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>Î ẼẼś ˘ÅśūĄj U˘ ʃ˘ẼśĄrÅÅÅĻśĦÅÅ ˘Å AYO

Dr Ivana Kuzmanovska, UNSW

LSAA Conference 2024, 13th September

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Australian Government
Australian Research Council

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**NĀ¡ ** [illegible]

Director
A/Prof M. Hank Haeusler, UNSW

Manager
Dr Ivana Kuzmanovska, UNSW

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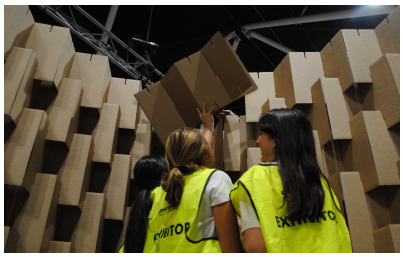

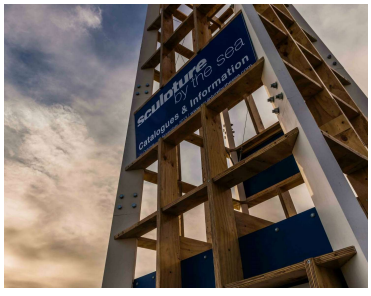

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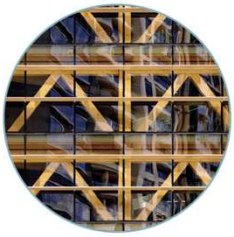
ARC ITTC
Constructing the Future of Housing

ARCHITECT
richard kirk architect

CRC-P
Innovation in Advanced Multi-storey Housing Manufacture

MANUFACTURER
DesignMake



DEVELOPER
Lendlease

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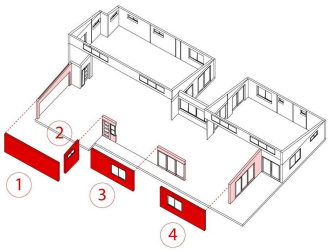
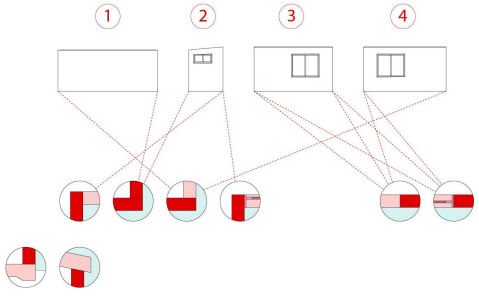
building 4.0 crc





CRC

CRC#6 Field data collation to support real-time operational management – Scoping Study
CRC#8 Prefab Wall Integrated System – Phase 1 Scoping Study
CRC#9 Implementing DfMA and Lean in Construction
CRC#10 Product Platform for Volumetric Building (Scoping Study)
CRC#18 Long-span, low carbon floor systems (Scoping Study)
CRC#28 Componentised Internal Wall Systems for multi-residential Applications
CRC#30 Critical Path Impact through Productisation
CRC#31 Demystifying Volumetric Construction

AūÅÎ ĒĄ íįș
;ÁĒĒžÁüĂĵśż˘ÃĴ NÎ˘Ãț˘ÃĴ ⍰?Oį O ĮDĎĔíjŭĒĒśĒi ÎĒĖDĵNÎ˘Ãț˘ÃĴ rÃ˘ĦśĦĻíįș{ ÁÃśĒ˙

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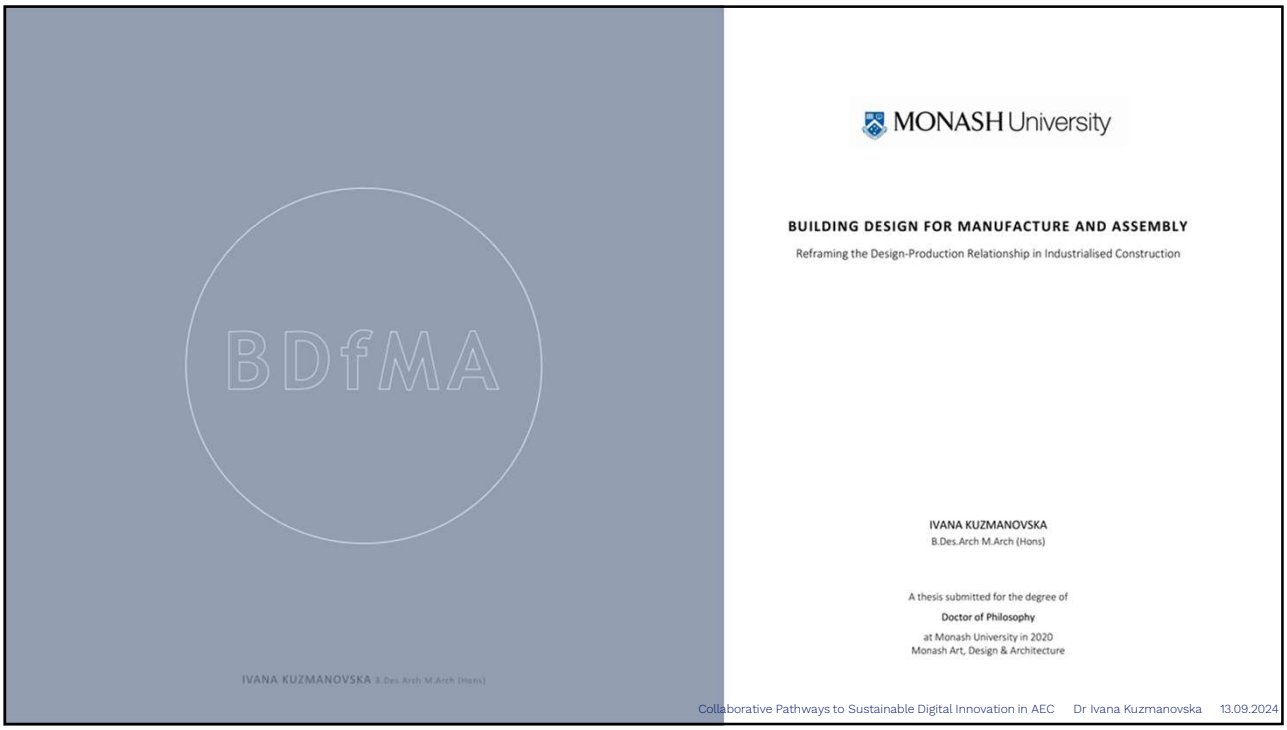
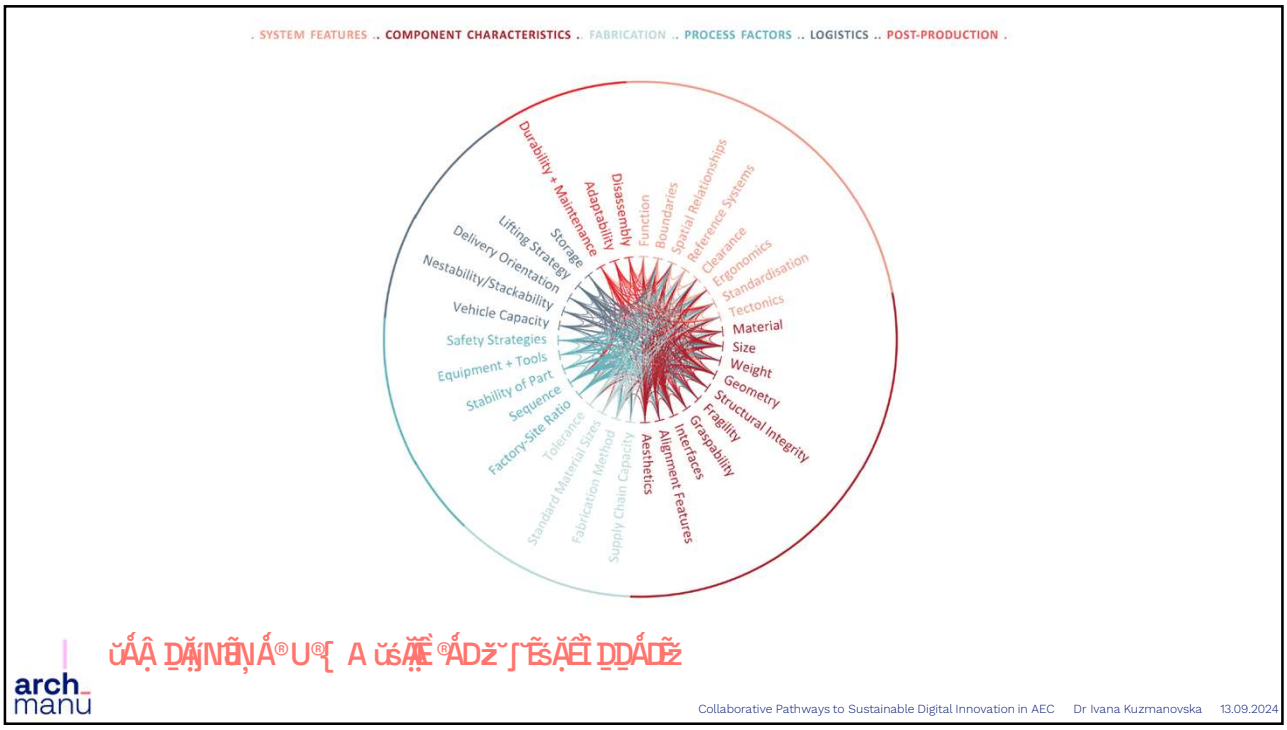

BDfMA
IVANA KUZMANOVSKA B.Des.Arch M.Arch (Hons)
MONASH University
BUILDING DESIGN FOR MANUFACTURE AND ASSEMBLY
Reframing the Design-Production Relationship in Industrialised Construction
IVANA KUZMANOVSKA
B.Des.Arch M.Arch (Hons)
A thesis submitted for the degree of
Doctor of Philosophy
at Monash University in 2020
Monash Art, Design & Architecture
Collaborative Pathways to Sustainable Digital Innovation in AEC Dr Ivana Kuzmanovska 13.09.2024

7


. SYSTEM FEATURES .. COMPONENT CHARACTERISTICS .. FABRICATION .. PROCESS FACTORS .. LOGISTICS .. POST-PRODUCTION .
Durability + Maintenance
Adaptability
Disassembly
Function
Boundaries
Spatial Relationships
Reference Systems
Clearance
Ergonomics
Standardisation
Tectonics
Material
Size
Weight
Geometry
Structural Integrity
Fragility
Graspability
Interfaces
Alignment Features
Aesthetics
Supply Chain Capacity
Fabrication Method
Standard Material Sizes
Tolerance
Factory-Site Ratio
Sequence
Stability of Part
Equipment + Tools
Safety Strategies
Vehicle Capacity
Nestability/Stackability
Delivery Orientation
Lifting Strategy
Storage
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ARC Centre for Next-Gen
Architectural Manufacturing

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Uíjśż ĄÂíj ŭÁÂÊĐšzÂÊĐ
Need to meet our Net-Zero targets by

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13

j DẮĻ Ẽ ŭÁÂÊĐšzÂÊĐ
Need to meet the Net-Zero targets with an increasing human population

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_ˇÂ íj ŭÁÂÊÊDšzÂÊÊ
Need to act fast

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>D̲šH̥šÄ̧ŭÁÂÊÊDšzÂÊÊ
Need to act everywhere

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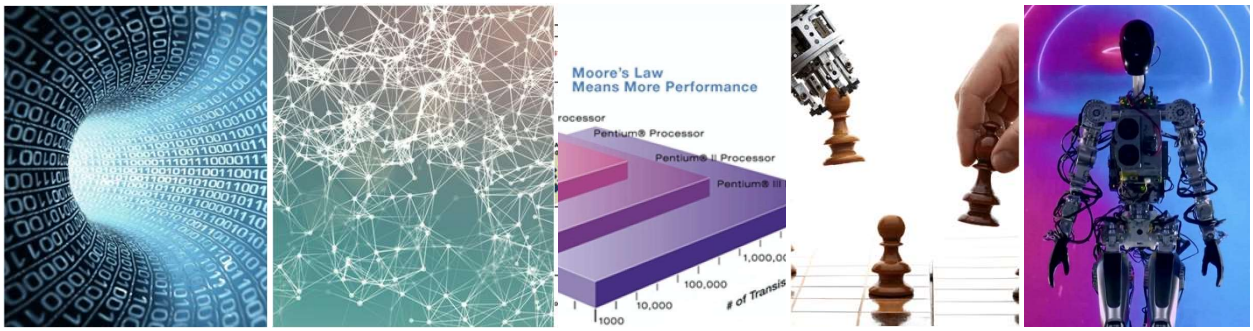

Big Data, Social Media, Digitalized Information, Internet of Things, Sensors, ML / AI, robotics offer speed and scalability.

Brynjolfsson, E; McAfee, A. (2014) The Second Machine Age - Work, Progress, and Prosperity in a Time of Brilliant Technologies, Norton Publisher

ĒjŭĂĂż Ậ śŭ ˘Ầíj ś ʃíj Ējŭ ĂĂĄĂ ʃ ĭjĒ

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\ ÎDĐĂĂĐjż ĻĒĂĂ
Enabling

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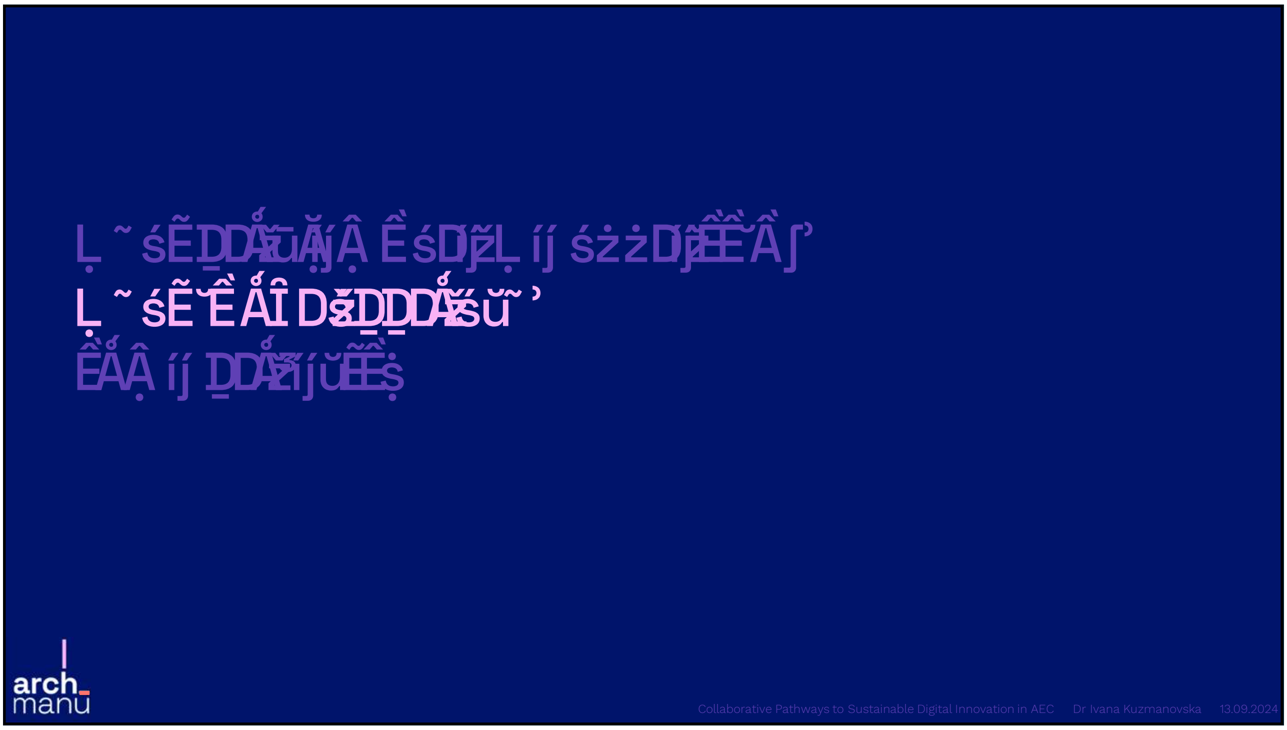
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Collaborative Pathways to Sustainable Digital Innovation in AEC Dr Ivana Kuzmanovska 13.09.2024

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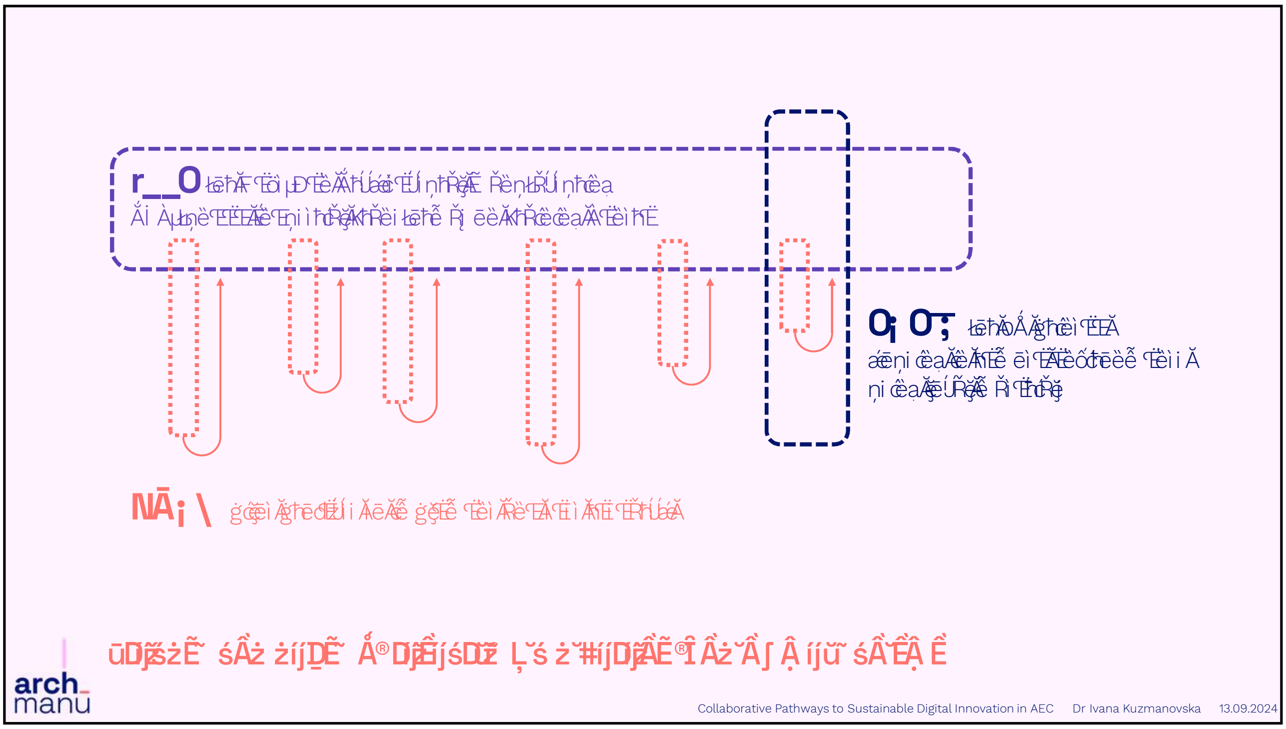
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Collaborative Pathways to Sustainable Digital Innovation in AEC Dr Ivana Kuzmanovska 13.09.2024

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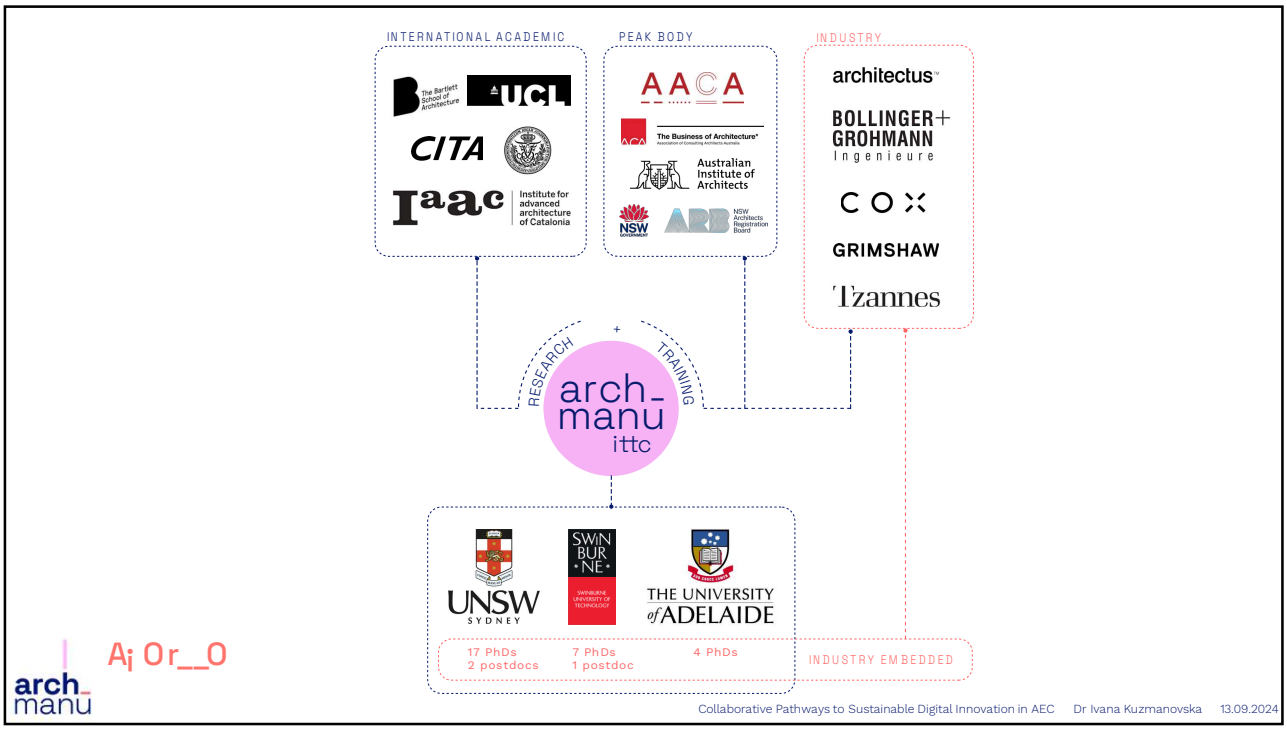

21

Establish **digital sustainability as a methodological foundation** to reframe the AEC design process towards an integrative and cross-sectoral approach.

Develop frameworks and tools to enable AEC design consultants to **harness digitalisation in workflows and outputs** for increased productivity and speed of delivery.

Remove the bottleneck between design and production caused by data and file interchange requirements.

Accelerate digital transformation in AEC businesses by **developing organisation-level interventions**.

Develop sector-specific **IP and training for software and/or AI-augmented design and delivery** of buildings.

Facilitate the **adoption, exploration, and innovation in training and lifelong learning** for architectural manufacturing and digital sustainability.

Train architects, designers and engineers to **develop and deliver design information in a format that can add value** to the architectural manufacturing process.

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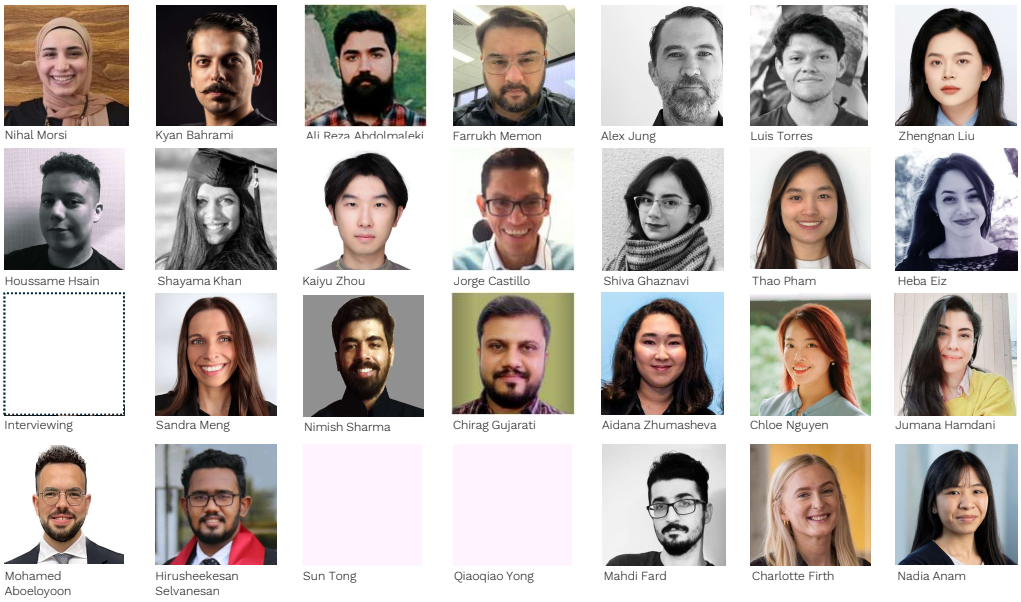
Nihal Morsi
Kyan Bahrami
Ali Reza Abdolmaleki
Farrukh Memon
Alex Jung
Luis Torres
Zhengnan Liu
Houssame Hsain
Shayama Khan
Kaiyu Zhou
Jorge Castillo
Shiva Ghaznavi
Thao Pham
Heba Eiz
Interviewing
Sandra Meng
Nimish Sharma
Chirag Gujarati
Aidana Zhumasheva
Chloe Nguyen
Jumana Hamdani
Mohamed Aboeloyoon
Hirusheekesan Selvanesan
Sun Tong
Qiaoqiao Yong
Mahdi Fard
Charlotte Firth
Nadia Anam

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25

25 PhD candidates and **3 postdocs**.

27 academics across **3 university** institutions.

9 industry partner organisations and **3 international academic partners**.

Affiliated PhD program, currently **3 affiliated PhD candidates**.

through

Education developer and web developer.

Delivery of **156 knowledge- and skills-based CPD courses** (1-hour each) across 5 years.

Regular knowledge exchange through **public forums, annual research symposia**.

through

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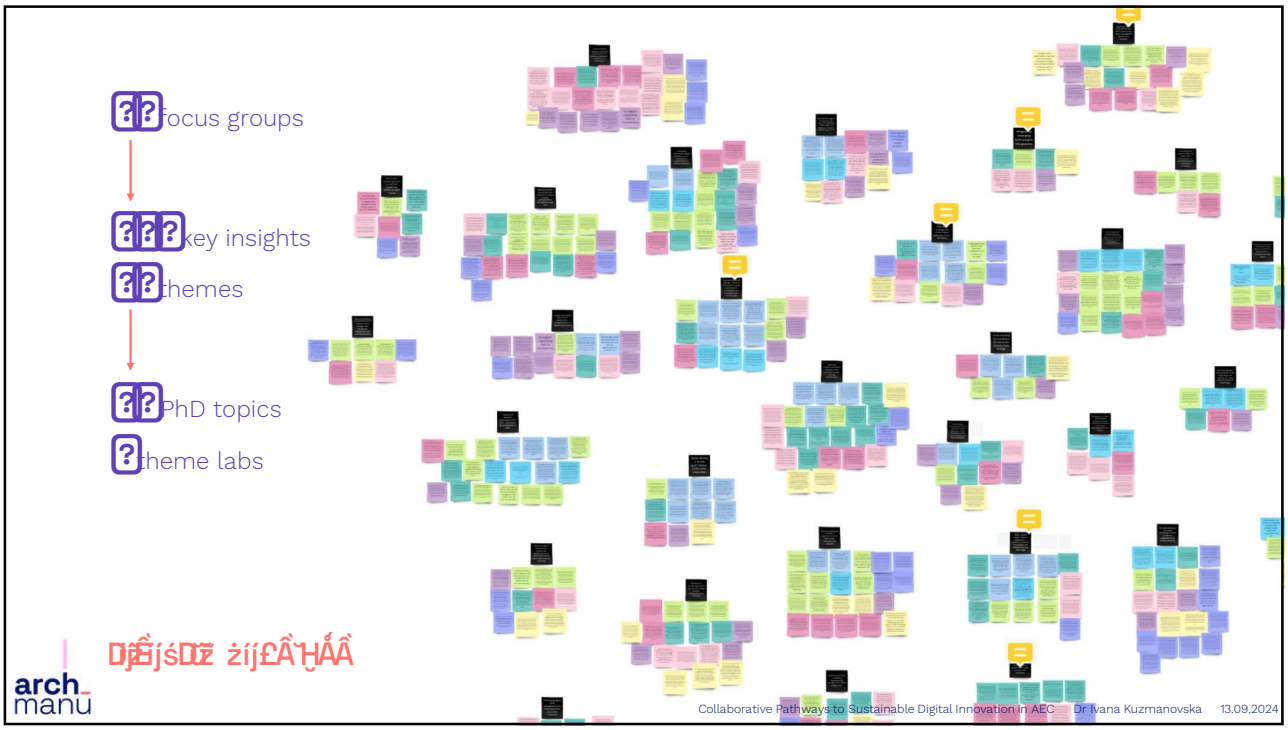
focus groups
key insights
themes
PhD topics
theme labs
arch manu
Collaborative Pathways to Sustainable Digital Innovation in AEC Dr Ivana Kuzmanovska 13.09.2024

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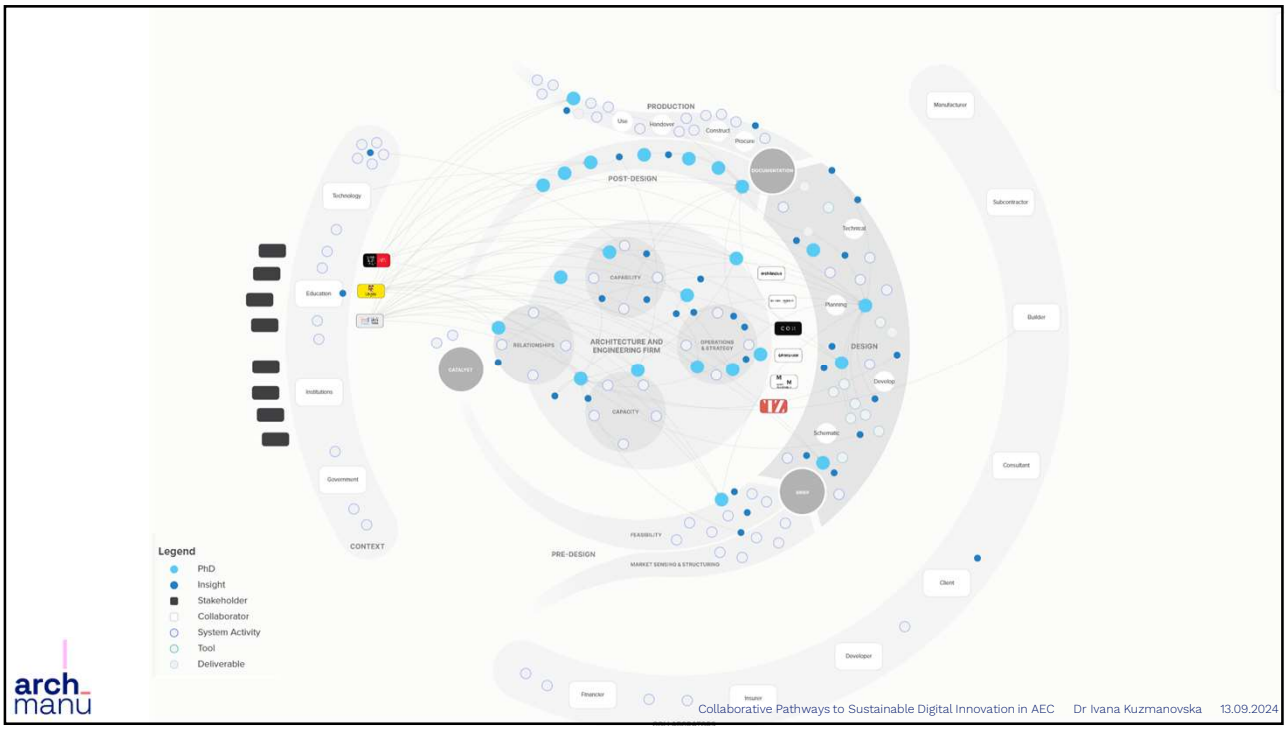
PRODUCTION
POST-DESIGN
PRE-DESIGN
CONTEXT
ARCHITECTURE AND ENGINEERING FIRM
DESIGN
Legend
PhD
Insight
Stakeholder
Collaborator
System Activity
Tool
Deliverable
arch manu
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28

What factors in the AEC work environment help and hinder knowledge flows and digital innovation within and between teams and projects?

PHD

Key Questions

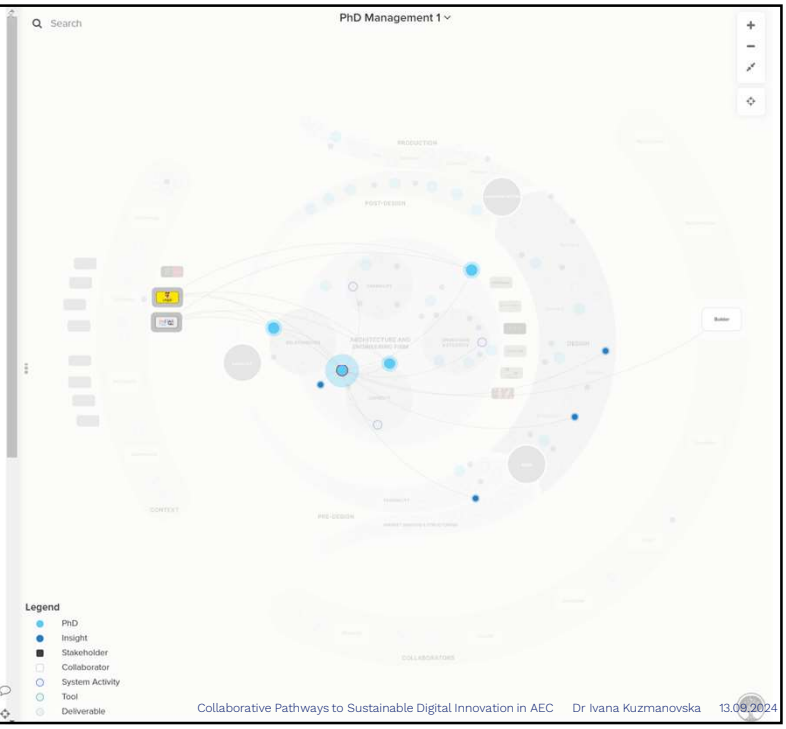
a) What factors in the AEC work environment helps and hinders knowledge flows within and between teams/projects?

b) Identify, trial and evalutate tools to facilitate knowledge flows and innovation within and between teams/projects.

c) Integrate systems thinking and strategic foresight research to develop a holistic framework for retaining and transferring knowledge between projects.

Executive Summary

The Architecture Engineering Construction (AEC) sector is responsible for the delivery of , multi-stakeholder infrastructure projects with high levels of uncertainty. Shaping the outcomes of these projects is a highly fragmented process that spans internally between a firm's teams and externally with project partners. Due to project uncertainty, knowledge needs to be shared quickly and easily within and across teams. At the firm level, responsibility is often segmented across specialised teams that contribute to the completion of a project, influencing the opportunities for effective and efficient knowledge transfer and innovation.



CENTRE OBJECTIVES Design process

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; ˜U _ÁĐ˜ü
Harvesting design data embedded in past AEC project documentation.

; ˜U _ÁĐ˜ü
Predictive modelling for scenario planning through leveraging design data.

; ˜U _ÁĐ˜ü
Knowledge accessibility, interoperability, and security of practice data (considering errors, risks, file sharing).

; ˜U _ÁĐ˜ü
Practical, legal, ethical, and commercial frameworks affecting storage, accessibility, security of design data.

; ˜U _ÁĐ˜ü
Value proposition definition and articulation using new and emerging technology.

; ˜U _ÁĐ˜ü
Barriers and implications of new technology adoption in the sector (considering individuals, teams, organisations).

; ˜U _ÁĐ˜ü
Application of digital twin concept towards a simulation of architectural manufacturing prior to construction.

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>ĮÃÊ˜ íjÊÊ6śūṣ
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; ˜U _ÁĐ˜ü
Leveraging automation to achieve project goals and preserve knowledge in the AEC sector.

; ˜U _ÁĐ˜ü
Computational methods and AI in AEC: Enhancing sustainability outcomes and optimising value creation.

; ˜U _ÁĐ˜ü
AEC technology to optimise data organisation, collaboration and content sharing.

; ˜U _ÁĐ˜ü
Designers and LOD/BIM: Overcoming challenges, enhancing sustainability and integrating building systems.

; ˜U _ÁĐ˜ü
Effective strategies for enhancing collaboration among actors in AEC sector.

; ˜U _ÁĐ˜ü
Modern methods of construction and data analysis: reconsidering pre-production and production processes.

; ˜U _ÁĐ˜ü
Using historic AEC data to achieve more sustainable and efficient future projects.

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;˜U _ǡ̂Ḏ˘ü⍰
Improving knowledge flows and digital innovation within / between teams / projects in AEC work environments.

;˜U _ǡ̂Ḏ˘ü⍰
Learning mechanisms + change processes for digital transformation + organisational performance improvement.

;˜U _ǡ̂Ḏ˘ü⍰
Addressing roadblocks to business model innovation in the sector.

;˜U _ǡ̂Ḏ˘ü⍰
Identifying proactive measures firms should take when preparing for the potential future scenarios.

;˜U _ǡ̂Ḏ˘ü⍰
Demands, forces, and stakeholder agency towards industry transformation.

;˜U _ǡ̂Ḏ˘ü⍰
Digital capabilities and information systems for overcoming challenges in digital transformation.

;˜U _ǡ̂Ḏ˘ü⍰
Impacts of sustainability pressures on the sector and its business models, considering the building life cycle.

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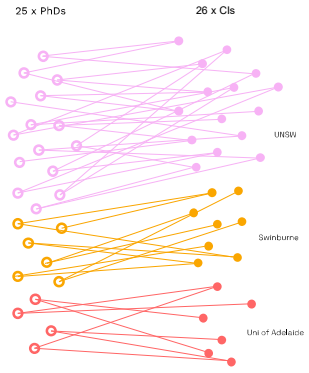

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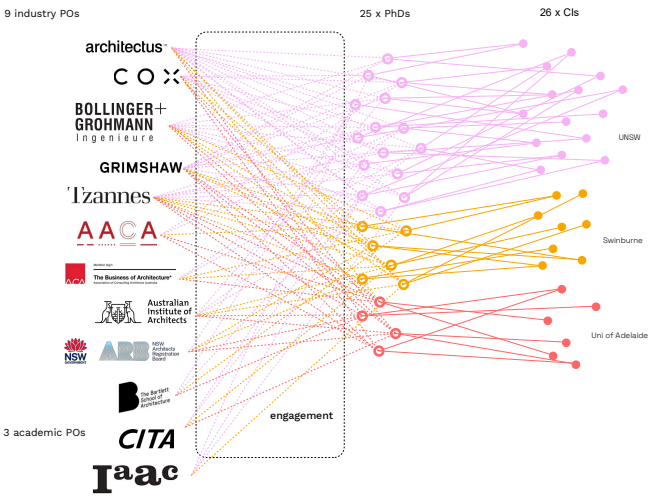

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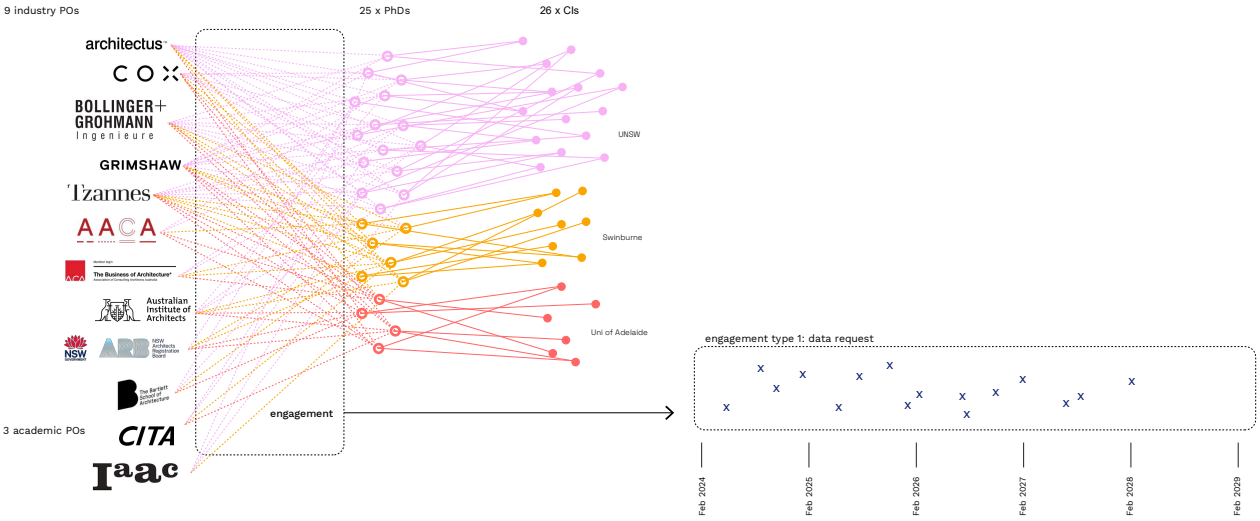

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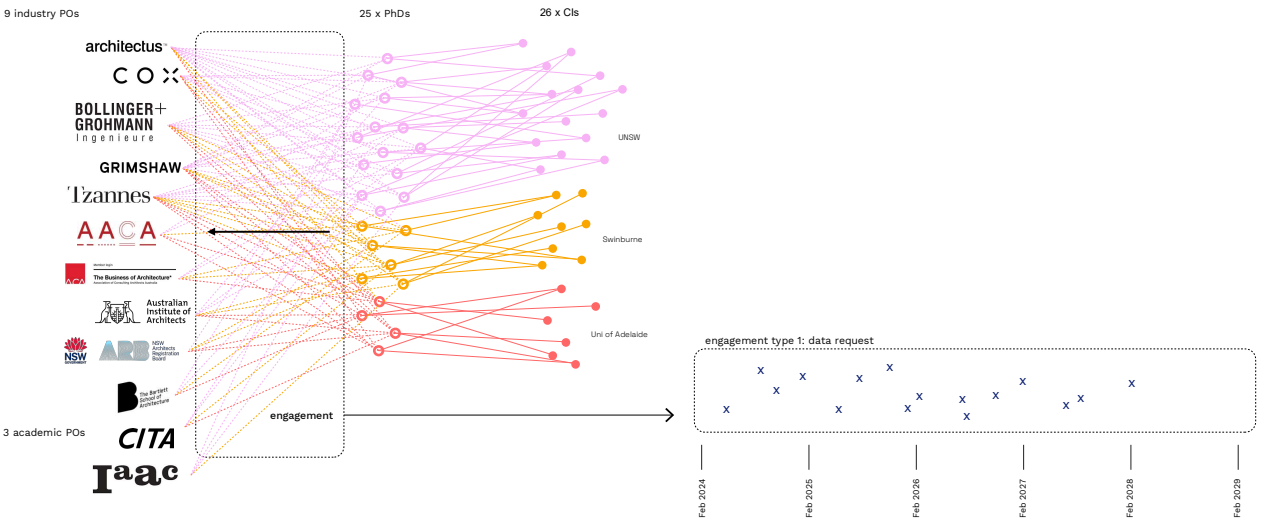
9 industry POs
25 x PhDs
26 x CIs
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GRIMSHAW
Tzannes
AACA
The Business of Architecture
Australian Institute of Architects
NSW Architects Registration Board
The Bartlett School of Architecture
CITA
Iaac
3 academic POs
engagement
UNSW
Swinburne
Uni of Adelaide
engagement type 1: data request
Feb 2024
Feb 2025
Feb 2026
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Feb 2028
Feb 2029

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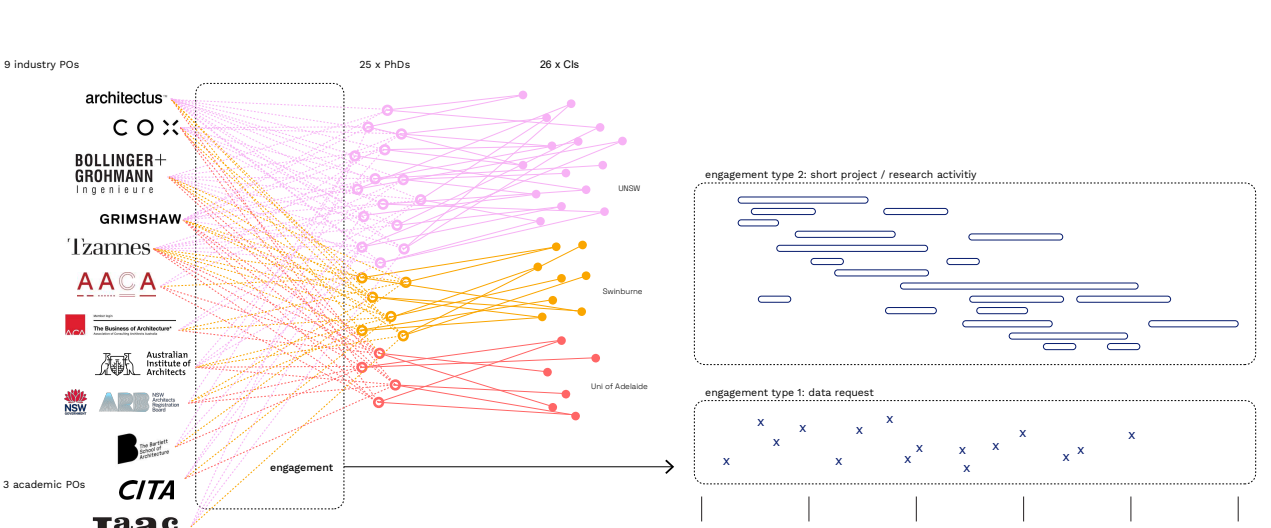
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25 x PhDs
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NSW Architects Registration Board
The Bartlett School of Architecture
CITA
Iaac
3 academic POs
engagement
UNSW
Swinburne
Uni of Adelaide
engagement type 2: short project / research activitiy
engagement type 1: data request
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Feb 2028
Feb 2029

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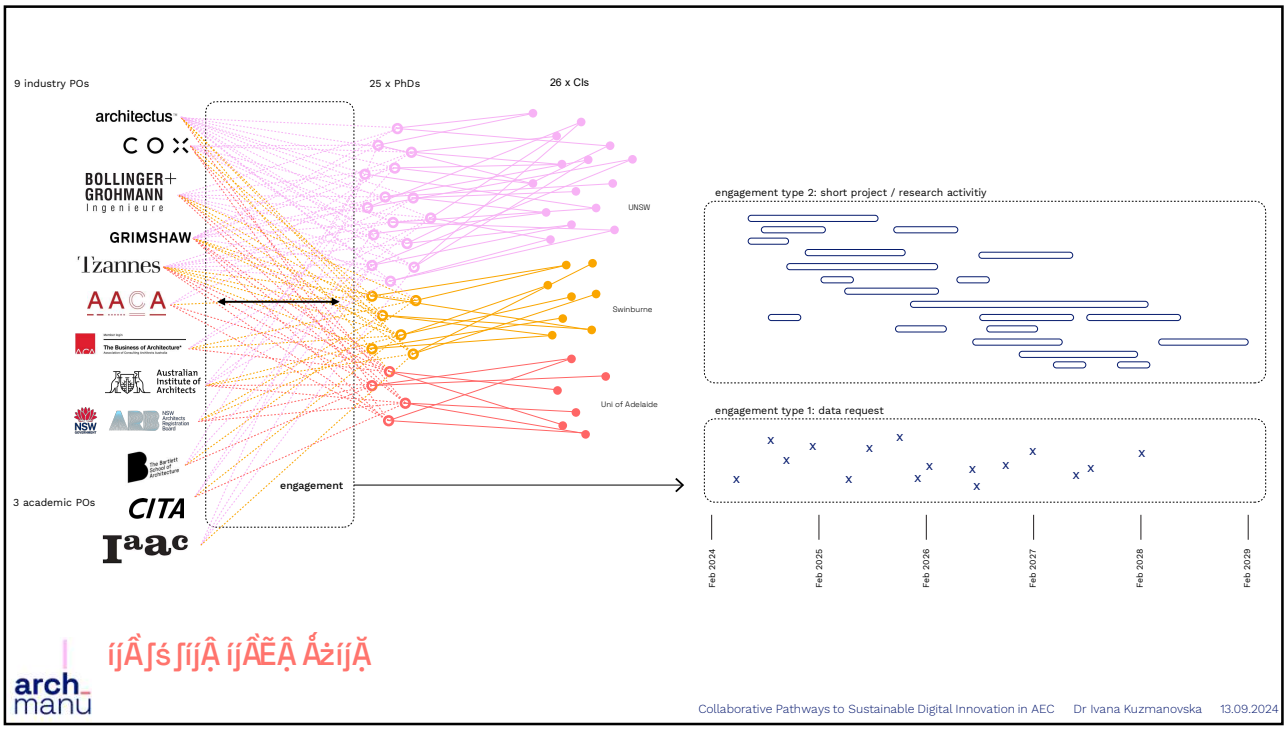
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3 academic POs
engagement
UNSW
Swinburne
Uni of Adelaide
engagement type 2: short project / research activitiy
engagement type 1: data request
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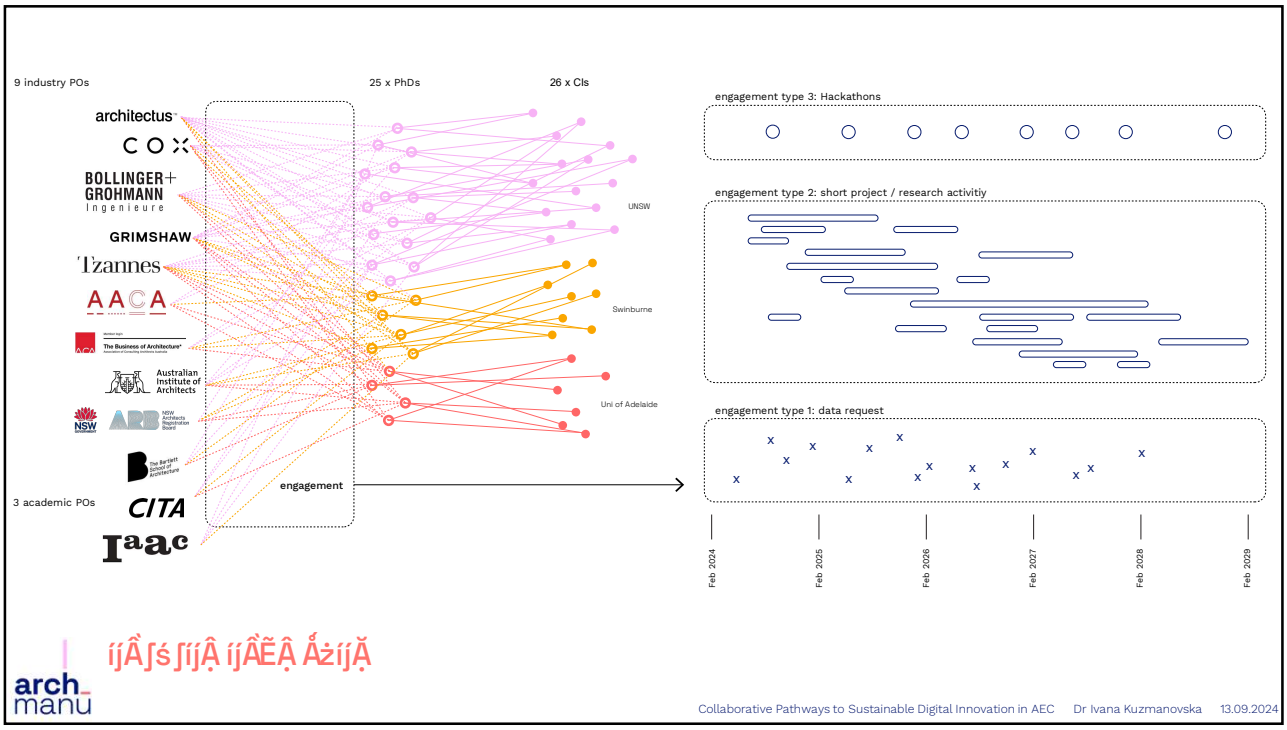
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The Business of Architecture
Australian Institute of Architects
NSW Architects Registration Board
The Bartlett School of Architecture
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3 academic POs
engagement
UNSW
Swinburne
Uni of Adelaide
engagement type 3: Hackathons
engagement type 2: short project / research activitiy
engagement type 1: data request
Feb 2024
Feb 2025
Feb 2026
Feb 2027
Feb 2028
Feb 2029

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ƨƬ Ǻíj ???? Hackathon

20 participants across Australia, Europe, US

Topics:

Post-classification of BIM Elements

Digitising Kits of Rules

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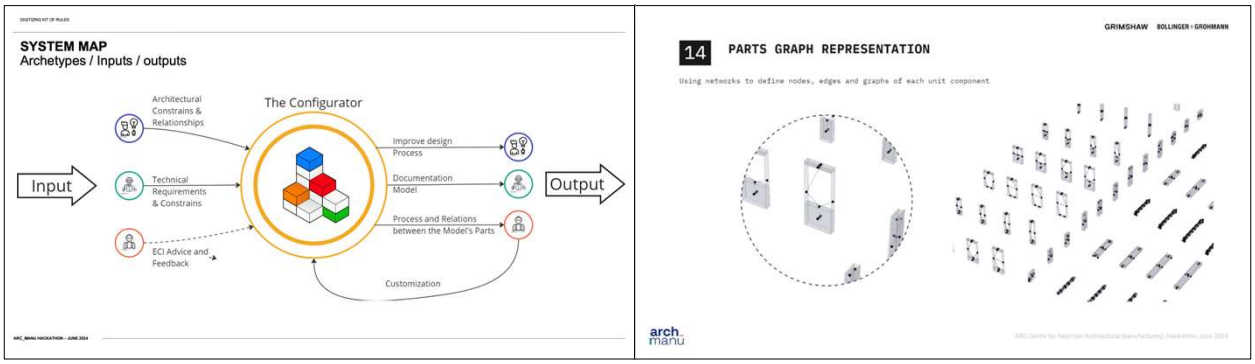

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2ĨÂíj ????Hackathon

20 participants across Australia, Europe, US

Topics:

- *Post-classification of BIM Elements*
- *Digitising Kits of Rules*

>íjD̲Ẽ????Hackathon

25 participants across Australia + Europe

Topics:

- Getting our house in order, together!
- Digitising Rules part 2
- Breaking through the buzz: Digital Twins
- "BIMVerse": Democratizing BIM Data with AI-Powered API Translation (Talking APIs)
- Predicting business-orientated project requirements

~ śŭ̥śẼ ÁÂÈ

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Collaborative Pathways to Sustainable Digital Innovation in AEC Dr Ivana Kuzmanovska 13.09.2024

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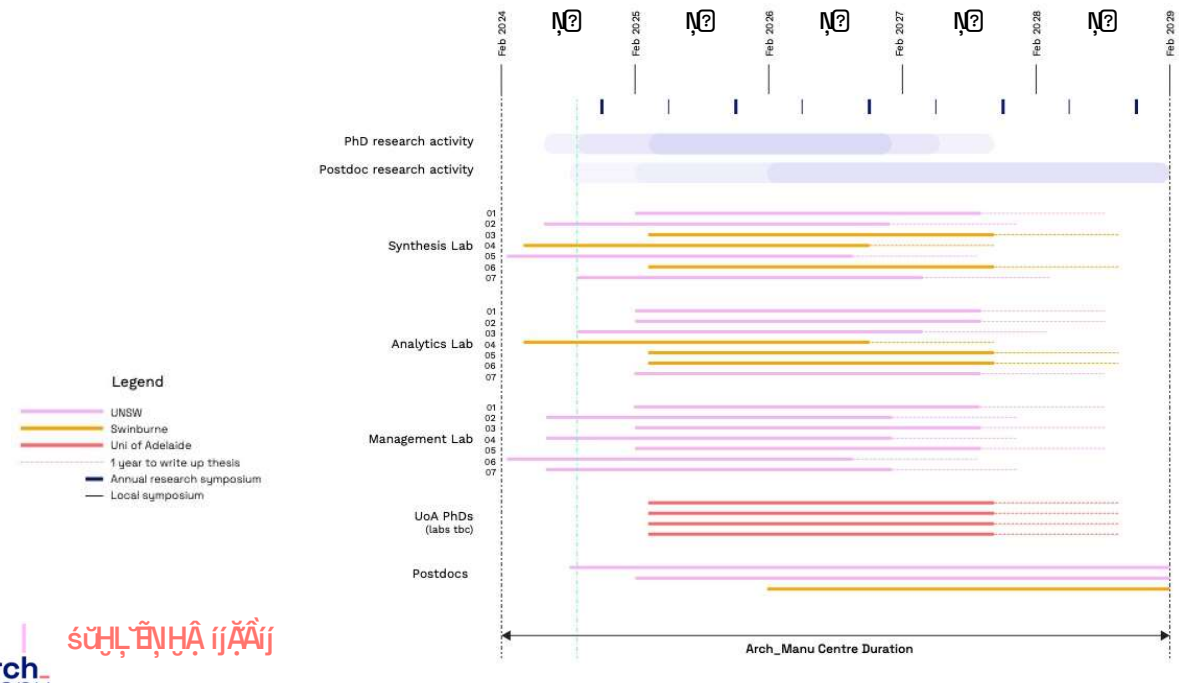

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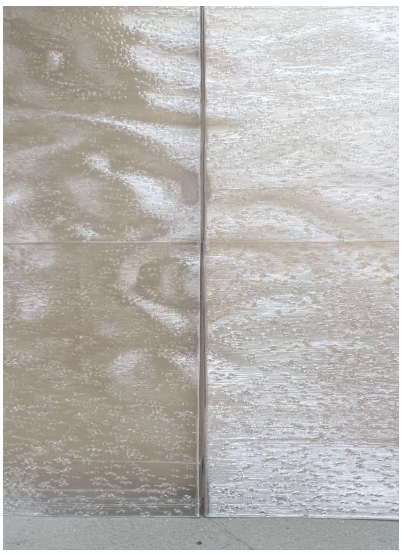

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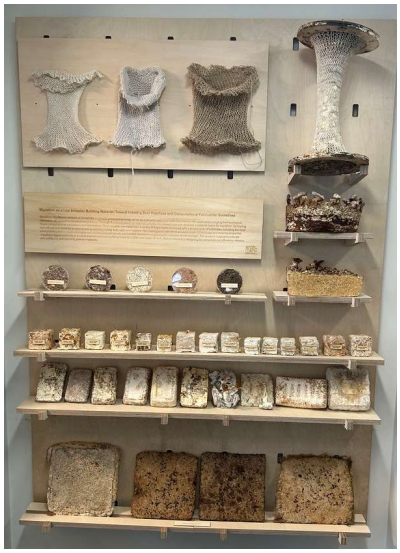

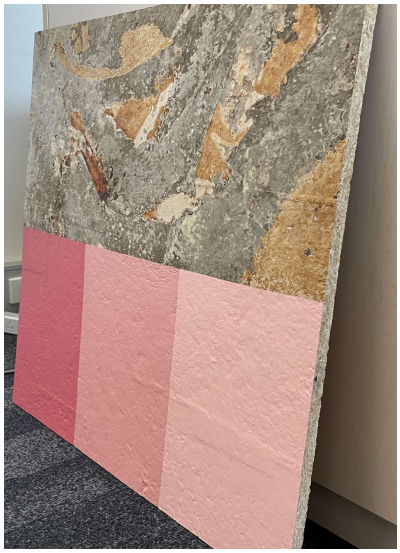

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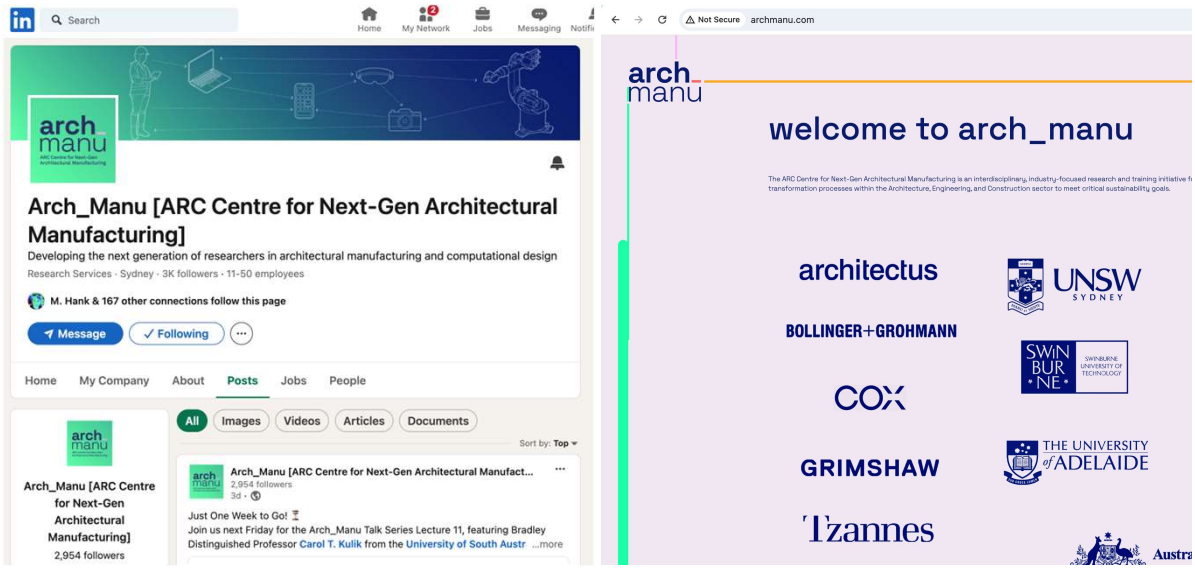

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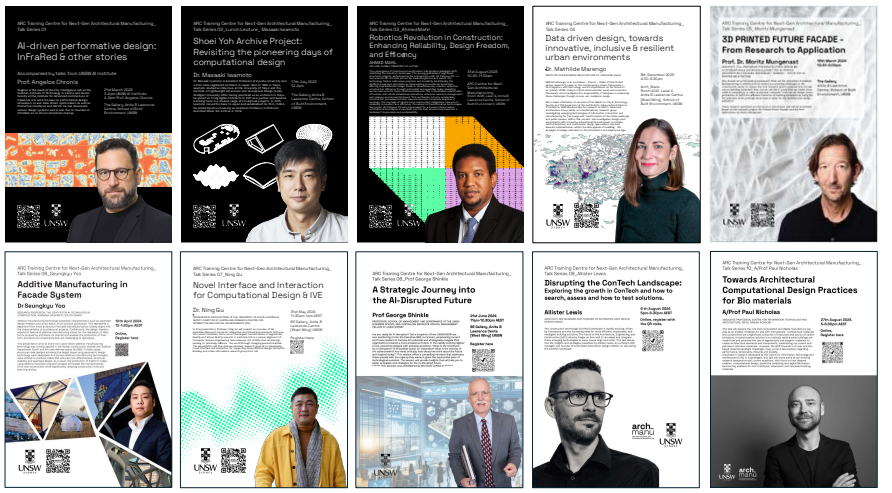

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