ACCELERATING DIGITAL TRANSFORMATION:
BIM CAPABILITY ASSESSMENT, MATERIAL PASSPORTS AND DTCHATBOT

Overview

This case study aims to accelerate digital adoption and sustainable, data-driven practices by identifying organisational needs, benchmarking capabilities, and enabling traceable, interoperable workflows. Aligned with DigitLab's objectives, it integrates BIM capability assessments, Material Passport testbeds, and an LLM-based DTchatbot to transform construction and manufacturing through digital innovation and advanced data use; thereby improving decision-making, traceability, and interoperability while reducing time and cost to engage.

Partners Involved

Network Rail:
UK rail infrastructure owner/operator advancing digital readiness, BIM integration, and data-led decision-making.

Natural Building Systems (NBS):
A sustainable construction product supplier implementing Material Passport (MP)– based supply chain transparency.

LLM-based DTchatbot collaborators:
A research-led initiative developing an LLM-based chatbot to elicit digital transformation needs via workflow-driven interviews; piloted with two manufacturing SMEs.

Challenges

BIM capability assessments and Material Passports:
Digital estates are constrained by legacy/technical debt and fragmented systems with inconsistent data models; uneven standards combined with departmental silos and skills gaps hinder interoperability; and limited resources and budgets restrict digital transformation, consistency, and the ability to scale transformation.

LLM-based DTchatbot:
Traditional elicitation methods, such as workshops and interviews are inefficient, costly, and difficult to scale; surveys are low-engagement and high-effort to analyse, leading to inconsistent insights across teams and languages; organisations require structured, repeatable workflows and automated needs acquisition to facilitate successful digital transformation.

1. Select the process to assess
2. Score the performance indicators
3. Identify the performance against each BIM attribute
4. Identify the BIM capability level

Opportunities

BIM capability assessments and Material Passports:
Enable sustainability and circularity through traceability and reuse; increase productivity and supply-chain visibility; and provide scalable, repeatable frameworks that reduce time to value and prepare foundations for digital twins and automation.

LLM-based DTchatbot:
Delivers automated, structured digital needs elicitation via workflow-guided, multilingual, speech-enabled interviews; increases inclusivity and engagement; improves data quality and insight depth; provides automated consultation at lower cost to inform actionable roadmaps.

Outcomes

BIM capability assessments and Material Passports:
Established clear benchmarks of BIM capability and compliance pathways via the self-assessment toolkit; identified priority gaps and informed strategic roadmaps; demonstrated MP-enabled traceability that strengthens quality assurance and certification readiness, with projected waste reductions of up to 30% and a scalable blueprint for broader deployment.

LLM-based DTchatbot:
Ability to automatically elicit structured digital transformation needs with better consistency and depth, reducing time and cost versus traditional methods; improved accessibility through voice input and multilingual capability; pilot results validated effectiveness and defined subsequent refinements (domain tuning, multilingual robustness, analytics automation).

Overall impact:
Combining BIM capability uplift, Material Passport–driven traceability, and an AI-enabled DTchatbot creates a clear, scalable pathway for digital transformation and sustainability. Together, these digital innovations reduce time and cost to engage, improve data quality, interoperability, and traceability, and make expert consultation more accessible. This, in turn, facilitates digital transformation, informing roadmaps and laying the foundations for digital twins, automation, and future AI applications.

Recognition:
BIM capability assessments and Material Passports are shortlisted for the Knowledge Exchange Awards (Early Career Bright Future Award). Video: https://youtu.be/_mjikI9AD4Y?si=rggRDyJv5TDsyjag

Activities

BIM capability assessments and Material Passports:
Delivered a self-assessment toolkit to benchmark BIM capability and target improvements and conducted BIM capability assessments with industry partners; developed and trialled MP-based traceability testbeds with unique identifiers and physical tagging to support quality assurance, certification readiness, circularity, and waste reduction; and shared guidance to improve interoperability and scale adoption.

LLM-based DTchatbot:
Designed and implemented a workflow-guided, LLM-powered virtual expert; integrated planning /reasoning with predefined workflows and speech-to-text for natural, multilingual interactions; ran pilot consultations with SMEs and experts to test usability, adherence to workflows, and insight capture.

Publications

Yilmaz, G., Hutton, C., Valsaladas, V., Donovan, C., Zvirgzda, K., Charlson, A., Heaton, R., Suc, C., & Ahmed-Kristensen, S. (2024). Material passport for modular construction. *IET Conference Proceedings* CP885, 2024(11), 159–164. https://doi.org/10.1049/icp.2024.3501

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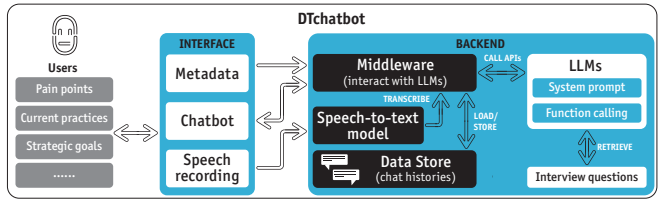
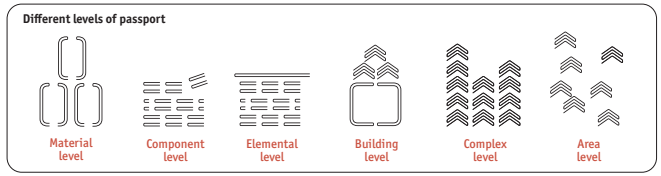
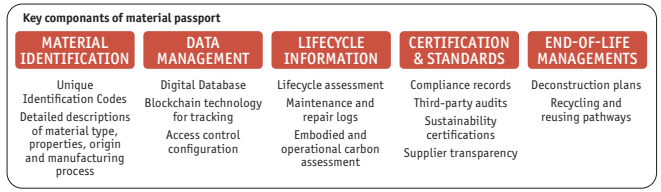
Zheng, J., Yilmaz, G., Han, J., Ahmed-Kristensen, S. (2025). Digital Transformation Chatbot (DTChatbot): Integrating Large Language Model-based Chatbot in Acquiring Digital Transformation Needs. *HCI International 2025* – Late Breaking Papers. HCII 2025. Lecture Notes in Computer Science, Springer.





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> "From insight to impact: adopt BIM and Material Passports, and utilise an LLM-based DTchatbot to fast-track digital transformation."

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