# DIGITAL TRANSFORMATION IN THE BUILT ENVIRONMENT

**Overview:** The aim of this case study is to bridge the digital divide in the construction sector, fostering sustainability and circularity through digital transformation. The case study seeks to enhance traceability, resource efficiency, and data-driven decision-making by implementing a 'Material Passport' to identify physical resources entering into the construction supply chain (MP). The objectives include developing a BIM-based MP, a Building Information Modelling (BIM) capability assessment tool, with the ultimate objective of enabling data integration across asset lifecycles.

Partners Involved:

- **Network Rail**: Infrastructure owner and operator, focused on enhancing the UK railway sector's digital readiness and BIM integration.

- **Natural Building Systems (NBS)**: SME and construction product supplier dedicated to sustainable building components, engaging in MP-based supply chain transparency.

The case study aligns closely with DIGIT Lab's objectives of accelerating digital adoption and supporting sustainable, data-driven growth. By integrating digital technologies and promoting circular economy principles, this project contributes to DIGIT Lab's mission to transform industries through digital innovation and advanced data utilisation.

Challenges:

- *Legacy Systems:* Limited digital infrastructure and reliance on outdated technology in the built environment.

- *Budget Constraints:* Resource limitations that restrict comprehensive digital adoption.

- *Lack of Standardization:* Need for standardized approaches to integrate Material Passports and BIM across the industry.

- *Departmental Silos:* Difficulties in achieving cross-functional collaboration within large organizations like Network Rail.

Opportunities:

- *Sustainability:* The project supports circular economy practices and sustainable resource management.

- *Competitive Advantage:* Enhanced digital capabilities can increase productivity, traceability, and compliance with regulatory standards.

- *Innovation and Scale:* MP testbeds and readiness assessments enable real-world application, paving the way for industry-wide adoption.



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

## The aim of this case study is to bridge the digital divide in the construction sector

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## Outcomes:

**Network Rail:** Evaluated the current BIM capability assessment of Network Rail, offering insights based on national standards and international practices whilst also providing a self-assessment tool for analysing existing capabilities and identifying areas for improvement, ensuring they meet the UK government-mandated BIM Level 2 usage. The insights from our assessment helped Network Rail to strategically increase BIM adoption across their projects and assets.

**Natural Building Systems:** Development of an MP testbed to enhance sustainable supply chain management, product traceability, and quality control. The unique product code of each building component embedded in the MP testbed is used for quality control and assurance which will be an important part of having their product certified and tested. Physically tagging assets using the MP will increase productivity and minimise waste by up to 30%. This project is also providing valuable insights into scaling up MP implementation from testbeds to real-world industry deployments, paving the way for wider adoption.

**Overall Impact:** By empowering both Network Rail, a major infrastructure player, and NBS, a forward-thinking SME, this project delivers tangible benefits that will have a lasting impact on the construction industry's journey towards a more sustainable and digitally connected future; establishing benchmarks and standard practices for integrating digital transformation and sustainability across the built environment.

## Activities:

- *BIM capability assessments:* Conducted with Network Rail to evaluate BIM implementation. The project establishes industry benchmarks for BIM usage and digital transformation readiness, allowing other stakeholders to assess their own capabilities.

- *MP Testbed Development:* Collaborating with NBS to create MP testbeds for traceable, reusable building materials. The case study contributes to the development of new knowledge and paves the way for standardization of Material Passports, a key enabler for digital twins in construction.

- Industry Collaboration – Engaging with sector stakeholders to promote MP and BIM, unlocking the potential for economic growth and competitiveness. The MP testbed allows NBS to trace materials within their systems, improving supply chain management and promoting a circular economy.

- Shortlisted for Knowledge Exchange Awards: Early Career Bright Future Award

https://www.youtube.com/watch?app=desktop&v=_mjikI9AD4Y

- This case study highlights a pathway for digital transformation in the built environment, enabling sustainability through Material Passports and BIM. Next steps include scaling up MP implementations, expanding the BIM assessments across more industry sectors, and refining best practices for wider adoption. Upcoming initiatives include pursuing additional partnerships to expand industry impact.

## Publications and Outputs:

- Gokcen Yilmaz, Chloe Hutton, Vishnu Valsaladas, Chloe Donovan, Krista Zvirgzda, Andrea Charlson, Rachel Heaton, Christa Suc, Saeema Ahmed-Kristensen, Material Passport for Modular Construction, Low-cost Digital Solutions for Industrial Automation, 2024, Cambridge, UK
.
- Gokcen Yilmaz, BIM Capability Assessment for Improving the Efficiency of Design in Railway Projects, ICE, Infrastructure Asset Management, 2024

- Future plans include extending the project's impact through further academic and industry collaborations, as well as large-scale MP deployments and BIM capability assessments within the wider sector.



*Different levels of passport:* Material level, Component level, Elemental level, Building level, Complex level, Area level

*Key components of Material Passport:*

| Material Identification | Data Management | Lifecycle Information | Certification & Standards | End-of-Life Management |
|---|---|---|---|---|
| Unique Identification Codes. Detailed descriptions of material type, properties, origin and manufacturing process | Digital Database. Blockchain technology for tracking. Access control configuration | Lifecycle assessment. Maintenance & repair logs. Embodied & operational carbon assessment | Compliance records. Third-Party audits. Sustainability certifications. Supplier transparency | Deconstruction plans. Recycling & reusing pathways |

*Implementation Steps:* Stakeholder Engagement → Technology Integration → Pilot Projects → Policy & Standards Development → Education & Training