005) mediator/intermediary distinction is central to examining human actants within socio-technical communication. The thesis explores how communication supports interdisciplinary collaboration and integral-circular practices by synthesising knowledge across project lifecycles toward a sustainable built environment.

References

McKinsey, 2024. Construction Productivity Index Update.

Greif, I. (ed.) (1988) Computer-Supported Cooperative Work. Morgan Kaufmann.

Braun, V. and Clarke, V. (2022b) 'Conceptual and design thinking for thematic analysis', Qualitative Psychology, 9(1)

Bektaş, E., 2013. Knowledge sharing strategies for large complex building projects. A+BE, 3(4)

Latour, B., 2005. Reassembling the Social. Oxford University Press.

Digital Sustainability & Sustainable Digitalisation: Towards Convergent Transformation

PhD candidate

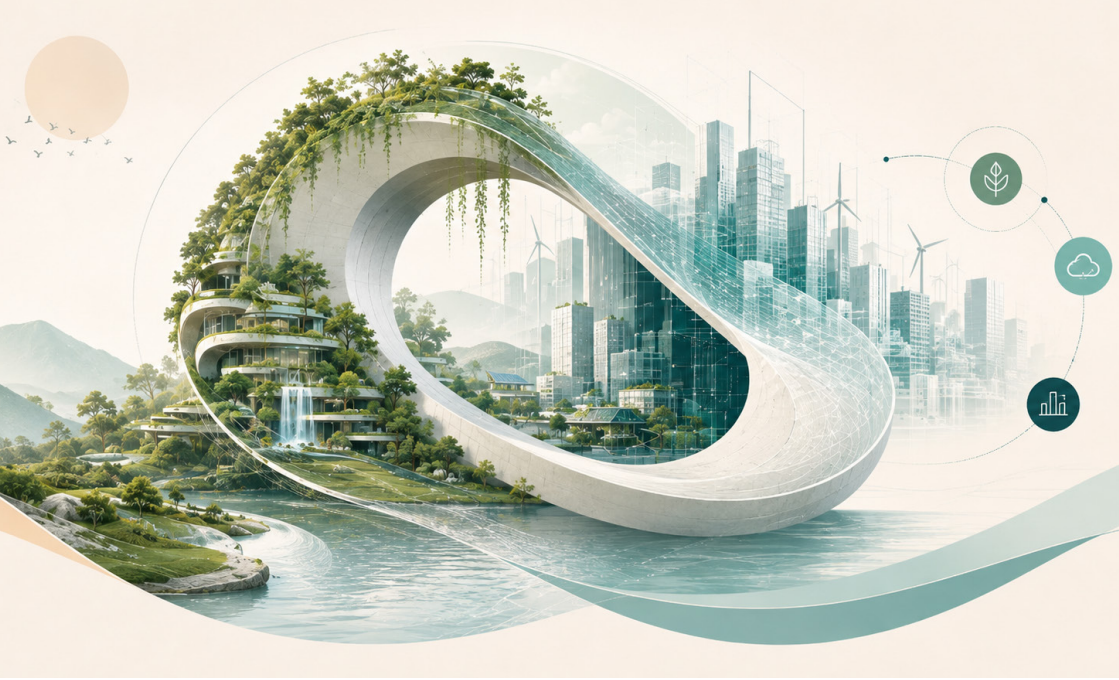
Chloe Nguyen, Management Lab
UNSW School of Information Systems and Technology Management

Supervisors
A/Prof Yenni Tim
A/Prof Sandeep Mysore Seshadrinath
Prof George Shinkle

Project summary

The AEC sector is undergoing two urgent transformations: the transition towards sustainability and the rapid adoption of digital technologies. The sector is responsible for approximately 37% of global carbon emissions, placing it at the centre of global climate action. At the same time, digital technologies are reshaping how built-environment professionals design, coordinate and deliver projects. However, digitalisation and sustainability are often pursued as separate organisational agendas. Sustainability initiatives are treated as compliance-driven additions, while digitalisation is primarily directed towards improving efficiency and productivity. This disconnection leads to missed opportunities and organisational misalignments. This research explores how digital innovation and sustainability can progress together through two complementary concepts: digital sustainability, where digital technologies are employed to advance sustainability goals, and sustainable digitalisation, where the focus lies at building sustainable digital technology.

The first study examines how organisations implement digital sustainability in practice. Drawing on 37 interviews with stakeholders across organisational functions, the research finds that successful digital sustainability implementation depends on more than the introduction of new technologies. Stakeholders may hold different understandings of a tool's purpose, use, capabilities and expected sustainability impact, creating misalignments



in implementation. The findings highlight the role of sustainability champions in creating a digital connection between organisational goals and technology implementation, translating sustainability goals into project-specific opportunities and keeping sustainability visible throughout project development. These insights point to the importance of aligning people, practices and technologies for sustainability outcomes.

The second study turns to sustainable digitalisation and explores how sustainability principles can be embedded into the design and development of digital systems. The study focuses on how digital systems can remain adaptable, maintainable and resilient as organisational needs and sustainability priorities evolve. This next phase of the research is open for collaboration with industry partners interested in co-developing sustainable digital systems in project or organisational settings.

Digital Sustainability in the Architecture, Engineering, and Construction (AEC) Sector

PhD candidate

Jumana Hamdani, Management Lab
UNSW School of Information Systems and Technology Management

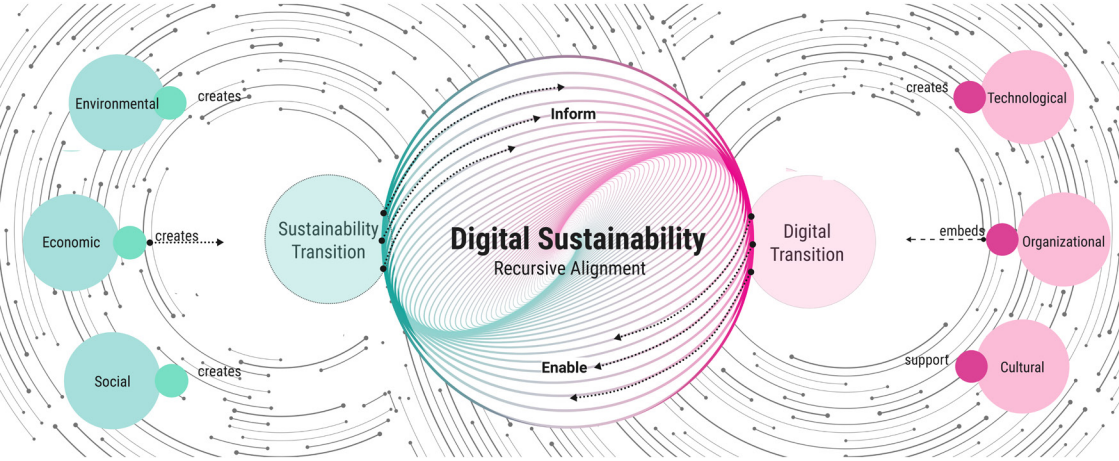
Supervisors

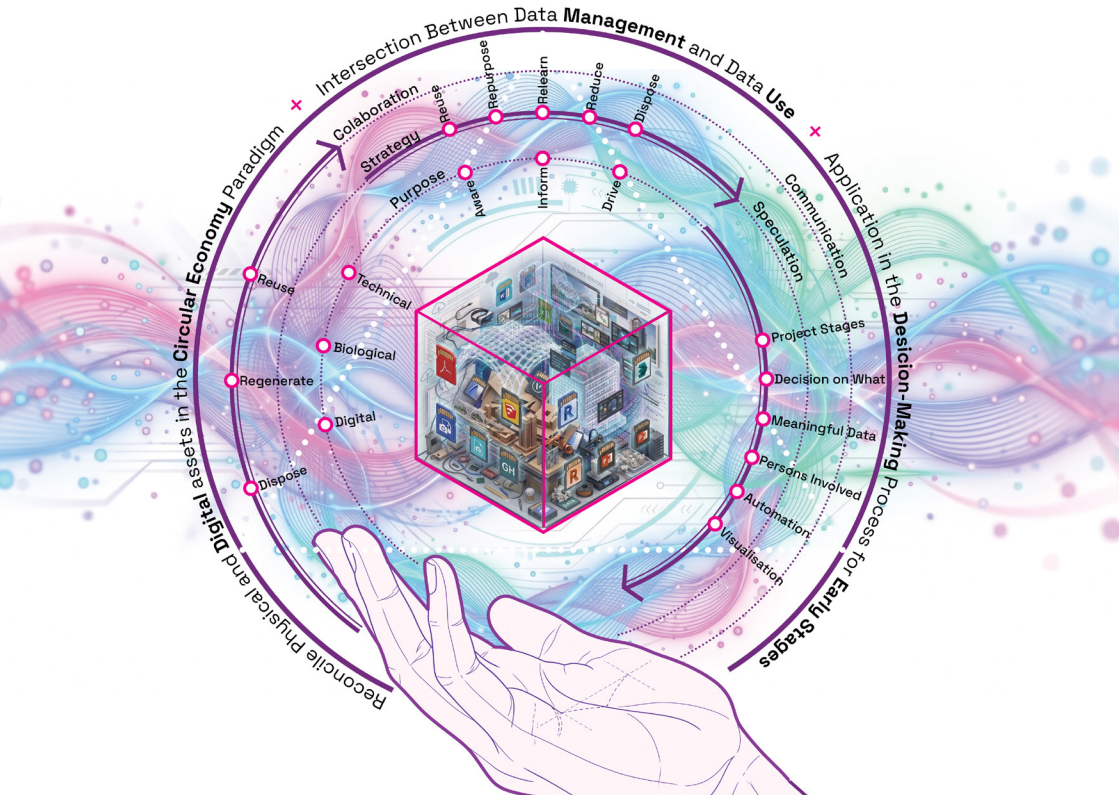
A/Prof Sandeep M.Seshadrinath
Prof Markus Höllerer
Emeritus Prof Shan Pan

Project summary

This research investigates the concept of Digital Sustainability (DS) within the Architecture, Engineering, and Construction (AEC) sector, addressing how digital transformation can be strategically aligned with sustainability imperatives to advance environmental, social, and economic goals. Positioned within the broader discourse of the twin transition, the study explores the convergence of emerging digital technologies—such as Building Information Modeling (BIM), digital twins, artificial intelligence (AI), and the Internet of Things (IoT)—with the pressing demand for sustainable development. Given increasing global pressures for the AEC sector to reduce environmental impact, understanding how these technologies can help achieve these goals is essential for industry stakeholders, policymakers, and researchers, offering transformative capabilities for data-driven decision-making, optimized resource use, and the implementation of circular economy practices. Despite the potential of these digital enablers, the research identifies critical barriers limiting the full adoption and scalability of digital sustainability solutions across the sector. These include organisational resistance, interoperability challenges, and a fragmented regulatory environment. To address these challenges, the research conducts an integrative review, synthesising insights from both Information Systems, Sustainability Studies and Built Environment research to conceptualise the core dimensions of Digital Sustainability, its digital enablers that support sustainability and to develop strategic frameworks necessary for successful DS implementation in the AEC sector. Findings contribute to the growing theoretical discourse on digital sustainability in Information Systems and the Built Environment while offering actionable insights for practitioners, and practical implications for stakeholders aiming at transforming sustainable practices by providing a structured understanding of how digitalisation can be harnessed to meet global sustainability goals in the AEC sector. Future studies are encouraged to empirically validate the core dimensions within the inductive framework of digital Sustainability, addressing the practical and theoretical gaps identified.

Digital Sustainability Model





Data Circularity in the AEC Sector: Implementing Circular Thinking into a Data Driven Process to Enhance Early Design Decisions

PhD candidate

Jorge Mario Castillo Velasquez, Analytics Lab
Swinburne University of Technology
School of Design and Architecture

Supervisors

Prof Marcus White
Dr Sascha Bohnenberger-Fehr

Project summary

Despite generating massive volumes of data across project lifecycles, the AEC industry often struggles to reuse this valuable, heterogeneous resource effectively. While current Data Management and Building Information Modelling (BIM) strategies demand and capture essential tacit and explicit knowledge, the absence of a comprehensive data reuse approach leaves much of this asset's potential untapped.

In this context, Data Circularity emerges as a sustainable approach that elevates data as an independent asset within the circular economy (CE) paradigm, where the core CE principles

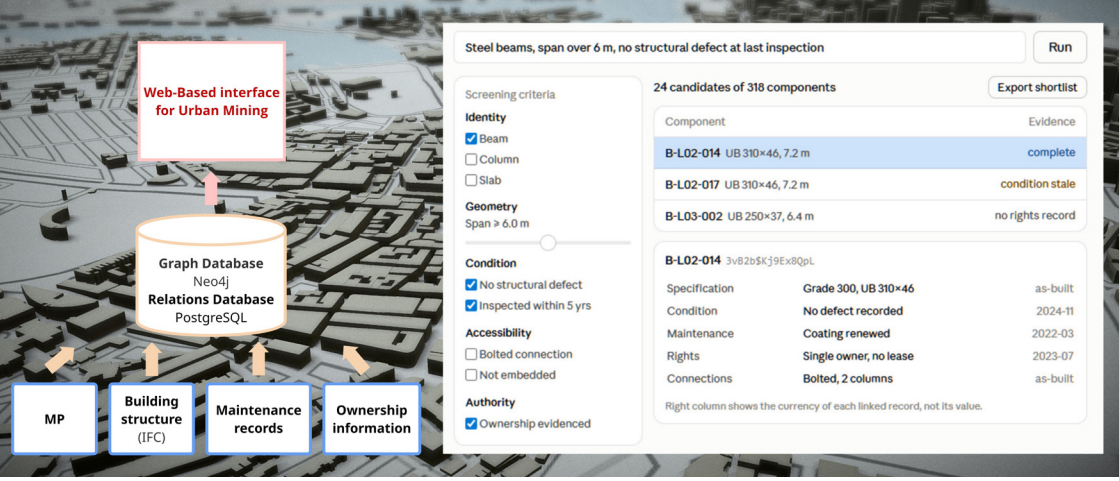
Lifecycle Data for Material Recovery →

Data Circularity: The anatomy of data flows, focusing on their selection, transformation, and circulation as knowledge and information to support early-stage design decision-making in the AEC industry. The framework integrates the Digital Cycle (Definition), Data Circularity (Strategies), and Design Decisions (Application)

of eliminate, recirculate, and regenerate can be applied. This research defines Data Circularity as a strategic data management framework tailored for the AEC sector. Moreover, it proposes adding a “digital cycle” to the established CE butterfly diagram, creating a theoretical model that reconciles the physical assets of the technical and biological cycles with the digital cycle within a unified circular context.

To bridge theory and practice, this study presents a layered application model that maps the intersection of data management and data usage to define which data is truly valuable. It provides a strategic roadmap for navigating complex data environments, enabling professionals to identify and select critical information for specific goals, thereby elevating the designer’s role in early design decisions.

Ultimately, this research demonstrates how the accurate reuse of intangible digital assets can augment early-stage design decisions. By providing a clear data management strategy, this innovative perspective empowers architects, fosters a digital mindset aligned with circular economy initiatives, and provides the fundamental framework for the AEC industry to extract maximum value from the information it captures.



Conceptual framework integrating fragmented building records around structural components through graph and relational databases to support information-based screening for building component reuse

Linking Building Records to Structural Components: A BIM-Based Information Framework for Reuse Screening

PhD candidate

Zhengnan Liu, Synthesis Lab
UNSW School of Built Environment

Supervisors

Prof M. Hank Haeusler
Prof Sisi Zlatanova

Project summary

Existing buildings hold substantial stocks of reusable structural components — beams, columns, and slabs — yet these are seldom recovered when buildings are adapted or demolished. The obstacle is increasingly informational rather than material: the evidence required to judge whether a component is worth recovering is fragmented across disciplines, frequently incomplete, and poorly maintained over a building's life. This research asks what kind of data model can consistently capture, organise, and maintain material-reuse information for structural components in existing buildings throughout their life cycle.

Rather than determining whether a component can be reused — a judgement that ultimately depends on on-site survey and physical testing — the work focuses on linking external records to individual components in a machine-readable structure. Four data sources are integrated: material composition, the IFC structural model, maintenance and inspection records, and ownership information. These are represented through a hybrid structure in which a knowledge graph captures inter-component connections for disassembly assessment, while relational records hold each component's attributes, geometry, location, condition and ownership. A web-based screening interface then retrieves a component's linked information and reports the currency and completeness of each record, enabling a transparent first-step reuse assessment.

The framework is developed and evaluated on a real adaptive-reuse building using an Action Design Research approach. Its contributions are threefold: an attribute template defining

the characteristics relevant to structural-component reuse; an integration layer that consolidates fragmented, multi-source records around individual components; and a web-based interface supporting reuse screening. By making reuse-relevant information consistent, current, and queryable, the framework supports more sustainable adaptive reuse and, ultimately, building-stock and urban-mining assessment at larger scales.

Managing End-of-Life Solar Photovoltaics in Achieving Circularity through Blockchain

PhD candidate

Wimarshi Jayathilaka, Affiliated PhD
Adelaide University School of Civil Engineering and Construction Management

Supervisors

Dr Navodana Rodrigo
Dr Daniel Oteng
Prof Jian Zuo

Project summary

The increasing uptake of renewable energy is driving the rapid adoption of solar photovoltaic (PV) technology worldwide. It also presents a significant challenge in managing end-of-life solar panels as systems installed in the early 2000s reach the end of their operational lifespan. The PV lifecycle raises concerns because it generates electronic waste at end-of-life (EoL). As solar panels reach the EoL, they generate electronic waste that requires careful handling. Current PV waste management practices lack effective monitoring, traceability, structured data flows, and circular economy (CE) evaluation mechanisms. Consequently, only about 10% of PV waste is recycled, while most panels are landfilled or exported offshore, limiting sustainable recovery.



Blockchain-supported circular lifecycle of solar panels

This gap between renewable-energy expansion and responsible waste management underscores the need for improved digital systems. Blockchain technology offers a practical solution to challenges such as limited security, trust, transparency, data manipulation, and stakeholder collaboration. Through immutable records and decentralised information flows, blockchain enables accurate tracking of PV components from manufacturing through installation, operation, and final disposal. This research therefore focuses on how blockchain technology can enhance effective monitoring and support CE-aligned decision-making in PV waste management.

The study adopts a structured data modelling approach to examine data requirements and lifecycle interactions within the PV supply chain. These data models include User Flow Diagrams, Input-Process-Output (IPO) Diagrams, Use Case Diagrams, and Entity-Relationship Diagrams for PV waste management. The proposed Blockchain-Enabled Data Model embeds CE-aligned main decision-making criteria: environmental impact and material recovery. This enables the structured evaluation of circular PV waste pathways, providing stakeholders in the solar PV supply chain with a reliable mechanism to track, monitor, and maintain lifecycle records. Ultimately, this research aims to deliver a transformative blockchain prototype system that improves tracking, monitoring, resource recovery, collaboration, and regulatory compliance, contributing to more sustainable and transparent management of solar PV waste.

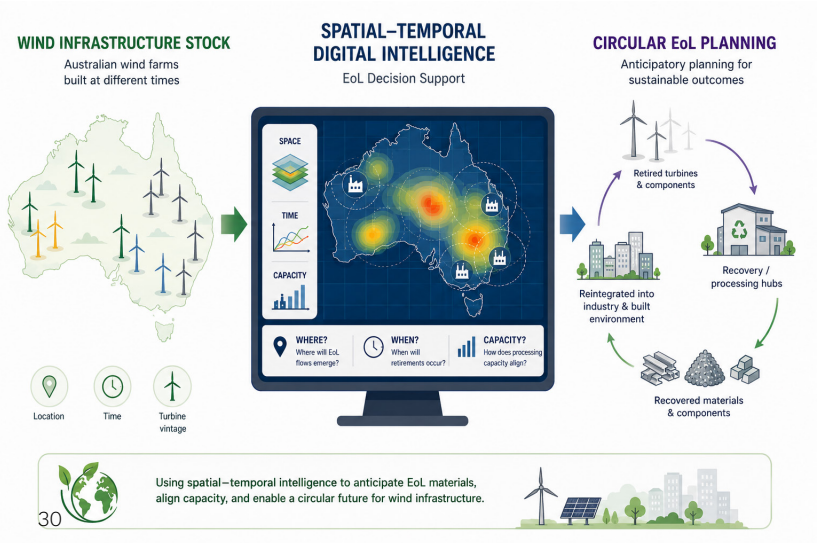
Mapping Future Material Stocks: A Digital Spatial Approach to Circular Management of Wind Energy Infrastructure

PhD candidate

Qiaoqiao Yong, Analytics Lab
Adelaide University School of Civil Engineering and Construction Management

Supervisors

Prof Jian Zuo
Dr Daniel Oteng
Dr Prince Antwi-Afari



Conceptual framework for spatial–temporal digital decision support, linking Australia's wind infrastructure stock with future end-of-life material flows and circular management planning

Early-Stage Design Decision Support →

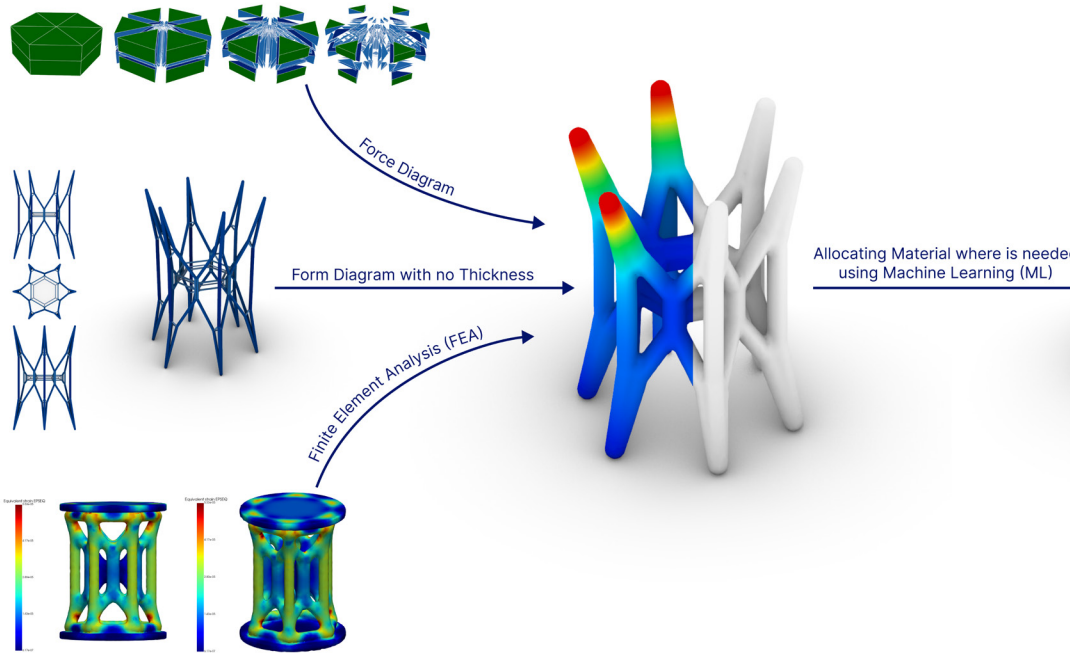
Project summary

The transition towards a circular built environment increasingly requires designers and planners to consider not only how materials can be reused, but also where and when future secondary material stocks will become available. While digital approaches are increasingly used to document material stocks within existing buildings, less attention has been given to large infrastructure systems approaching end-of-life (EoL). Renewable energy infrastructure presents an emerging example, where future decommissioning will release substantial material flows across geographically dispersed locations.

This research investigates how digital spatial and asset information can be used to anticipate these future material flows through the case of wind energy infrastructure in Australia. Wind turbines are deployed across different regions and generations, meaning that retirement will occur at different times and locations. Although multiple reuse, recycling and recovery pathways are available, their practical implementation depends on whether suitable collection, transport, pre-processing and recovery capacity is available when and where retired components and materials emerge.

The research first establishes an evidence base for EoL and value-retention pathways and their technological, economic, infrastructural and institutional requirements. Wind farm location, commissioning history, installed capacity and turbine characteristics are then integrated into a digital infrastructure-stock model. Alternative service-life scenarios are used to simulate future retirement flows, which are spatially mapped and linked with regional processing capacity, facility accessibility and transport requirements. This enables potential waste–capacity gaps and preparation windows to be identified and alternative reverse-supply-chain configurations to be explored.

The expected contribution is a scenario-based spatial decision-support approach that makes future secondary material availability and associated recovery constraints visible across space and time. By connecting infrastructure stocks, decommissioning and material recovery, the research extends digital circularity thinking beyond individual buildings towards larger infrastructure systems and their potential contribution to a circular built environment.



Investigating Machine Learning (ML) Supported Structural Form-Finding for Early-Stage Architectural Design

PhD candidate

Alireza Abdolmaleki, Synthesis Lab
Swinburne University of Technology
School of Design and Architecture

Supervisors

A/Prof Mehrnoush Latifi
Dr Pantea Alambeigi

Project summary

Early-stage architectural design increasingly uses computational tools while structural reasoning remains a post-hoc evaluation. Although ML has increasingly been applied to structural performance prediction, optimisation, and generative design, its use as an interactive form-finding mechanism within early-stage architectural design remains comparatively limited. This research investigates how ML can support structural form-finding as an active part of early-stage architectural design.

The research has developed through a series of investigations. A literature review and industry engagement with COX Architecture highlighted the impact of structural material on embodied carbon, and the potential of computational workflows to predict performance. Two exploratory hackathons further tested this issue. The first investigation explored whether ML could learn structural and embodied-carbon relationships from solver-generated data. While this demonstrated potential for performance prediction, it also revealed that learning simulation outputs does not necessarily mean learning structural logic. The second introduced graph-based representations to support relational reasoning, but revealed that connectivity alone does not encode equilibrium. These findings established the need to represent structural behaviour explicitly rather than only through analysis results.

This direction was then tested and exhibited through prototyping a project at the Digital Futures international conference, where I designed structural models using

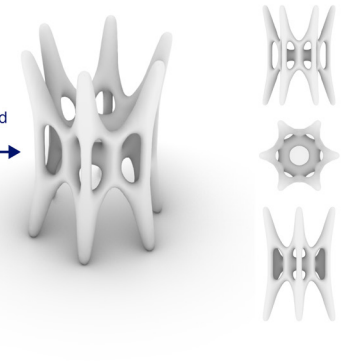


Image by Alireza Abdolmaleki

Polyhedral Graphic Statics (PGS). The process demonstrated the potential of graphical form-finding methods, but also highlighted the materiality gap, as the method does not directly determine material selection or member thickness, requiring additional analysis to translate forms into materially resolved structures.

These findings inform the next phase of the research, which investigates a computational framework that extends PGS from geometric equilibrium toward adaptive structural materialisation. It integrates finite element analysis, volumetric modelling, Signed Distance Functions (SDF), and physics-informed ML to relate geometry, equilibrium, and structural response to spatially differentiated thickness adaptation. Rather than seeking a universally optimal material distribution, the framework is conceived as a decision-support system that generates condition-dependent material responses while preserving opportunities for designer judgement and reinterpretation.

Designing an LLM-Supported Iterative Building Material Selection Framework with Knowledge Taxonomy and Decision Memory

PhD candidate

Kaiyu Zhou, Analytics Lab
UNSW School of Built Environment

Supervisors

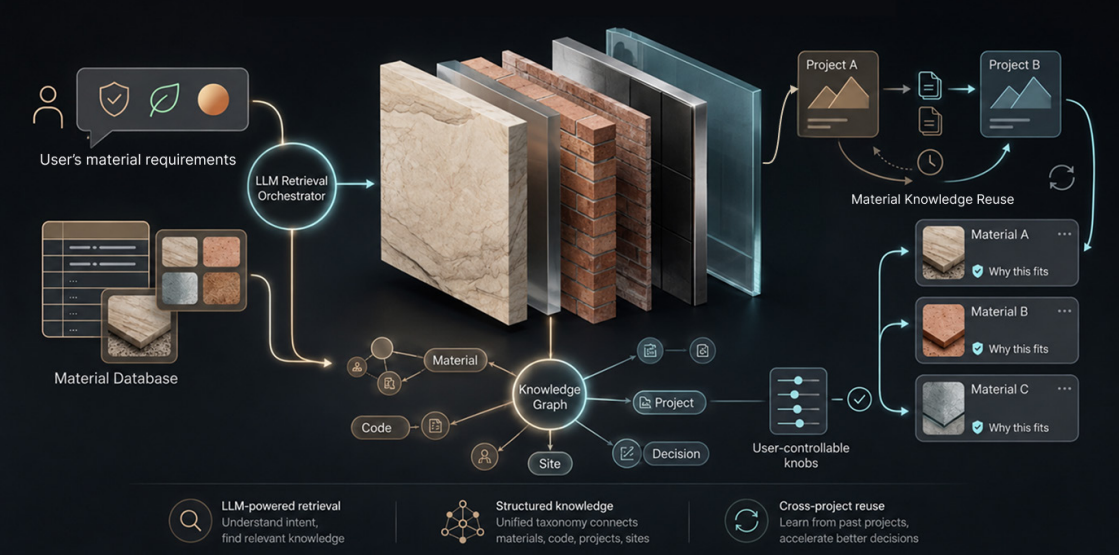
Prof M. Hank Haeusler
Dr Geoff Kimm
A/Prof Oliver Bown

Project summary

This study addresses the difficulty architects face when selecting building materials under multiple criteria across iterative design stages, in a context where material data is fragmented, and searched mainly by keywords. Existing multi criteria decision making frameworks and online material libraries formalise factors such as performance, cost, and sustainability, yet they rarely capture how designers actually interpret ambiguous scenario, balance trade-offs over time, or reuse prior decisions, because they overlook the implicit and tacit knowledge in material selection. Current LLM based BIM model query prototypes remain tightly coupled within prompt engineering to translate user's natural language query into SQL for material databases, with little integration of external knowledge or transparent memory mechanisms. Which raised two questions for this study:

- What knowledge taxonomy best characterises knowledge of architects used in building material selection across design stages?
- How can a knowledge-organisation and retrieval framework be designed to support iterative building material selection and cross-project knowledge reuse?

In response, the research will develop an LLM powered material selection system based on the integration of relational material database and unstructured material design code documents, combines a modular retrieval and



query translation layer that maps multi criteria natural language requirements. Building on an empirically grounded knowledge taxonomy, the system separates explicit material facts, graph based contextual relations, and human tacit intuition, the first two are formalised while designers retain control over final decisions.

The overall aim is to support multi criteria, iterative and transparent material selection in early design, enabling non-technical designers to search, compare and justify suitable materials more efficiently across projects, while improving the reuse of past project experience and contributing to more digitally integrated practice in the AEC sector.

Knowledge Taxonomy for Iterative Building Material Selection

Redefining Architectural Design Process through Human Experience Data in Micro-Living Spaces

PhD candidate

Shiva Ghaznavi, Analytics Lab
Swinburne University of Technology
School of Design and Architecture

Supervisors

Prof Marcus White
Prof Blair Kuys
Dr Pantea Alambeigi

Project summary

The global housing shortage, rapid urbanisation, and increasing student mobility have accelerated the growth of high-density residential developments such as purpose-built student accommodations. While these developments address pressing housing demands, they are often shaped by economic and regulatory pressures that prioritise efficiency over occupants' lived experiences.

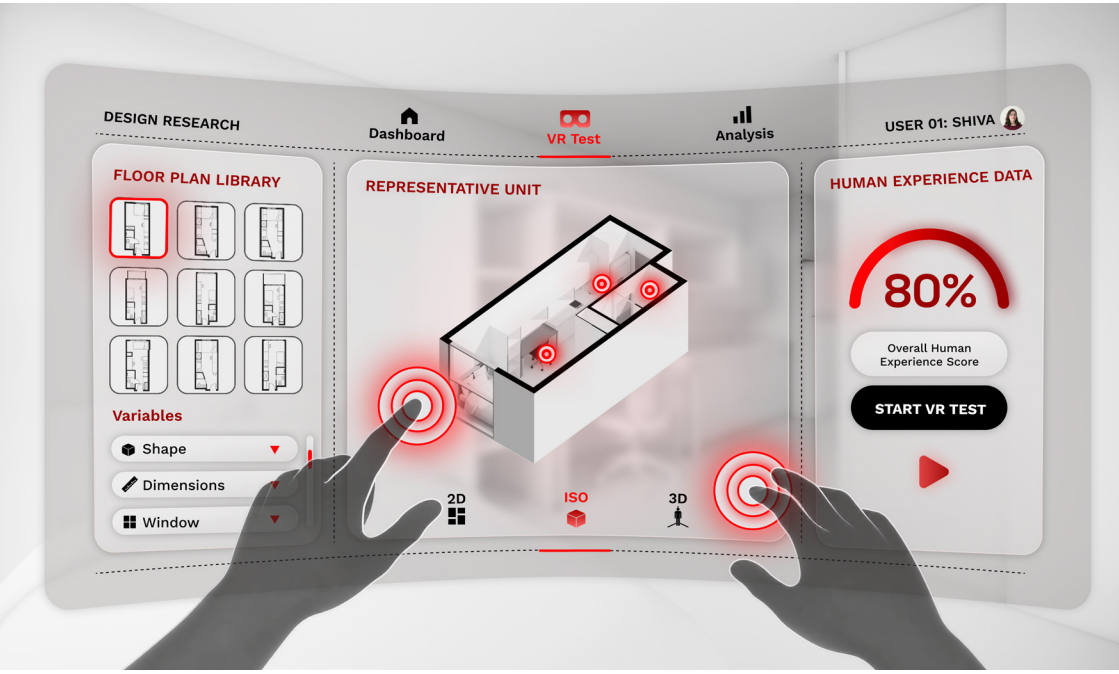
Consequently, many architectural design decisions continue to rely on precedent and intuition rather than experimental evidence of how spatial characteristics influence human experience, wellbeing, and everyday living.

Although user-centred design and evidence-based design aim to place people at the center of the design process, both have limitations in practice. User-centred design depends on meaningful stakeholder engagement, which is often difficult to achieve during the early design stages of large-scale housing projects. Evidence-based design largely relies on post-occupancy evaluations, producing valuable insights only after construction, when opportunities for design improvement are limited. As a result, architects have few reliable methods for predicting occupants' experiences before construction while supporting design decisions with measurable evidence.

VR addresses this gap by enabling users to experience and evaluate architectural spaces before they are built. However, current VR applications often rely on hypothetical environments, investigate isolated design variables, or lack validation against existing buildings. This limits their ability to generate reliable evidence for architectural decision-making.

This research develops a human-centred, evidence-based framework that integrates analysis of existing purpose-built student accommodations with immersive VR experimentation. Representative spatial typologies are identified from existing accommodation, refined through stakeholder engagement, and recreated in VR to investigate how measurable spatial characteristics influence occupants' subjective experiences. By linking these spatial attributes with human responses, the framework generates evidence to inform architectural decision making during the early design stages. The resulting methodology enables architects to evaluate, refine, and optimise design alternatives before construction, while informing evidence-based architectural design guidelines for future purpose-built student accommodations and other high-density residential developments.

Image by Shiva Ghaznavi



AI-Powered Solutions for Decarbonising AEC, with Focus on Façade Systems

PhD candidate

Shahdad S. Fard, Affiliated PhD
UNSW School of Built Environment

Supervisors

Prof Hank Haeusler
Prof Sisi Zlatanova

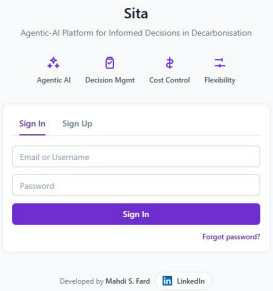
Project summary

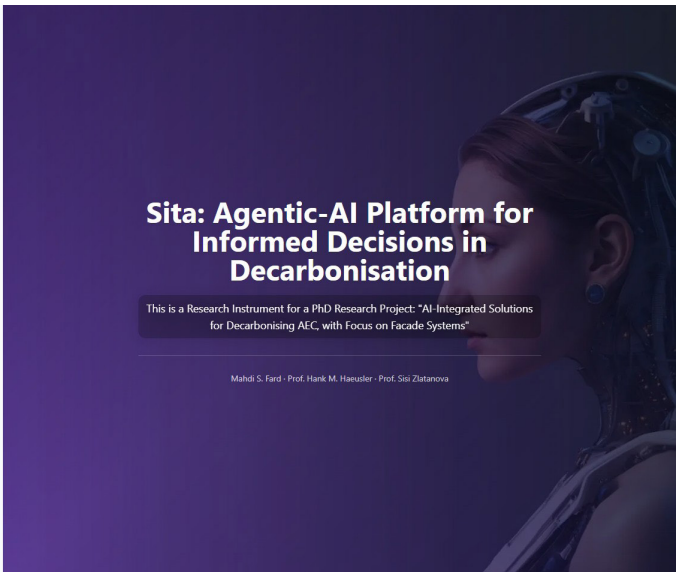
This research develops an AI-driven framework for decarbonising building façade systems by transforming BIM models into AI-readable graph data models. Rather than treating façade components as isolated objects, the framework represents the façade as a system of systems that preserves element identity, hierarchy, geometry, spatial topology, assembly dependencies, material attributes, and model versions. A specialised façade ontology gives these connections explicit machine-readable meaning.

The framework is organised through three interconnected memory layers. Structural Memory contains the graph representation of the façade model and its geometric and functional relationships in each project. Reference Memory connects this graph to external knowledge, including material and carbon datasets, cost records, lifecycle and time of component replacement, specifications, and building regulations. Decision Memory records the alternatives considered, supporting evidence, agent reasoning, human feedback and final decisions. It creates a traceable history that can be reused across later design iterations and projects.

A planner agent coordinates four specialised domains: Material and Carbon, Cost, Lifecycle and Replacement, and Regulation. These agents combine deterministic calculations, rule checking and quantity extraction with reasoning managed through GraphRAG. The planner decomposes each task, requests relevant evidence, compares outputs, manages conflicts and presents coordinated decarbonisation alternatives. Consequential changes remain subject to human review, with accept, reject and revise actions linked back to the affected model elements and evidence sources.

Graph Neural Networks (GNNs) operate as a supplementary, offline or semi-offline learning

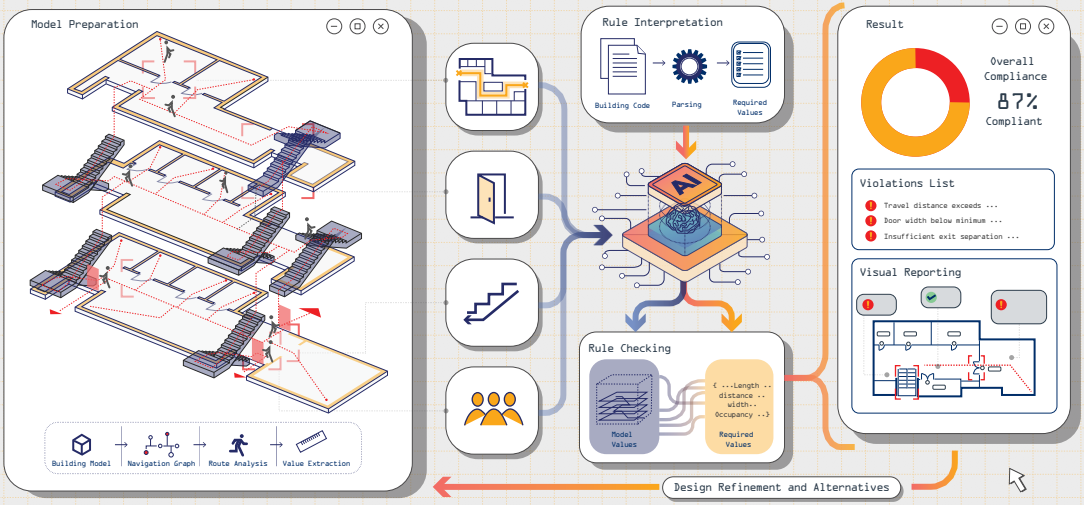




Standards-Based Building Assessment

layer, identifying recurring patterns and prioritising high-impact components across project datasets. Through lightweight graph data models, standardised data structures and APIs, the framework supports relational interoperability between BIM, analytical tools and industry data. Its contribution is an integrated environment for geometry-aware, evidence-grounded and traceable human–AI decision-making across façade design, while establishing a scalable foundation for organisational learning and wider decarbonisation applications across the AEC sector.

Sita: Agentic-AI Platform for Informed Decisions in Decarbonisation



Space Automation Using Generative AI for Enhancing Circulation in Public Buildings

PhD candidate

Nihal Morsi, Synthesis Lab
UNSW School of Built Environment

Supervisors

Prof Sisi Zlatanova
Dr Michael Bain

Project summary

Indoor building circulation controls the pattern of people's movement, their sequence of accessing spaces and in emergency situations their evacuation (Ching, 2007). To ensure user safety, authorities establish requirements for means of egress through building codes. These requirements consider building function, occupant load, and users' physical abilities, making them complex to apply and check. Compliance is predominantly assessed manually by architects, making the process time-consuming and error prone (Fischer et al., 2023). Several approaches have been proposed to automate compliance checking process.

This research investigates a hybrid approach to automated egress compliance checking based on Eastman's four-step framework of rule interpretation, model preparation, rule checking, and result reporting (Eastman et al., 2009). For rule interpretation, the use of LLMs to parse building-code provisions and identify compliance requirements is investigated. For model preparation, building and circulation information are extracted from building models and floor plans, then navigation graphs are generated to represent routes and destination points. The resulting graph can provide a structured representation of both semantic and geometric circulation information, including travel distances, corridor widths, and room access information required for egress assessment. LLMs are then used to compare building-code text and navigation-graph data to check compliance and generate violation reports. Generative AI models are also investigated to suggest design solutions.

A review of computational methods for circulation evaluation is conducted, considering geometric and user information and mapping the data and measures supported by each method. The Building Code of Australia (NCC -Volume One: Building Code of Australia (BCA), 2025) is analysed to identify information required for egress compliance assessment. Experiments are currently underway to automate the extraction of circulation information and the generation of navigation graphs from Revit models. Future work will

investigate LLM-based rule checking and generative AI to check compliance and suggest design solutions. The approach will be evaluated in terms of accuracy in detecting errors, effectiveness in identifying solutions, and the overall efficiency of the checking process.

References

Ching, F. D. K. (2007). Architecture: Form, space, & order (3. ed). Wiley.

Eastman, C., Lee, J., Jeong, Y., & Lee, J. (2009). Automatic rule-based checking of building designs. Automation in Construction, 18(8), 1011–1033. https://doi.org/10.1016/j.autcon.2009.07.002

Fischer, S., Schranz, C., Urban, H., & Pfeiffer, D. (2023). Automation of escape route analysis for BIM-based building code checking. Automation in Construction, 156, 105092. https://doi.org/10.1016/j.autcon.2023.105092

National Construction Code -Volume One: Building Code of Australia (BCA) (2025). https://ncc.abcb.gov.au

Developing an Automated Code Compliance Tool for Modular Construction Projects in Australia

PhD candidate

Hirusheekesan Selvanesan, Synthesis Lab
Adelaide University School of Civil Engineering and Construction Management

Supervisors

Prof Jane Burry
Dr Daniel Oteng

Project summary

Modern Methods of Construction (MMCs) are reshaping the way buildings are designed and delivered, making construction faster, smarter, and more sustainable. As Australia strives to deliver more housing and infrastructure with greater efficiency, MMCs have become increasingly important, prompting significant investment and support from federal and state governments, as well as industry bodies, to accelerate their adoption. However, despite this growing momentum, much of the discussion surrounding MMCs in Australia continues to rely on the frameworks developed in the United Kingdom, which do not fully reflect the unique landscape, industry characteristics, priorities, and challenges of the Australian construction industry. Hence, there is value in researching a guideline framework for MMCs in the Australian context, based on holistic inputs from the multiple stakeholders involved in the Construction Industry.

Modular construction represents the highest level of industrialisation within the MMC spectrum, most frequently engaging overseas working design and manufacturing. As prefabricated modules gain momentum in Australian construction, Architects face the dual challenges of 1) non-conformity of manufacturers' modular design to Australian NCC Standards, and 2) ensuring the shop drawings provided by the manufacturers adhere to both the NCC standards and the initial design drawings. These challenges lead to significant re-work and elevated professional time, circular communication, and cost. NCC requirements are primarily conceived for traditional buildings, and through poor communication, offshore manufacturers often misinterpret the Australian standards. This warrants digital intervention to automate code compliance checks and shop drawing reviews, flag errors, and suggest alternative design alternatives.

Accordingly, this study aims to develop a guideline framework for MMCs in the Australian



Guideline Framework for MMC in Australia (Conceptual illustration created by author using generative AI and refined)

context, and a digital tool that could be used to automate the code compliance and shop drawing review of modular construction projects, for architects in Australia, underpinned by design science research and stakeholder feedback.

Simplifying Envelope Retrofit for Australian Detached Dwellings: a Decision Support System for Deciding with Uncertainty

PhD candidate

Sasanka Gallage, Analytics Lab
Adelaide University School of Architecture and Built Environment

Supervisors

A/Prof Scott Hawken
A/Prof Ruidong Chang

Project summary

Australian detached dwellings form a major share of the national housing stock, yet many perform poorly under increasing climate extremes, contributing to high heating and cooling loads. Envelope retrofits can substantially improve thermal performance, but retrofit decision-making remains complex, expert-dependent and difficult for everyday



homeowners. This research aims to develop an envelope-retrofit decision-support system for detached dwellings within their site contexts.

The research first characterises the retrofit decision context by reviewing relevant Australian standards, guidelines and benchmarks, and interviewing homeowners and practitioners to identify key decision criteria, particularly cost. It then develops an accessible data-collection and fusion process combining archival records, plans, remote-sensed imagery and handheld mobile-device scans, with each attribute tagged for provenance and confidence. Established segmentation methods are used to classify envelope elements, openings, materials and performance characteristics while retaining confidence information. These data, together with standards, uncertainties and retrofit options, are represented in a knowledge graph to support uncertainty-aware reasoning and rank retrofit strategies against the identified decision criteria. A large language model, constrained to explain the reasoning trace, translates ranked recommendations into plain language.

The system is validated through two independent evaluation strands using a purposive stratified sample of detached dwellings across three South Australian climate zones and four construction periods: pre-2003, 2003–2009, 2010–2024 and post-2024. Practitioners assess technical validity, while homeowners evaluate usability.

The expected contribution is a connected decision-support workflow integrating digital capture, data fusion, segmentation, uncertainty-aware reasoning, knowledge graphs and constrained language-model explanations. The system is expected to simplify retrofit decisions for homeowners, provide actionable and transparent guidance, and support improvements in thermal performance, household energy costs and compliance with current standards, while enabling more consistent, evidence-based retrofit choices that account for dwelling condition, uncertainty, homeowner priorities and differences in climatic and construction contexts over time.

Learning and Knowledge in Architectural Practice →

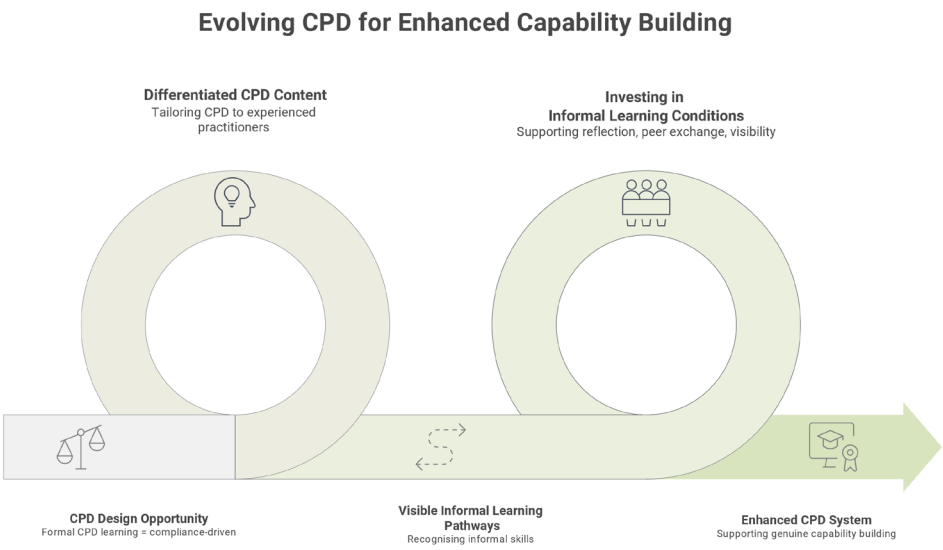


Image by author

Reimagining Professional Development in a Digital Age: Integrating Human and Technical Learning Capabilities

PhD candidate

Sandra Meng, Management Lab
UNSW School of Management and Governance

Supervisors

A/Prof Catherine Collins
A/Prof Nicole Gardner

Project summary

Across regulated professions, Continuing Professional Development (CPD) provides the formal backbone for maintaining and demonstrating professional competence. This research project asks what else drives capability in fast-paced, project-based work environments, and how CPD systems might evolve to capture more of it.

The first project explored how registered architects in Australia navigate mandatory CPD learning alongside the informal learning they rely on daily. Drawing on 19 interviews across organisational sizes, career stages and registration status, the findings are clear: informal, self-directed learning (such as peer exchange, on-the-job problem-solving, reflective practice) is what professionals consistently describe as most valuable and most likely to translate into better work. Formal CPD anchors a necessary baseline of structured, accredited learning across a profession's full scope of practice, though professionals often experience it primarily as a compliance requirement. One senior architect estimated the associated unbillable cost at around $7,000 annually. Much valuable informal learning activity currently sits outside formal frameworks. This points to a clear opportunity: CPD design that recognises informal, practice-embedded learning such as through differentiated content for experienced practitioners; and clearer pathways for informal skills to count toward professional recognition.

For organisations, this means investing in the informal conditions that support the learning link between compliance and genuine capability development (e.g., time for reflection, mentoring, and visibility for skills outside formal frameworks). The second project extends

this through a large-scale survey of project professionals across architecture, engineering and technology, testing whether they cluster into distinct combinations of social learning (through people) and technical learning (through digital tools and systems).

Together, these studies build an evidence base for redesigning professional development around how people learn in a digital age.

Educating Future Architects: Investigating Cultures of Collaboration in Architectural Design Studios

PhD candidate

Annette Joseph, Affiliated PhD
Adelaide University School of Architecture and Built Environment

Supervisors

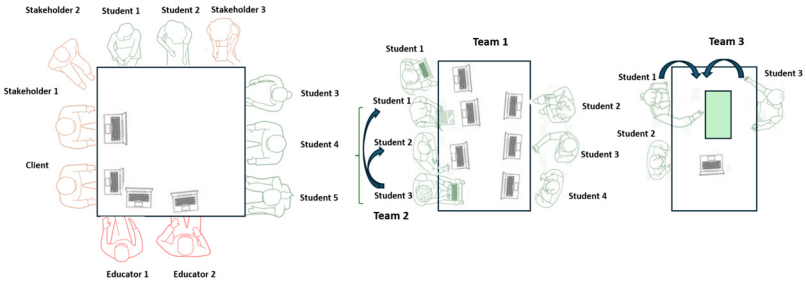
A/Prof David Kroll,
Dr Amit Srivastava,
Dr Ehan Sharifi and
Dr Aparna Datey

Project summary

Today's built environment is increasingly shaped by interdisciplinary teams, working alongside digital tools and AI. As the architectural profession evolves, collaboration plays a crucial role, shifting the dominant image of the architect from a solo creative practitioner to being more sociable and collaborative. However, architectural education, still influenced by the Beaux-Arts apprenticeship studio model, continues to train students with an emphasis on individual authorship. Given that the culture of design studios is shaped through a simulation of what happens in practice, studio practices need to adapt to reflect these changing professional practices. Therefore, this thesis addresses the question, "What does collaboration look like within architectural design studios?"

This study aims to examine existing cultures of collaboration within architectural design studios as a basis to inform future studio teaching practices. By employing a qualitative research design, this study utilised a multi-method approach drawing on documentary analysis, surveys, semi-structured interviews, and direct studio observations, using the Theory of Practice Architectures (TPA) to analyse the data. Through this multi-method approach, the study investigates how collaboration is conceptualised, perceived, and practised in selected design studios across two universities in a single geographical region of Australia.

This study aims to offer four distinct contributions. Empirically, it indicates how digital collaboration tends to be inadequately supported in architectural design studios, and how professional collaborative mandates are often less emphasised in studio teaching. Methodologically, it applies the TPA to help understand the human, behavioural, and socio-material processes underpinning architectural



Left image: Studio discussion, Annette's fieldwork, Design Studio 1 at University 1, Aug 2024

Right image: Design charrettes, Annette's fieldwork, Design Studio 2 at University 1, Sep 2024

studio collaboration, generating a transferable framework that can be applied to other studio-based disciplines, including design, engineering, and the performing arts. Theoretically, it proposes reframing collaboration from a singular, continuous activity to a multi-layered, give-and-take process of professional socialisation. Finally, as a contribution to practice, the study suggests an actionable roadmap to help better support collaborative work at four levels of the educational system, namely educators, institutions, curricula and the profession.

Investigating Reverse Mentoring to Support Digital Transformation in the Australian Architecture Profession

MPhil candidate

Michael Lewarne, Management Lab
UNSW School of Built Environment

Supervisors

A/Prof Nicole Gardner
A/Prof Catherine Collins

Project summary

The architecture, engineering and construction (AEC) sector is historically slow to adopt digital technologies, the sector hindered by its project-based workflow, risk aversion and culture of conservatism. Whilst there is developing research into digital transformation in AEC, it has not predominantly focused on the human and behavioural dimensions of this change. Whilst approaches to delivering behavioural change, like mentoring with its top-down knowledge flow, have acted to reinforce existing hierarchies, mindsets and power dynamics. Bringing into question mentoring's suitability in navigating technological change.

With an inverted relationship, reverse mentoring (RM) offers an alternative to traditional mentoring. In RM digitally literate team members (mentors) share their digital skills and knowledge with senior decision makers and leaders (mentees), who in turn share tacit, professional, and organisational knowledge. Research shows RM's many benefits, including developing leadership, innovative behaviour,



Image by Andrea Piacquadio edited by author

https://www.pexels.com/photo/cheerful-colleagues-working-on-project-together-in-office-3860841/

and closing knowledge gaps. It is a low friction solution for a profession that is time and resource poor, offering a methodology for developing senior leaders' digital literacy, whilst building junior team members' agency, visibility and professional knowledge.

This research undertakes a mixed-methods quasi-experiment to assess how a RM intervention changes mentee and mentor behaviour. Participants are paired in suitable dyads, undertake a 90 minute RM workshop, and work together on a digital innovation project as a framework for their RM relationship. Data is collected through one pre-test and two post-test surveys, measuring constructs such as psychological safety, knowledge sharing, affective trust and innovative thinking.

It is anticipated this research will show empirical evidence of reverse mentoring's facility to deliver behavioural change supporting knowledge sharing and digital innovation and extend organisational behaviour theory into the architecture context. In practical terms, it is expected it offers architecture practices a socially driven low-friction strategy supporting digital capability and preparedness for technological change.

Project Knowledge Capture for Architectural Design: Towards Organisational Insights and Learning

PhD candidate

Houssame Eddine Hsain, Analytics Lab
UNSW School of Built Environment

Supervisors

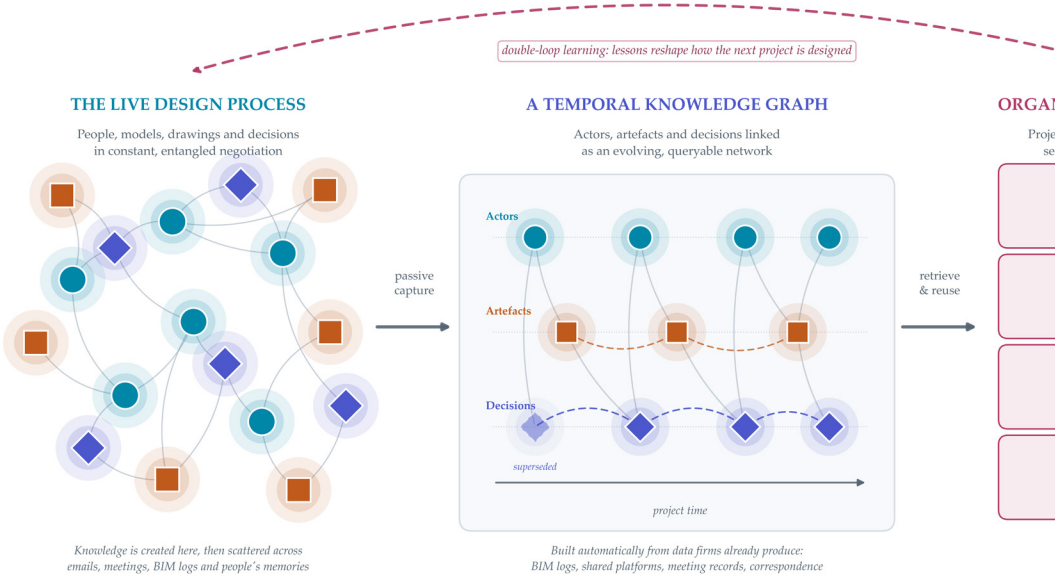
Scientia Prof Michael J. Ostwald
A/Prof Ju Hyun Lee

Project summary

Architectural design generates enormous amounts of valuable knowledge, yet most of it is ephemeral. It lives in team members' memories, in meeting conversations, and invisibly inside complex digital models, and is lost when teams disband. The result is systemic knowledge loss across the Architecture, Engineering and Construction (AEC) sector: firms repeatedly reinvent the wheel, efficiency suffers, and innovation opportunities are missed. The problem is urgent, much of Australia's construction workforce is approaching retirement, while few organisations capture what departing staff know.

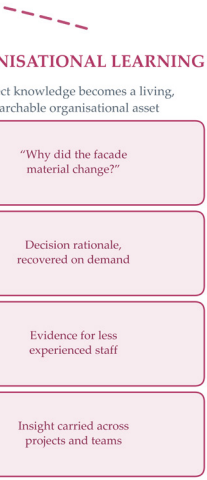
This research asks how architectural organisations can learn systematically from their own project data. A systematic review of 31 peer-reviewed studies (2000-2025), currently under peer review at the ASCE Journal of Architectural Engineering, identified two gaps. Knowledge is dynamic but capture methods are static; design decisions are proposed, debated, revised and superseded over months, yet no reviewed method tracks this evolution. Data and project process remain disconnected, technologies such as Building Information Modelling (BIM) record what was designed, but not how or why.

The project develops a computational knowledge capture framework that models design as an evolving sociotechnical network. Design knowledge already exists in the digital traces firms routinely produce, i.e. model histories, shared-platform activity, meeting records and correspondence, but is unstructured and unretrievable. The framework passively structures these traces into a temporal knowledge graph in which people, artefacts and decisions coexist as interconnected nodes, every relationship carrying time, so that superseded and revisited decisions are preserved rather than overwritten.



Advances in AI-based extraction and graph retrieval allow the graph to be queried in natural language.

The work is empirical, combining Australian case studies from Cox Architecture and Architectus, a global practitioner survey and expert evaluation, with privacy and data sovereignty safeguards. The aim is to turn project archives from unsearchable storage into a living organisational asset that supports double-loop learning; not merely correcting errors but improving the standards guiding future projects and practice.



Conceptual overview of the proposed framework. Knowledge generated in the live design process (left) is passively captured from the digital traces firms already produce, then structured into a temporal knowledge graph in which actors, artefacts and decisions are linked over project time (centre), so that the reasoning behind past decisions can be retrieved and reused to support organisational learning (right)

More Projects →

Designing Circular, Site-Specific Façade Systems using Computational Workflows and Additive Manufacturing with Recycled Polymers

PhD candidate

Charlotte Firth, Affiliated PhD
UNSW School of Built Environment

Supervisors

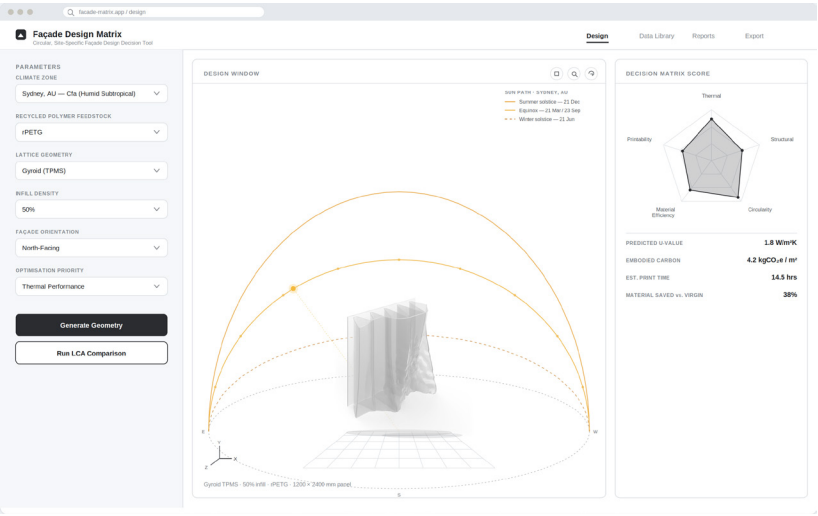
Scientia Prof Michael J. Ostwald
Prof M. Hank Haeusler

Project summary

The construction industry faces an urgent need to reduce material waste, embodied carbon, and reliance on carbon-intensive façade systems. This PhD research investigates whether recycled polymers, when combined with computational design workflows and additive manufacturing, can produce site-specific façade panels with improved environmental and thermal performance. Addressing this challenge, the research develops an integrated computational design workflow and decision-making matrix that synthesises climate data, material behaviour, and fabrication constraints to generate façade geometries tailored to local environmental conditions. Using a structured Design of Experiments (DoE) approach, this research measures the mechanical and thermal performance of recycled polymers suitable for large-format extrusion, providing the empirical foundation for design optimisation.

Building on this data, the research explores how variable-density lattice geometries can balance structural integrity, passive thermal regulation, and material efficiency within a mono-material façade system. Prototypes are fabricated using large-scale 3D printing and evaluated through mechanical testing, thermal analysis, and comparative Life Cycle Assessment (LCA).

The results demonstrate that geometry-driven performance optimisation and circular material strategies can significantly reduce environmental burdens while enabling novel façade typologies tailored to climate and manufacture. Ultimately, this research contributes new knowledge on recycled-polymer behaviour, lattice-based façade optimisation, and computational decision-making frameworks for sustainable design, offering a replicable model for next-generation façade systems.



Mock-up image of the design-decision matrix, drawing on material datasets, climate data and printing behaviour

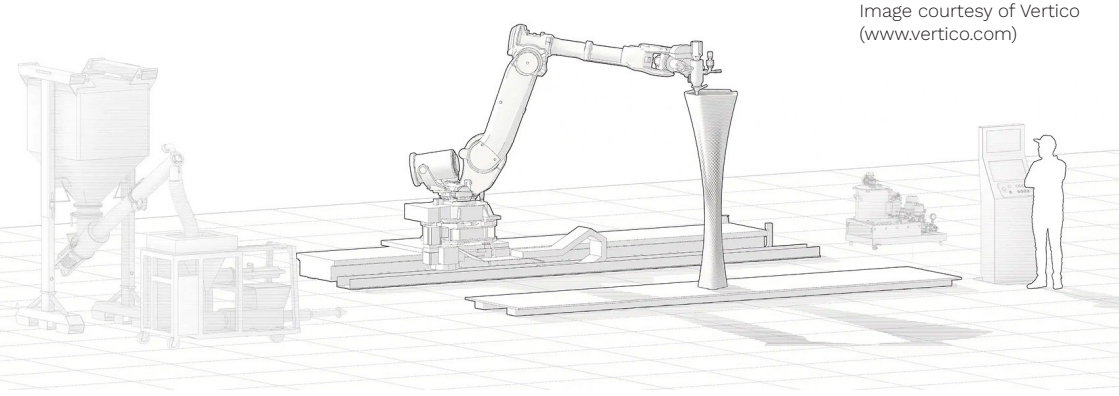


Image courtesy of Vertico (www.vertico.com)

Will it Print? Designing a Digital Twin System for Large-Format Additive Manufacturing

MPhil candidate

Louis Lamont, Analytics Lab
UNSW School of Built Environment

Supervisors

A/Prof Nicole Gardner
Dr Christopher Bamborough

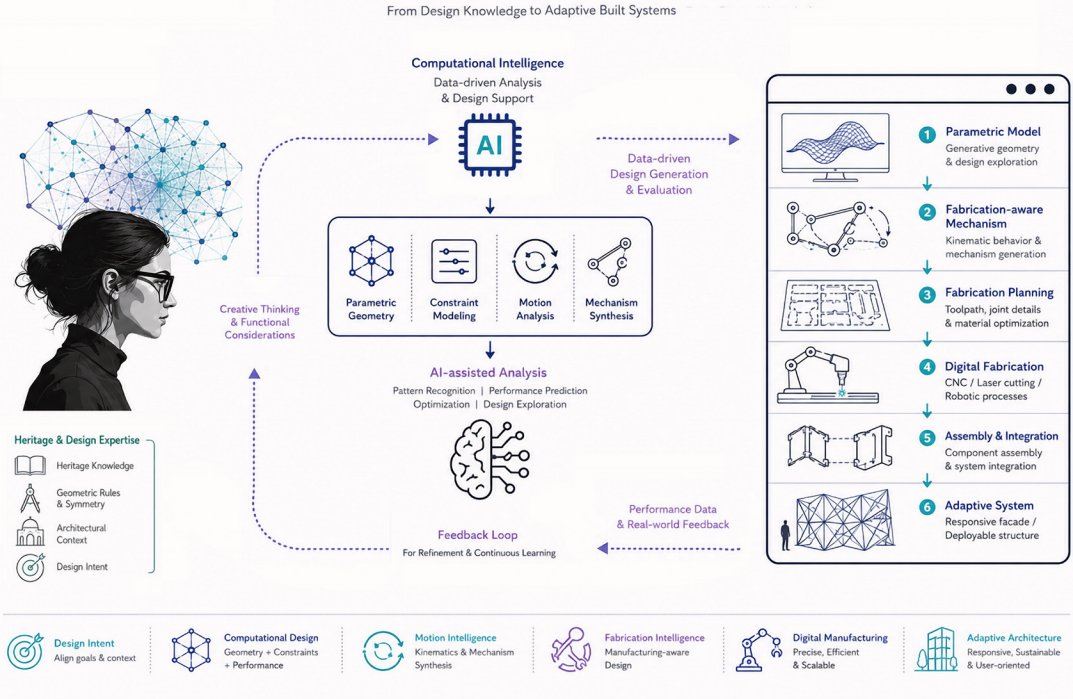
Project summary

The architecture, engineering and construction (AEC) sector remains a leading contributor to global emissions, resource extraction and landfill, whilst consistently struggling to meet its own budget and timeline forecasts on large projects. These outcomes are influenced by the sector's limited adoption of circular material strategies and advanced digital technologies which offer means to improve these shortfalls. Large-format additive manufacturing (LFAM), specifically pellet-based techniques, has emerged as a promising method for producing highly custom façade elements, formwork, moulds and furniture-scale components from recycled and bio-based thermoplastics. However, the transition from desktop 3D printing to large-format production introduces thermal, material and process behaviours that are difficult to anticipate at the design stage. LFAM workflows remain heavily dependent on iterative trial-and-error and print failures at architectural scale represent significant material and time cost.

In adjacent additive manufacturing fields, Digital Twin (DT) approaches have begun to address comparable challenges by coordinating simulation, monitoring and validation across the design–fabrication interface. Their translation into polymer-based LFAM, however, remains largely unexamined.

This research investigates how DT principles and technologies can be integrated into pellet-based LFAM workflows to improve printability prediction and reduce process deviation during fabrication. The work is pursued through a design research approach, delivered across three coordinated stages: pre-print simulation, live-print monitoring and post-print evaluation. A small-scale architectural fabrication case study, conducted at Composite Sydney, will iteratively refine the platform against measurable print outcomes.

The anticipated contribution is a DT-integrated LFAM workflow and generalisable process framework, extensible to other LFAM platforms to support more predictable, material-efficient production of polymer components in the built environment.



A Computational Approach to the Kinetic Transformation of Geometric Patterns based on Islamic Architectural Heritage

PhD candidate

Farnaz Nazarzadeh Ansaroudi, Affiliated PhD
Adelaide University School of Civil Engineering and Construction Management

Supervisors

Prof Jane Burry
A/Prof David Kroll
Dr Peter Charles

Project summary

This research investigates the transformation of Islamic geometric patterns, derived from Islamic architectural heritage, into kinetic architectural systems through computational design, geometric analysis, digital fabrication, and physical prototyping. These patterns are characterised by precise geometric rules, symmetry, modularity, and topological relationships that provide a strong foundation for developing adaptive, transformable architectural systems. The research explores how these inherent geometric properties can be translated into controlled physical transformations while preserving the identity, continuity, and topological structure of the original patterns. The project develops a computational design framework that systematically analyses, generates, and evaluates transformable Islamic geometric patterns. Parametric modelling and physical prototyping are combined to investigate geometric configurations, kinematic constraints, fabrication strategies, and assembly behaviour. Physical models are used to validate the feasibility of transformation mechanisms and examine how geometric relationships can be maintained throughout movement. A key contribution of the research is the development

Proposed computational design-to-fabrication with fabrication-aware physical realisation for transforming Islamic geometric patterns into kinetic architectural systems

of a topology-conserving computational framework that supports the identification, analysis, transformation, fabrication, and evaluation of kinetic Islamic geometric patterns. By bridging computational design and digital fabrication, the framework establishes a systematic workflow for translating historical geometric knowledge into contemporary kinetic architectural applications.

The framework will be further extended through artificial intelligence and computer vision techniques to automate pattern identification, support geometric analysis, and assist in generating and evaluating transformable pattern configurations. Rather than replacing the underlying geometric principles, these techniques will enhance the efficiency, scalability, and analytical capability of the proposed computational workflow. The research contributes to the fields of Islamic architectural heritage, computational design, kinetic architecture, and digital fabrication by providing new methodologies for interpreting, analysing, and transforming traditional geometric systems into adaptive architectural applications.

Forest Structures: Negotiating Human and Ecological Agency Through Light Architecture

PhD candidate

Marziah Zad, Affiliated PhD
Swinburne University of Technology
School of Design and Architecture

Supervisors

Prof Jane Burry
A/Prof Mehrnoush Latifi Khorasgani
Dr Chiara Farinea
Dr Sascha Bohnenberger-Fehr

Advisor

Dr Mathilde Marengo

Project summary This research explores designed urban forest ecologies as sites where architectural, human and ecological agencies can interact within a shared territory. It asks how light architectural interventions can establish conditions for ecological processes to participate in the production of spatial form, and how design can negotiate the distribution of control with ecological agency.

The human propensity to control nature through design spans built and natural urban environments. The lightest interventions for urban expansion still disrupt or destroy natural environments, and standard design practice controls and simplifies natural systems, curtailing self organization and adaptation (1). Urban forests meant to offset ecological loss often remain limited to monocultural, simplified solutions, instrumentalizing forest systems for human benefit rather than engaging them as partners in shaping urban territories (2).

Two shifts counter this tendency: ecological designers cultivating an approach to agency

premised on territorial outcomes driven by ecological processes (3)(4), and architectural designers who pursue a light, neutral and minimal architecture of intentionally indeterminate form that is defined relationally through ties to human spatial occupation and the natural environments (5)(6)(7). While sharing the principle of distributed agency, these two approaches do not yet offer an integrated operative method for how architectural and ecological authorship should negotiate shared territorial formation.

To achieve this aim, the research involves developing a computational strategy to model relationships between human, architectural and ecological agents, enabling territorial form to emerge through relational rules.

This research contributes to architectural approaches to ecological design by investigating how lightness can operate not only as a material or structural strategy, but as a means of distributing authorship, including: (i) developing an analytical framework for identifying design decisions, spatial strategies and negotiation mechanisms that facilitate ecological agency, (ii) identifying operative principles through which architectural design can engage with ecological processes and drivers, and (iii) developing a relational rules-based design methodology for shared human and ecological agency in emergent territories.

References

Hobbs, R. J., Higgs, E. S., & Hall, C. M. (Eds.). (2013). Novel Ecosystems: Intervening in the New Ecological World Order. Wiley-Blackwell.

de Meulder, B., & Shannon, K. (2024). Forest Urbanisms : New Non-Human and Human Ecologies for the 21st Century (1st ed.). Leuven University Press.

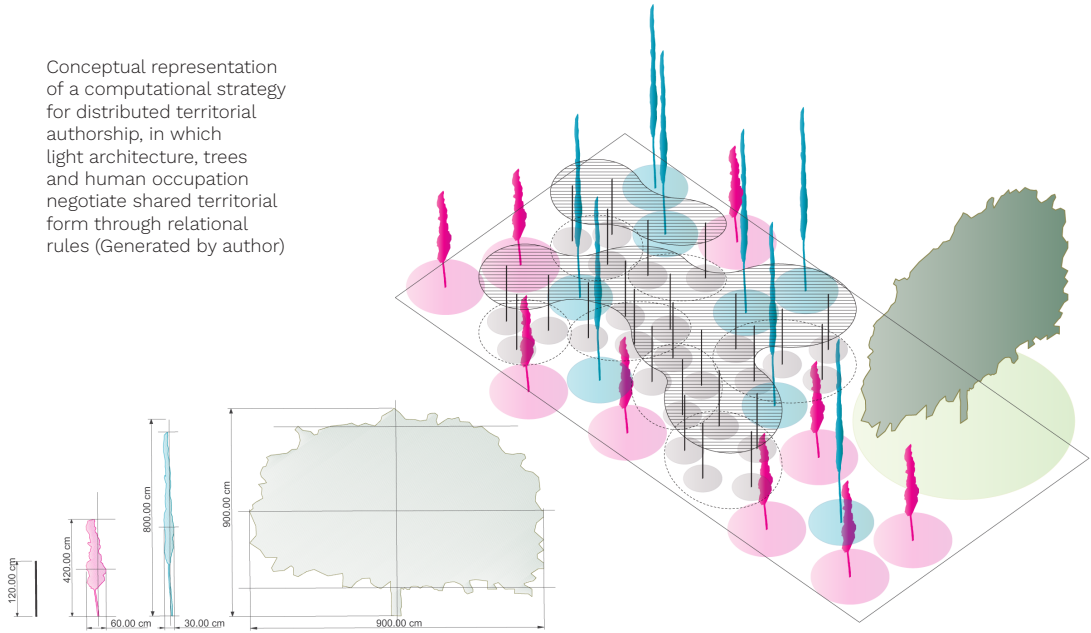
Clément, G., & Jones, L. (2006). Gilles Clément : une écologie humaniste. Aubanel.

Saunders, W. S., & Yu, K. (2012). Designed ecologies : the landscape architecture of Kongjian Yu (1st ed.). Birkhäuser.

Seraj, N., & Veillon, C. (Eds.). (2015). Yona Friedman: The dilution of architecture. Park Books.

Ishigami, J. (2019). Another scale of architecture. LIXIL Publishing

Modena, L. (2011). Italo Calvino's architecture of lightness: The utopian imagination in an age of urban crisis. Routledge



Conceptual representation of a computational strategy for distributed territorial authorship, in which light architecture, trees and human occupation negotiate shared territorial form through relational rules (Generated by author)

Streamlining Architect-to-client Interactions: The Toolkit

PhD candidate

Nadia Anam, Affiliated PhD
Swinburne University of Technology
School of Design and Architecture

Supervisors

A/Prof Charlie Ranscombe
Dr Linus Tan

Project summary

This research project explores the opportunities of using Text-to-image GenAI for supporting architects and engaging clients early in the architectural design process. This aim stems from the growing interests on the applications and implications of Text-to-image GenAI on creative design practices. Specifically, on how Text-to-image GenAI's ability to translate ordinary text into sophisticated visuals have permitted non-designers to engage in the process of visualisation in an unprecedented manner. However, due to the relative infancy of research on Text-to-image GenAI in design, support for non-design engagements in visualisation are limited. To understand the kinds of support needed to leverage a best practice use of Text-to-image GenAI among architects and non-designers, this specific study developed a toolkit of design interventions grounded on existing architect and non-design visualisation tendencies in idea evolution and exploration with Midjourney as observed from a previous study.

Three design intervention prototypes have been developed to date. These particular prototypes had focused on the adaptation of established creative writing and visualisation exercises implemented to evolve and explore ideas, such as Snowballing and Moodboarding. As such, this study demonstrates a preliminary exploration of support for divergent-convergent design idea evolution and exploration with Text-to-image GenAI among design and non-design individuals.



An Architectural Design Toolkit prototype for complementing visualisation of idea explorations and evolution with Text-to-image GenAI

Arch_Manu 2026 CPD Offering

Arch_Manu's Continuing Professional Development framework extends our research and training mission to the broader AEC sector. This year marked a shift from knowledge-based CPD towards practical, skills-based learning through the launch of our SkillsLAB series. This and the 2026 International Conference on Computational Design and Robotic Fabrication Masterclasses offered hands-on professional development focused on the capabilities needed for digital transformation in architecture, design and engineering. In 2026 to date, Arch_Manu has delivered 99 CPD activities through our CPD framework and industry collaborations, reaching more than 1,200 professionals and growing our mailing list to over 500 subscribers. We are building a growing community committed to sharing knowledge, developing practical skills and supporting meaningful change across the AEC sector. For more information and access to free on-demand CPD content, visit www.archmanu.com/cpd.

Total Formal CPD Events Delivered

99

Arch_Manu Talk Series

38

- **32** UNSW
- **05** SUT
- **01** UoA

Arch_Manu SkillsLAB + Workshops

5

- **5** UNSW

Arch_Manu Events

24

- **07** 2025 Research Symposium
- **05** AI x Architectural Education Panels
- **12** DigitalFutures CDRF2026

Collaborations

32

- **06** ACA
- **11** AIA
- **10** AMRN
- **02** RAA
- **01** Grimshaw
- **02** COX


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 39
The Craft of Engineering Collaboration: Working with design teams and fabricators to deliver architectural design concepts
CPD
Tom Donald
Director, Eckersley O'Callaghan (EOC) Sydney
05 February 2025
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 40
3D-Printed Architecture as a Digital Delivery System: From a Construction Technique to a Project Operating System
CPD
Wael Kikhia
Architect & Co-founder of ETI
12 February 2025
4:00-5:30PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 41
From Polymer to Earth: Designing with 3D-Printed Materials
CPD
Dr Sascha Bohnenberger-Fehr
Managing Director at Bollinger+Grohmann, Melbourne
& Lecturer in Architecture at Swinburne University
24 February 2025
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 42
Your Software Was Designed in the 1900s: Why We Must Evolve to BIM 2.0
CPD
Allister Lewis
Architect, Digital Transformation Advisor & CEO of
Automated Data Driven Design (ADDD)
28 February 2025
6:00-7:30PM AEST
Online
Register here
AutoCAD
Revit
Rhino
Sketchup
Vectorworks
1982
1997
1998
2000
2001
43
28
27
25
Years Old
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 43
Concrete 3D-Printing Technologies: comparison between 3d printing technologies based on real-time applications.
CPD
Hussam Salah
Operations Manager, Twinvinci
5 March 2026
4:00-5:30PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 44
THE NEW BAUHAUS?
- an approach
CPD
Professor Dr.-Ing Moritz Mungenast
(Lehrstuhl University, Munich)
11 March 2026
12:30-2:00PM AEST
Online + In-person
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 45
Towards Baroque Tendencies: digital fabrication approach to architectural design
CPD
Professor Paul Loh
Co-founder of LLDS, Professor of Architecture, & Head of
the Alsadian School of Architecture, Bond University
David Leggett
Co-founder & Practice Lead of LLDS
10 March 2026
1:00-2:30PM AEST
Online + In-person
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 46
Laminated Bamboo Architecture:
a Crop-based System for Australian Housing
CPD
Federico Riches
Bamboo Engineer Specialist, House of Bamboo &
Co-Founder OFFSITE STUDIO
07 May 2026
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 47
Reframing 3D Concrete Printing through a Sustainability Lens
CPD
Dr Katie Heywood
Post-doctoral Researcher in Architecture & Digital
Fabrication, QUT
13 May 2026
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 48
Shifting Scales: Contemporary Applications and Design Guidelines for Polymer-based Large-Format 3D Printing
CPD
Louis Lamont
Co-founder & Technical Lead, Composite Sydney
& UPHI candidate at Arch Manu, UNSW
19 May 2026
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 50
Designed for Disassembly –
Future Life Cycle of Facades
CPD
Janine Campbell
Architect & MSc in Facade Engineering
19 June 2026
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing
_Talk Series 49
Digital Tools, Analog Problems:
Improving Communication and Collaboration in AEC
CPD
Alexander Jung
Architect, Founder & Principal of Reinhardt_Jung
& PhD Candidate, Arch_Manu, UNSW
21 May 2026
12:30-2:00PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing_SkillsLAB Series 01
Human-Centric Assessment of High-Rise Building Performance in Fostering Wellbeing
CPD
Dr Juliana Croffi
Computational Designer & Researcher, Developer
of SpinpLace!
16 June 2026
10:30-2:30PM AEST
Online
Register here
arch_manu
UNSW


ARC Training Centre for Next-Gen Architectural Manufacturing_SkillsLAB Series 02
Slicing at Scale: An Introduction to Custom Toolpath Generation for Architectural Large-Format 3D Printing
CPD
Louis Lamont
Co-founder & Technical Lead, Composite Sydney
& UPHI candidate at Arch Manu, UNSW
23 June 2026
11:30-1:00PM AEST
Online
Register here
arch_manu
UNSW


Research talk - CPD:
Navigating the landscape of Early Design Supporting/Generative Design tools
Aims:
Presenters:
Time:
Learning outcomes:
GRIMSHAW
arch_manu


Research Talks
A Pathway Towards Adaptable Retrofits
National Webinar:
10 December 2025
12pm AEST
Jorge Luis Rivero Torres
Dr Jacqueline Baker
Learning Outcomes:
COX
arch_manu

Arch_Manu Academic Partners

Host university: UNSW

The UNSW School of Built Environment shapes future cities – cities that are resilient, sustainable, connected, healthy, smart, liveable and inclusive. We focus on the challenges of cities at every scale, from industrial designed products to the architectural design of buildings and landscapes, as well as urban and regional policy and planning. We interrogate global environmental challenges, such as urban heat and urban health, as well as socio-economic inequality. We create high-performing built environments that contribute to tackling the climate crisis, while our human-centred design ethos responds to the needs of the individual as well as society and our cultural landscape. Our education and research respond to the changing needs of the professions while also anticipating the future challenges society faces. We develop skilled and enquiring graduates, with a conscience, who can positively engage, adapt and shape our future cities for the benefit of all people, with the planet firmly in mind.

- Dr Philip Oldfield, Head of School

Node: Swinburne University of Technology

Swinburne's School of Design and Architecture leads the world in high-quality, industry-relevant, technology-led design education and research.

We pursue future production and interaction technologies, design for health and wellbeing and sustainable urban ecologies.

Our innovative courses are grounded in design history, theory, culture and diversity with our undergraduates, postgraduates and researchers embracing global challenges, spanning disciplines.

Our graduates are renowned internationally for their creative leadership.





Node: University of Adelaide

Adelaide University is a leading contemporary university of global standing. We are dedicated to ensuring the prosperity, wellbeing and cohesion of society by addressing educational inequality through our actions and through the success and impact of our students, staff and alumni.

The School of Architecture and Built Environment at Adelaide University integrates design-led thinking, studio practice, sustainability, and the highest levels of industry collaboration to create the places and spaces that shape our future. We are committed to community, society and the planet.

At Adelaide University's School of Civil Engineering and Construction Management, we drive innovation in digital engineering, modelling and automation while addressing evolving industry complexities.

Partner Organisation: IAAC

The Institute for Advanced Architecture of Catalonia (IAAC) is a centre for research, education, production and outreach, with the mission of envisioning the future habitat of our society and building it in the present.

IAAC follows the digital revolution at all scales (from bits to geography, from micro-controllers to cities, from materials to the territory) to expand the boundaries of architecture and design and meet the challenges faced by humanity. IAAC is an experimental and experiential centre where one learns by doing, through a test methodology that promotes real solutions. IAAC is an open, independent and radical non-profit foundation, with 20 years of activity; inspired by the values of Barcelona, the capital of architecture and design, where urbanism was invented and where a local high quality and innovation-oriented research is connected to an international network of excellence in technology, architecture and society fields.





Partner Organisation: CITA

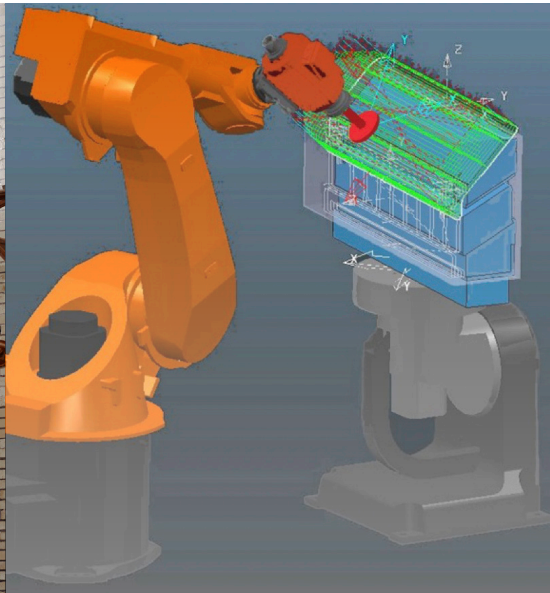
The Centre for Information Technology and Architecture (CITA) is an innovative research environment at the Royal Danish Academy exploring the intersections between architecture and digital technologies. CITA investigates how the current forming of a digital culture impacts on architectural thinking and practice.

CITA examines how architecture is influenced by new digital design and production tools as well as the digital practices that are informing our societies culturally, socially and technologically. Using design and practice based research methods, CITA works through the conceptualisation, design and realisation of working prototypes. CITA is highly collaborative with both industry and practice creating new collaborations with interdisciplinary partners from the fields of computer graphics, human computer interaction, robotics, artificial intelligence as well as the practice based fields of furniture design, fashion and textiles, industrial design, film, dance and interactive arts.

Partner Organisation: The Bartlett, UCL

The Bartlett is University College London's (UCL) Faculty of the Built Environment and is currently ranked by QS as No.1 in the world for Architecture and The Built Environment. With over 1000 research active staff including more than 300 Professors, it is home to the UK's largest and most diverse built environment research community, bringing together a multidisciplinary approach to tackle the world's most pressing challenges. Its 13 schools and institutes span a unique variety of disciplines including architecture, urban design, planning, construction, resources, policy and heritage, that include renowned specialist groupings such as the DPU, CASA and Space Syntax. The Bartlett's cross-disciplinary approach intertwines methodologies and expands architectural research to reach other fields in the arts and humanities, social and environmental sciences, and technology, in collaboration with partners from across UCL, practice and industry, and other UK institutions.





Arch_Manu Industry Partners

Partner Organisation: ADDD

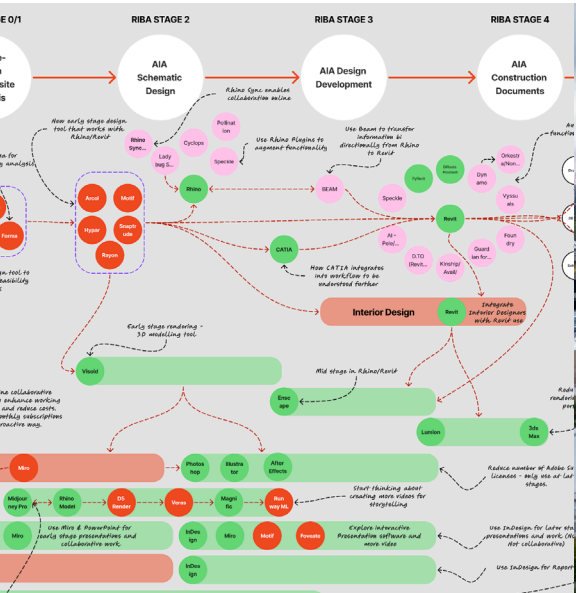
Automated Data Driven Design (ADDD) is an independent platform helping architecture practices make better technology decisions. ADDD was founded to address a growing reality in architecture: technology is no longer a support function, it shapes how practices operate, compete, and manage risk. ADDD reflects a simple belief: Architecture practices should not adopt technology reactively. They should adopt it deliberately, with clarity around workflows, data, governance, and long-term impact. The focus is not on software hype. It is on better decisions.

Through research, advisory, structured workshops, and the ADDDitive newsletter, ADDD helps practices move from tool experimentation to strategic direction.

ADDD is led by Allister Lewis - Architect, BIM Manager, and Digital Design Lead, he now acts as a technology translator for the AEC industry - bridging the gap between design, data, and strategic implementation.

Partner Organisation: Architectus

Architectus is one of Australasia's largest and most diverse design firms, with more than 730 talented designers and specialists working across nine Australian studios and three affiliated New Zealand studios. Together, Architectus design to make a positive and lasting impact on people, cities, and communities. The practice combines deep expertise in every sector with critical problem-solving skills and a commitment to exceptional design. Led by Principal Steve Fox, the Architectus Digital team integrates design technology into workflows to enhance design thinking, project delivery, and user experience. The strategy is centred on delivering projects efficiently, boosting staff's digital skills, and fostering innovation through systems development and research. The Architectus Digital team actively seeks out user-friendly digital tools that work seamlessly with existing systems. while prioritising data security and client confidentiality.





Partner Organisation: Bollinger+Grohmann

Bollinger+Grohmann are engineers driven by passion for high-quality architecture, sustainable solutions and technical innovation. This passion has motivated the firm's founders Klaus Bollinger and Manfred Grohmann, and their team, since the company's foundation in 1983. Over the years, Bollinger+Grohmann have had the opportunity to work on exceptional projects with inspiring collaborators whose ideas challenged the firm to continuously excel at their work in structural engineering, façade engineering, building physics and fire engineering. Today, Bollginer+Grohmann resides in 20 offices within ten countries across the world. Bollinger+Grohmann are passionate supporters of research and learning, with many of their team members teaching at respected institutions worldwide. The organisation regards individual development and research as an essential part of individual and collective growth; hence, supporting the spread of innovative ideas improves not only their workflow but also the workflows of the construction industry.

Partner Organisation: COX

Cox Architecture (COX) is a design-focused, award winning contemporary architectural practice with studios located in every major Australian city and now in Auckland. COX works with a collaborative framework allowing the best ideas to come to the fore – 'by the many for the many'. The practice is some 600 talented architects, urban planners, interior designers, graphic designers, researchers, computational designers and digital visualisation experts. The COX team brings the latest thinking and proven expertise in design and sustainability across many sectors – public & cultural, transport infrastructure, workplace & retail, sports & recreation, education, housing, and research & health. Key to the COX design ethos is enhancing the public life of our cities by ensuring every project makes a positive contribution to its public realm – that it gives more than it takes. COX has a highly skilled team of computational designers that are deployed on projects to provide both established and bespoke computational solutions.





GRIMSHAW

Partner Organisation: Grimshaw

Founded in 1980 in the UK, Grimshaw is a now global firm employing more than 550 staff and covering virtually all sectors. Grimshaw's dedication to high quality design is paramount, whether working on low budget structures or high large buildings with complex technical specifications. The practice believes in its responsibility for its work to contribute to worldwide environmental improvement and sustainability. The practice was amongst the first to become carbon neutral and presently is targeting regenerative designs for all its client's projects by 2030. Grimshaw are experienced collaborators, adept at organising multi-disciplinary teams and have a wide knowledge base of specialist functions that enables the challenging of ideas and preconceptions, creating a coherent, high-quality design that satisfies the parameters set by the client's vision. Grimshaw's thirst for research-based knowledge continues as an integral part of the Grimshaw studio across all project types and across the globe.

Tzannes

Partner Organisation: Tzannes

Tzannes is an Australian studio and a leader in the design of the built environment. Tzannes' work spans across architecture, urban design, interiors and product design. Driven by curiosity and passion for design excellence, Tzannes is recognised for their creative work that is evidence-based and Country-focused. Tzannes establishes long-lasting relationships with their clients and collaborators with whom they share a commitment to deliver sustainable and enduring design. Tzannes is committed to design excellence and a more sustainable built environment through the application of advanced science, technology and engineering. Tzannes is guided by the wisdom of Traditional Custodians and empowered by the ambitions of their clients. Tzannes values the trust they have earned as architects, placemakers and product designers, with designs that have been proven to appreciate in value over time in this fast-changing world.







Arch_Manu Professional Body Partners

Partner Organisation: AACA

The Australian Acreditation Council of Australia (AACA) is the national voice for architect registration boards around Australia. AACA owns the National Standard of Competency for Architects. The National Standard underpins all assessment processes including the accreditation of architecture programs leading to registration as an architect in Australia. Set up as a not-for-profit organisation, the AACA was established in the 1970s in response to the need for a nationally consistent approach to eligibility for registration and the recognition of overseas qualifications in architecture. The AACA is building its capacity as the key source of information about the architecture profession in Australia and how it compares with architectural education and regulation around the world.

Partner Organisation: ACA

The Association of Consulting Architects (ACA) leads the discussion on business matters in architecture in Australia. The association is a registered employer body under the Fair Work Commission, representing architectural employers. The ACA was founded in 1987 as the national peak body representing the interests of employers in industrial matters, including workplace conditions and Award negotiations. Since then, the ACA has evolved to address the “business of architecture” more broadly, with industrial relations remaining as a vital core of ACA activity alongside its responsibility to positively influence practice management in architecture. The ACA helps architectural firms navigate the changing world of practice by providing regular advice and information on business and employment matters, by promoting awareness of and discussion about business issues, and by advocating for better business practices and legislative frameworks.





Partner Organisation: AIA

The Australian Institute of Architects (AIA) is the peak body for architecture in Australia. Representing over 14,500 members globally, the AIA is committed to raising design standards and positively shaping the places where we live, work and meet. The AIA is dedicated to improving our built environment and the communities we call home by promoting quality, responsible, sustainable design and advocating on behalf of the profession for the benefit of all Australians. Showcasing a commitment to engagement and communication, the AIA collaborates with key stakeholders across government and industry and with affiliate peak organisations. From sustainable urban development to community-driven initiatives, the AIA is dedicated to creating a future where architecture serves as a catalyst for positive change. The AIA champions the breadth and diversity of the profession, and is passionate about contributing to society, culture, and Country.

Partner Organisation: NSW ARB

The NSW Architects Registration Board (ARB) is constituted by, and operates under, the Architects Act 2003, the legislation regulating architects in NSW. We sit within the NSW Government Department of Customer Service and are responsible to the Minister for Better Regulation and Fair Trading, Minister for Building. We are a self-funded government regulatory body, totally funded by fees paid by NSW architects and architect corporations and firms.

Dr Kirsten Orr is the CEO and Registrar of the NSW ARB and is responsible for leading the effective governance and performance of regulatory functions and registration of 6000+ architects in NSW. At a time of significant Government reform of the NSW building industry to address housing supply and construction quality issues and improve consumer confidence and protection, Kirsten's leadership contributions are enhanced by sustained industry partnerships yielding research-led perspectives to inform regulatory initiatives.





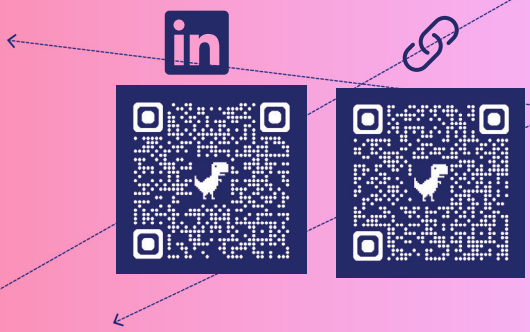

arch_
manu
research
symposium
2025
17-18
September

arch_
manu

ARC Centre for Next-Gen
Architectural Manufacturing

archmanu@unsw.edu.au

Anita B. Lawrence Centre (West Wing)
Level 4 Room 4041
UNSW Kensington Campus 2052
Australia



All images copyright © Arch_Manu