Northumbria University NEWCASTLE

# Towards responsible AI integration in built environment curriculum

A Community of Practice Approach

A CHOBE funded project

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# CHOBE COMMUNITY OF PRACTICE GRANT SCHEME 2024

## Futureproofing Built Environment Students through Responsible AI Integration

Northumbria University at Newcastle



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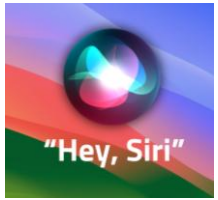
University of the West of England



Dr. Grazyna Wiejak-Roy



Dr. Ytzen Van Der Werf












# AI Applications in Various Sectors / Fields

Smarter solution • Greater efficiency • A more sustainable future

## Healthcare



- Disease diagnosis & early detection
- Personalised treatment plans
- Drug discovery & development
- Robotic surgery
- Patient monitoring (wearables)

## Agriculture



- Crop monitoring & yield prediction
- Precision farming
- Pest and disease detection
- Soil and weather analysis
- Automated harvesting

## Manufacturing & Industry



- Predictive maintenance
- Quality control (computer vision)
- Process optimisation
- Robotics & automation
- Smart factories (Industry 4.0)

## Education



- Personalised learning
- Intelligent tutoring systems
- Automated assessment
- AI-powered content creation
- Learning analytics

## Built Environment & Construction



- Energy performance analysis
- Building design optimisation
- Condition monitoring & predictive maintenance
- Smart buildings and facilities management
- Air-leakage and thermal imaging analysis

## AI

**Artificial Intelligence**

Learning | Reasoning
Solving | Innovating

## Transport & Mobility



- Autonomous vehicles
- Traffic management
- Route optimisation
- Predictive maintenance
- Smart logistics and delivery

## Finance & Banking



- Fraud detection
- Risk assessment
- Algorithmic trading
- Customer service (chatbots)
- Credit scoring

## Environment & Sustainability



- Climate modelling & forecasting
- Pollution monitoring
- …timisation
- …nt
- …lysis



## Security & Defence



- Threat detection & surveillance
- Cybersecurity
- Facial recognition
- Disaster response
- Autonomous defence systems

## Retail & E-commerce



- Recommendation systems
- Demand forecasting
- Inventory management
- Chatbots & virtual assistants
- Personalised marketing





# Potential contribution of AI in BE



### Self-managing buildings

Heating, cooling, and lighting adjust automatically based on occupancy and weather.



### Spotting problems early

Sensors flag unusual behaviour in lifts, boilers, and HVAC before they break down.



### Smarter, faster design

AI generates and tests dozens of design options in the time it takes to sketch one.



### Safer construction sites

Cameras flag missing safety gear and spot structural issues humans might miss.



### Prioritising retrofits

Identifies which buildings to upgrade first for the biggest carbon and cost savings.

### UK Curriculum is falling behind

Building-related degrees are teaching AI far more slowly than subjects like computer science.

### Some countries are ahead

China already use AI-powered robots and smart tools to train construction students.

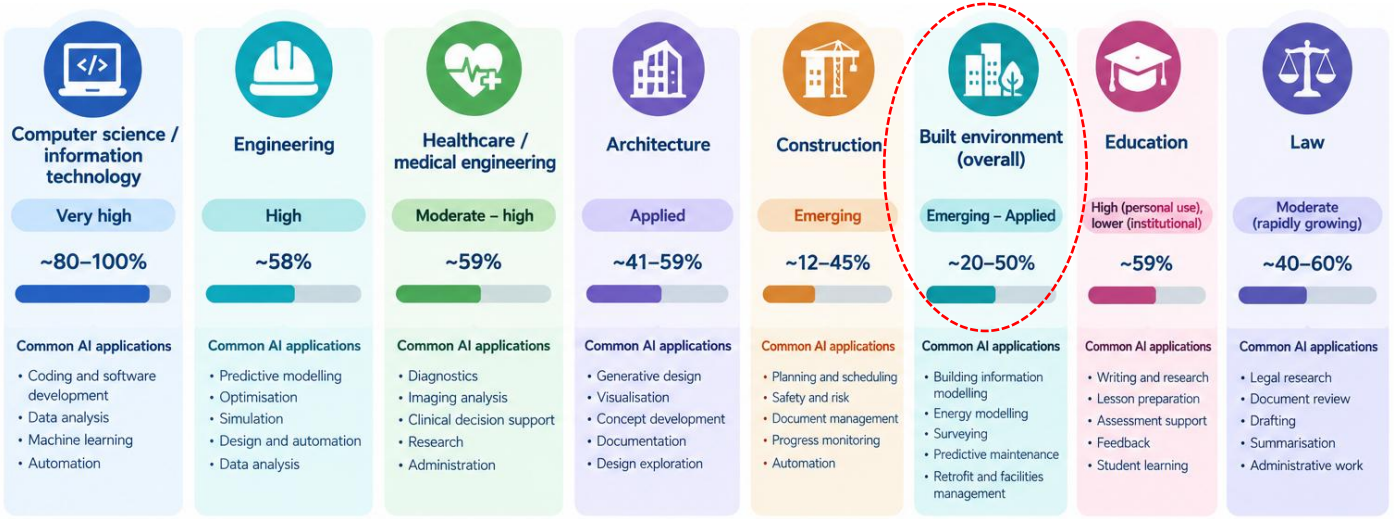
### AI is changing how BE is designed

AI can speed up and inspire design work — but experts warn against relying on it too heavily.

### Employers want AI skills now

Industry groups and global bodies say workers urgently need AI skills to stay employable.

# AI adoption across various disciplines







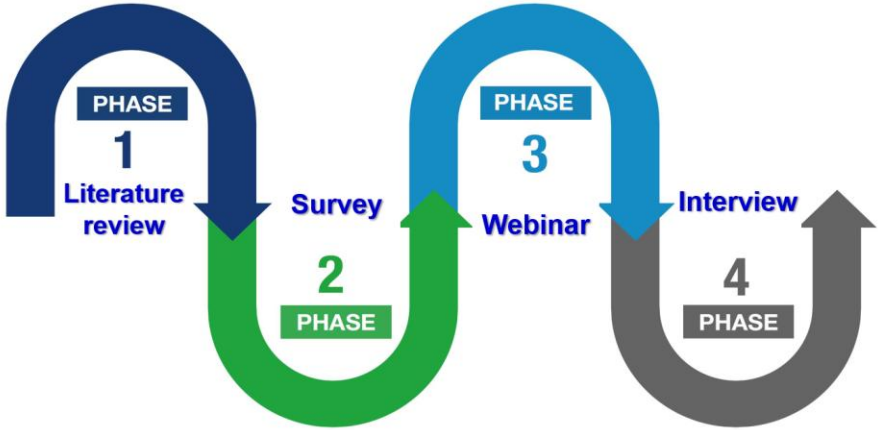
**AIM →** To develop a policy framework for responsible AI integration in built environment curriculum

# Objectives of the project

1. To compare the AI adoption in built environment higher education around the world.

2. To understand the opportunities and barriers for UK educators to AI adoption in BE higher education.

3. To identify best AI applications in teaching and assessment and build skills and support systems for the BE students in making responsible use of AI.



# Literature on AI in Built Environment HE



| AUTHOR & YEAR | CONTEXT (UK / INT'L) | STUDY FOCUS | METHODOLOGY | AI APPLICATION IN BE TEACHING | KEY FINDINGS | REMARKS |
|---|---|---|---|---|---|---|
| Boland et al. (2021) | UK | AI awareness in construction education | Survey of students and professionals | Introductory AI literacy, BIM-linked tools | Low AI awareness; limited curriculum integration | Highlights skills gap in UK education |
| UK Government (2021) | UK | AI readiness in education sectors | Policy report and data analysis | General AI adoption in higher education | Built environment disciplines lag behind computing fields | Shows policy-level gap affecting curriculum |
| Pan & Zhang (2023) | International (China-focused) | AI integration in construction training | Case study + curriculum analysis | Smart construction, automation, robotics | Strong integration of AI in technical modules | Demonstrates state-driven curriculum innovation |
| Abioye et al. (2021) | | | | | | Limited discussion of pedagogy → teaching gap |
| Becerik-Gerber et al. (2022) | | | | | | Suggests integration across design + computing |
| Liu et al. (2022) | | | | | | Weak link to construction practice |
| Sacks et al. (2020) | International | Construction 4.0 and education | Conceptual framework | AI + BIM + IoT integration | Calls for curriculum transformation | Lacks empirical validation in classrooms |
| Royal Institution of Chartered Surveyors (2023) | UK | Skills for future built environment workforce | Industry report | AI in valuation, risk, project analytics | Urgent need for AI upskilling | Confirms industry–education mismatch |
| Eastman et al. (2018) | International | BIM education evolution | Foundational academic text | Early AI-linked BIM workflows | BIM dominates teaching; AI still secondary | Shows historical lag before AI adoption |
| Koutamanis (2020) | International (EU-focused) | AI in architectural education | Theoretical + studio-based analysis | Generative design, computational creativity | AI reshapes design thinking | Limited adoption in UK studios |
| Zhang et al. (2024) | International | Generative AI in design studios | Experimental teaching study | GANs, parametric AI tools | Enhances creativity but risks over-reliance | Raises pedagogical and ethical concerns |
| World Economic Forum (2023) | International | Skills transformation due to AI | International labour market analysis | AI-related competencies in education | Demand for hybrid AI + domain skills | Supports curriculum redesign argument |

- AI integration in the built environment education is emerging globally
- UK curriculum is lagging behind and there is need for
  - ✓ structured,
  - ✓ interdisciplinary and
  - ✓ practise-driven approach.

# Online survey

## Survey questionnaire

n = 32 respondents • 23 UK academic institutions

1. Whether AI is used in teaching and assessment, and in what mode (on-campus, online, apprenticeship)
2. Perceived benefits, lessons learned, and responsible-use suggestions
3. Support staff and students need to use AI effectively and responsibly

## AI adoption is emerging, but uneven

n = 32 respondents across 23 UK academic institutions

- 47% using AI in teaching
- 53% not yet adopted
- 75% want more support

17 of 32 face barriers such as skills gaps, unclear guidance, and integrity concerns.

24 of 32 called for training, clear policy, and access to the right tools.

**Top participating institutions**



# Additional support

- Staff and student AI training
- Clear institutional policies and guidance
- Practical examples tailored to BE disciplines
- Equitable access to appropriate AI tools
- Guidance on assessment and academic integrity
- Opportunities to share case studies and good practice

# Webinar

**n = 19 participants · 13 UK academic institutions**

- Identify the best AI applications for BE teaching and assessment
- Build skills and support systems for responsible student AI use
- Learn directly from academic and industry practitioners

# Academic view

- BE design is iterative, non-linear and creative
- AI can support ideation, synthesis and visualisation
- Human creativity, empathy and imagination remain central
- Educators remain the “expert in the room”
- AI outputs require critical verification

# Industry view

**RED — AI not allowed**

Assessment focuses on independent human work

**AMBER — AI allowed as an assistant**

Assessment focuses on students' brainstorming, structuring, refinement; use must be transparent

**GREEN — AI is central**

Assessment focuses on students' critique, evaluate and demonstrate responsible use of AI

Across all levels:

- ✓ AI declaration + reflective documentation + critical evaluation
- ✓ Prompt craft is an emerging skill worth teaching explicitly
- ✓ Soft skills – problem-solving, communication, teamwork – still highly valued

# Recommendations

- Develop reflective, transparent and process-based assessment
- Establish staff development and AI training programmes
- Build industry–academia collaboration around future AI skills
- Create national/international networks for sharing practice
- Develop discipline-specific responsible AI frameworks
- Evaluate the impact of AI integration on student learning outcomes

# Implications for Curriculum and Assessment

**Need for change of approach “FROM" → "TO"**

Final product only → Process + final outcome

Generic questions → Authentic/scenario-based tasks

Hidden AI use → Transparent AI declaration

AI-generated answers → Critical evaluation of AI outputs

Technical skills alone → AI + communication + teamwork + professional judgement

# Conclusions

- ✓ AI integration in BE higher education is emerging but uneven
- ✓ AI can enhance creativity, sustainability and efficiency
- ✓ Key barriers are skills, policy, trust, integrity, time and resources
- ✓ AI should augment rather than replace human expertise
- ✓ Responsible adoption requires ethical guidance, capacity building and institutional support
- ✓ Futureproofing BE education requires a human-centred approach to AI.




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