A Comparative Analysis of Smart Infrastructure Technology Adoption in UK Bridges, Highways, and Railways[1]

Reda Al-Baldawi [i] and Khamis Al-Romaimi [ii]

[i] bj06ar@student.sunderland.ac.uk, [ii] khamis.al-romaimi@sunderland.ac.uk
Faculty of Business and Technology, School of Computer Science and Engineering, University of Sunderland. UK

Abstract

While various British Standards and international frameworks exist to assist in the project management of smart infrastructure projects, they do not contribute to the discussion of the means of governing digital infrastructure adoption within these projects. The purpose of this article is to discuss three projects that are developing smart infrastructure: the construction of a digital twin for the Staffordshire bridge of Network Rail, the construction of a digital twin for the A1(M) motorway, and the development of the High Speed Two (HS2) railway between major cities of the United Kingdom. Each of these projects will be reviewed for their compliance with British Standards, digital tools, and governance models for each project. The study employed theories of program and project management (P/PM) to review these projects: Benefits Realization Management (BRM), the Organizational Project Management Maturity Model (OPM3), models of change management (Kotter; ADKAR), and the framework for Enterprise Governance of IT (EGIT). Each of these theories allows for an understanding of the digital adoption of infrastructure within each of these projects, as well as the extent to which each is embedded within a governing body. Each of the projects revealed the extent to which digital technology adoption is embedded within a governing body for smart infrastructure projects. The results of these analyses permit an understanding of how the standards and frameworks for governing smart infrastructure projects are necessary but not sufficient for effective project management, and provides a framework for P/PM staff to address the gaps in existing frameworks.

Keywords: smart infrastructure; asset management; BIM; digital twin; British Standards; project governance; enterprise governance of IT; benefits realization management

[1] How to cite this paper: Al-Baldawi, R., Al-Romaimi, K. (2026). A Comparative Analysis of Smart Infrastructure Technology Adoption in UK Bridges, Highways, and Railways, PM World Journal. Vol XV, Issue IX, September.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

1. Introduction

The bridges, highways, and railways of the United Kingdom are all beginning to be managed through digital technologies, such as Building Information Modelling (BIM), Digital Twins, the Internet of Things (IoT), and Geographic Information Systems (GIS). Zhou et al. (2024) investigated the use of BIM and GIS software platforms within a large highway construction project, and found that using these technologies improved the management of construction crews and their safety on the road. Furthermore, National Highways, the organization responsible for England's highways, has committed to the digital management of those highways (National Highways, 2021). However, an independent review of the organization by the Office of Rail and Road (2024) found that the organization had published plans for the development of "Digital Roads" within its publications, but there were no digital initiatives for the management of England's Road systems that were currently underway.

The gap between the digital ambitions of public sector organizations and the governed delivery of their program and projects is rarely discussed in terms of program and project management (P/PM). Much of the existing literature on the digital and infrastructural transformation of public sector organizations has focused upon the digital technologies that have been adopted by those organizations (BIM, Digital Twins, IoT, GIS, etc.), rather than discussing how those technologies have been incorporated into P/PM governance of those organizations. Consequently, this article seeks to fill that gap in the literature by investigating in what ways the British Standards and international best practice in the digital transformation of public sector organizations are (or are not) incorporated into the governance of the UK's bridges, highways, and railways, and by reviewing which theories of P/PM can help to explain such a lack of incorporation of digital standards and practices by those organizations.

2. Literature Review

2.1 Standards and Asset Management Frameworks

The international standard for asset management is ISO 55000, which defines a set of activities that an organization undertakes to achieve value from its assets (International Organization for Standardization, 2024). This standard does not contain any sector-specific guidelines, and is therefore generic across different industries. Within the UK, there are additional standards in specific sectors. For instance, the construction and maintenance of highways are overseen by National Highways and their Design Manual for Roads and Bridges (National Highways, 2024). For the UK's railway system, the Office of Rail and Road controls the industry and found the rail infrastructure firm Network Rail to have mismanaged the railway during Control Period 7, leading to a £43.1 billion

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

settlement from the company (Office of Rail and Road, 2023). The international standard for information management within the construction and operation of assets is ISO 19650. ISO 19650 is based on the guidelines of the UK's PAS 1192 standard and the UK BIM Framework (UK BIM Framework, 2020). Thus, the UK's domestic guidelines have become the basis for an international standard for information management in the construction and operation of transport assets. This point on the relationship between the UK and international standards is returned to in the Discussion section of the paper.

2.2 Digital Technology Research in Infrastructure

Nhamage, et al. (2025) examined over 130 studies on Digital Twin strategies for bridges and found that Building Information Modelling and IoT sensor networks were effective technical methods for bridges but that there was a lack of engineering management of these Digital Twin strategies. Similarly, Mohammed et al. (2025) examined 600 studies on GIS methods for bridge management and identified that three technical methods were lacking within the field: AI methods, GNSS systems, and IoT methods. Jiang et al. (2022) created a Digital Twin model of a motorway using only the data from the map from which the model was downloaded, bypassing the need for a physical survey of the road. Furthermore, Al-Ali et al. (2024) created an IoT system for monitoring bridge health that used fuzzy logic to alert engineers of potential issues with those bridges. While each of these case studies indicate the technical feasibility of implementing these methods, each studied bridge and created Digital Twin was outside of the UK compliance standards that are examined in this article.

2.3 Programme and Project Management Theoretical Frameworks

Existing digital-infrastructure literature rarely engages explicitly with established P/PM theory. Four frameworks are used in this article to interpret the case evidence.

Benefits Realization Management (BRM). Defines how a digital initiative should be treated as a change program with identifiable business case values (Project Management Institute, 2016). Love *et al.* (2014) created a framework for building information modelling (BIM) for asset owners as a continuous process of learning and identifying benefits from the BIM software, which is information that can be used to understand the digital initiatives of organizations like National Highways, Network Rail, and HS2.

The Organizational Project Management Maturity Model (OPM3). The PMA maturity model, published by the Project Management Institute, rates the level of maturity of project, program and portfolio management within an organization on a scale of standardization, measurement and control to continuous improvement (Project Management Institute, 2003). The continuum model allows for each of the cases within

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

this article to be compared in regard to how far along they have progressed along this scale.

Change management models. Kotter's (1996) eight-step model and the Prosci ADKAR model (Awareness, Desire, Knowledge, Ability, Reinforcement) - both describe the process by which an organization moves from its current state to a desired future state. Kotter's model places emphasis on steps for the organization as a whole, whereas the ADKAR model focuses on the individual steps that must be followed for successful adoption of change. Therefore, change made through only an exploratory pilot that has not been anchored to the organization and individuals would have stalled at some point prior to the later stages of Kotter's model.

Enterprise Governance of IT (EGIT). is defined by Van Grembergen and De Haes (2009, cited in De Haes et al., 2020) as the structures, processes, and mechanisms that organizations employ to enable alignment between IT investments and value/ Accountability. The authors note that the implementation of these governance mechanisms does not necessarily ensure alignment between IT and strategic business objectives (De Haes et al., 2020). A finding that relates directly to the article's own findings on the relationship between the two concepts.

2.4 Professional and Process Standards

At the professional level, the UK Standard for Professional Engineering Competence and Commitment (UK-SPEC) by the Engineering Council lays out the expectations of individual engineers (Engineering Council, 2020). The Project Management Institute's PMBOK Guide is a standard process used globally in project management, structured around twelve principles and eight performance domains (Project Management Institute, 2021). In both cases, there is no mention of how digital governance can be applied within an infrastructure domain. A recent systematic review of the literature on digital technologies in building and infrastructure projects conducted by Papadonikolaki *et al.* (2022), which analysed 87 scientific journal articles, also found that most studies looked at the impact of digital technology on individual projects, but there were few studies investigating digital governance within organizations in the construction and built environment.

3. Research Questions

Drawing on the gap identified above, this article addresses one main research question and three sub-questions.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

Main research question: How are British Standards and international best practice incorporated into the governance of digital technology adoption across UK bridges, highways, and railways?

- **RQ1:** What governance mechanisms, if any, connect digital tool adoption (BIM, Digital Twin, IoT, GIS) to standards compliance in each case?
- **RQ2:** Read through BRM, OPM3, change management, and EGIT lenses, what stage of organizational maturity does each case represent?
- **RQ3:** What practical implications follow for P/PM practitioners responsible for procurement, capability-building, and multi-stakeholder oversight of smart infrastructure programs?

4. Research Methodology

This is a qualitative research study that employs a desk-based methodology. According to Saunders, Lewis and Thornhill (2023), the study adopts an interpretivist and pragmatist research philosophy, using a case study research design to investigate three different cases within the transport infrastructure domain. No data was collected directly from the case study participants. Specifically, no interviews, surveys or field visits were conducted. All the data used in the research comes from secondary sources only. Secondary sources include published academic literature, transport and infrastructure industry journals, and the official documentation of the transport infrastructure projects investigated. Each of the three cases that were selected for investigation includes the use of at least one of the digital technologies (BIM, Digital Twin, IoT or GIS) and makes available for review the documentation of the projects that used these technologies. Also, Figure 1 explains the process flow for the study. Moreover, the findings from each of the cases were compared along seven different dimensions before being interpreted through the lens of the four P/PM frameworks introduced in Section 2.3.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

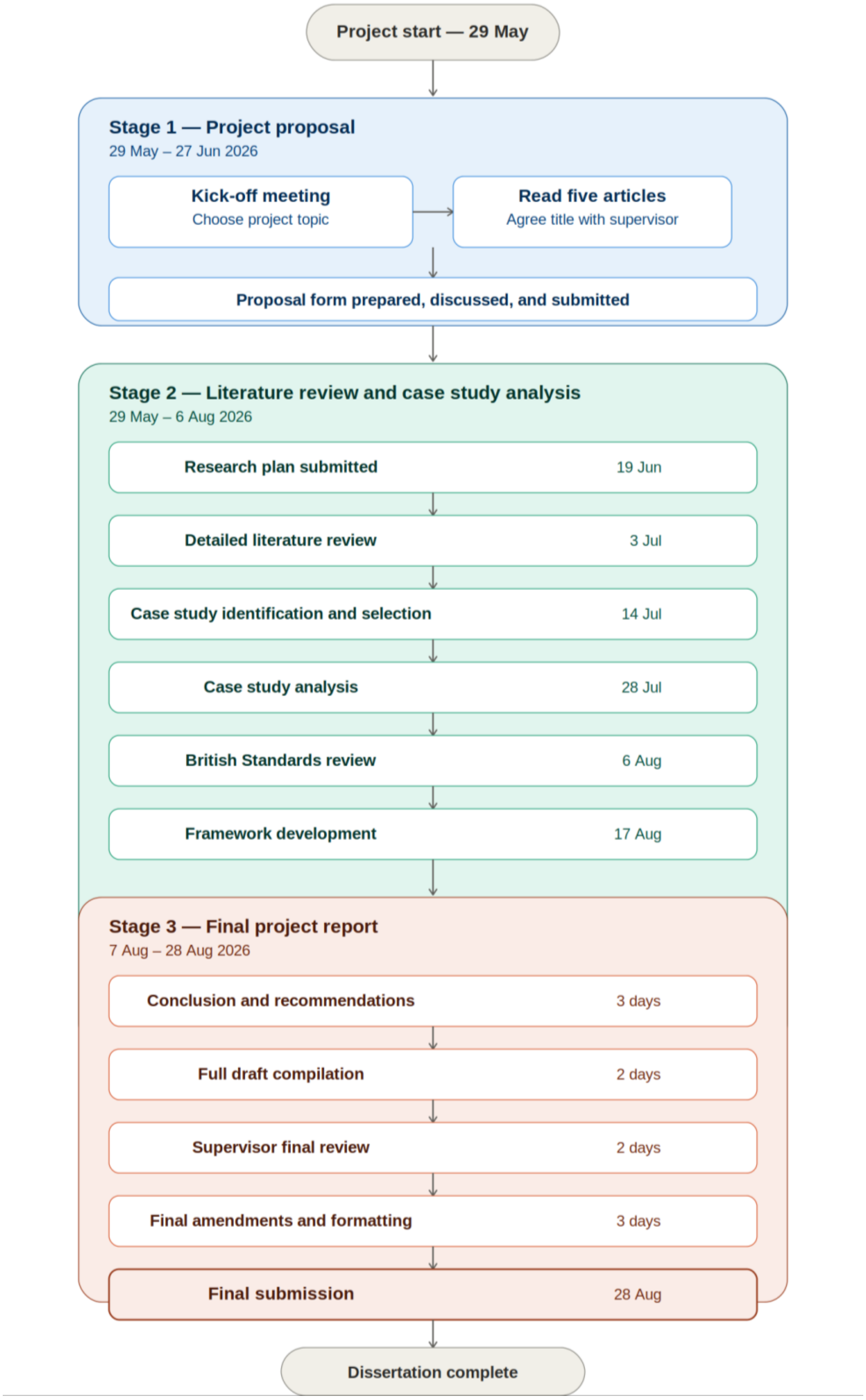

Figure 1: Study Process Flow Diagram

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

5. Findings

The bridge case study is the Staffordshire Bridges project conducted by Network Rail to instrument two new bridges with fiber optic sensors to create a Digital Twin of the bridges for condition monitoring (Centre for Smart Infrastructure and Construction, Centre for Digital Built Britain, 2021). Network Rail manages over 28,000 bridges, many of which are older than 150 years. The highest level of structural assessment of the bridges is rarely used due to the lack of instrumentation along the bridge to measure the loads from the passing trains (Centre for Digital Built Britain, 2021). This project was developed as a research prototype that is not currently used by Network Rail.

The highway case is based upon the Digital Twin model established by Jiang et al. (2022), who constructed a centimeter-accurate model of a 6.3-kilometre section of the A1(M) motorway from downloaded map data. This is the only example of standards linkage in the study. The authors constructed the cross-section and lane width of the road from the documents published by the National Highways organization.

The railway case is based upon the use of BIM by the HS2 railway project in the UK. The use of BIM was made mandatory for all construction projects by the 2016 Construction Strategy of the UK government, and through the use of a Common Data Environment (Alberola and Ruff, 2020; Fancourt et al., 2020). HS2 is the only company in this study that uses BIM, Digital Twin, GIS and IoT sensors within a project. The main civils contracts for HS2 were awarded on the NEC3 Engineering and Construction Contract, Option C. This contract is mandated for public sector construction works by the UK Cabinet Office, and has been used by HS2 for all of its Phase One construction works.

Table 1 summarizes the three cases along the seven dimensions: digital tools, standards linkage, governance mechanism, institutional driver, procurement model, an OPM3-consistent maturity reading, and disclosures regarding the expected benefits or return on investment of the e-government initiatives. Two dimensions that would ideally be included in a table comparing the cases as practitioners - Technology Readiness Level and return-on-investment horizon - are instead simplified to a single row because neither of these factors is disclosed in any of the three cases. The absence of such a disclosure is, however, a finding that is discussed in Section 6.3.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

Table 1: Comparative summary of the three cases across seven evidenced dimensions

Dimension	Bridges (Staffordshire)	Highways (A1(M))	Railways (HS2)
Primary digital tools	Digital Twin + BIM (data management)	Digital Twin + GIS (map-derived)	BIM + Digital Twin + GIS + IoT
Standards link (documented)	General bridge assessment context only	DMRB cited by document number (CD 109, CD 127, CD 226, CG 501)	UK BIM Mandate (2016); ISO 19650 lineage
Governance mechanism	None documented (exploratory)	Design-level only (standards embedded in twin logic)	Programme-level, contractual (Common Data Environment)
Institutional driver	Academic-research collaboration (Cambridge CSIC)	Academic research (UCL, Huazhong University)	Client-mandated across supply chain (HS2 Ltd)
Procurement / contract model	Not disclosed in available sources	Not applicable (research study)	NEC3 Engineering and Construction Contract, Option C
OPM3-consistent maturity reading	Standardization stage	Standardization stage	Measurement-and-control stage
Benefits / ROI disclosure	Not disclosed in available sources	Not disclosed in available sources	Not disclosed in available sources

6. Discussion

6.1 Answering the Research Questions

RQ1 - Governance mechanisms. Only the HS2 project demonstrates an explicit (and contracted) IT system to link IT to standards compliance. The highway project demonstrates a design-level mechanism for linking IT to standards compliance, but not a program-level mechanism. The bridge project demonstrates no link between IT and standards compliance.

RQ2 - Organizational maturity. OPM3's model places the bridge and highway projects at the stage of standardization, while the HS2 CDE represents the stage of measurement and control. Kotter's model shows that the bridge and highway projects are in the initial stage of change implementation, while the HS2 CDE represents an established change.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

The benefits case and the tracking of the benefits of a new digital investment in the transport sectors are neither mentioned in any of the three cases. This finding refutes the argument of Love et al. (2014) that the adoption of BIM should be a continuous process with the tracking of the benefits of such an adoption. Furthermore, the CDE that HS2 has implemented is a governance process in place to manage the construction of the high-speed railway, while the other two projects showed only the technological capabilities of their infrastructure projects. This finding supports the argument of De Haes et al. (2020) that the establishment of a governance process does not necessarily result in the establishment of a structure of an infrastructure project itself.

RQ3 - Practical implications. These are developed in full in Section 7.

6.2 The Standard-Setting Paradox, Revisited

The PAS 1192 framework that underpins the ISO 19650 standard (UK BIM Framework, 2020) is the framework that the Office of Rail and Road (2024) found to be difficult to measure within the works of National Highways. Thus, while the PAS 1192 and ISO 19650 frameworks may provide a foundation for digital delivery within the UK and Europe, it does not ensure that those digital initiatives will be successfully implemented within the infrastructure projects of individual countries. Furthermore, as the Office of Rail and Road has indicated, the construction of the HS2 railway is one of many projects that has built the structures and processes necessary to ensure that the EGIT framework is followed within the project.

6.3 Cybersecurity, Interoperability, and Legacy Systems

In none of the three cases' documented efforts is there any discussion of cybersecurity governance in particular. The United Kingdom's Network and Information Systems Regulations 2018, for instance, already classify transport as one of the sectors that is to be regulated in the United Kingdom regarding its "Operators of Essential Services," and the Cyber Security and Resilience Bill (introduced to Parliament in November of 2025) will expand upon those regulations to include critical suppliers within the supply chain - an aspect of both HS2 and its subcontractors' CDEs. Furthermore, the ISO/IEC 27001:2022 standard for information security management systems (which includes 93 different controls regarding people, physical, technical, and organizational aspects of information security) could be integrated with the ISO 19650 standard for information management that is already in use in HS2's construction project, but none of the available sources for this article indicate that such an integration has been completed.

The legacy physical assets also compound the problem. Network Rail's own evidence shows that most of its 28,000 bridges cannot be instrumented at all; so, the interoperability specifications have to account for bridges with no data at all. Furthermore, the fact that retrofitting sensors onto a 150-year-old bridge is a different problem from including sensor capabilities in a new-build HS2 bridge is likely the reason for the maturity gap in the first place - independent of the will of the organization to adopt such technologies.

7. A Practical Framework for P/PM Practitioners

Building on Sections 5 and 6, four practical actions are proposed for program and project management practitioners responsible for smart infrastructure delivery.

1. Treat digital governance as a BRM-tracked benefit, not a one-off deployment. Following Love et al. (2014), asset owners should define the benefits case for each digital initiative with owners and review points for the initiative, rather than merely determining that the pilot phase of the initiative has created value for the company.

2. Build the governance mechanism into procurement, not around it. HS2's experience shows that a collaborative contract with a target cost clause, such as the NEC3/NEC4 Engineering and Construction Contract, can be effective in embedding digital and data contract requirements within the construction contract. Any parties who own bridge and highway assets who wish to construct digital pilots for these projects should include data and digital standards within the construction contract.

3. Close capability gaps deliberately, using both Kotter and ADKAR. Kotter's model points the leadership of the program toward gaining mandate and anchoring the change at the organization; ADKAR points toward the building of the individual capabilities within the site teams and asset managers. Considering these two models together as applicable to the situation simultaneously resolves both of the questions regarding the reasons for the stall at the pilot stage and who is capable of utilizing the digital tool.

4. Establish multi-stakeholder PMO oversight with explicit cyber-resilience and legacy-asset scope. Alongside the tightening of the UK's regulatory position on cybersecurity (the NIS Regulations 2018 and the Cyber Security and Resilience Bill) there will need to be a program management office to oversee digital infrastructure investments - with cybersecurity and the feasibility of retrofitting cybersecurity controls onto the legacy assets to be standing agenda items for that office.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

8. Conclusions, Limitations, and Future Research

8.1 Theoretical Contributions

This article makes three contributions to the P/PM theory of infrastructure delivery. Firstly, it demonstrates that management frameworks developed outside of the area of infrastructure delivery, such as BRM, OPM3, Kotter/ADKAR, and EGIT, can be applied to the case study evidence of smart infrastructure projects to reveal findings that would not have been obtained through a technology-focused analysis of that same evidence. Secondly, it extends the "governance gap" that has been identified in the literature regarding infrastructure and digital transformation (Nhamage *et al.*, 2025; Papadonikolaki *et al.*, 2022) to the area of infrastructure delivery. Thirdly, it makes explicit that the absence of case studies on smart infrastructure projects that disclose information regarding the benefits that were provided by the implementation of those technologies and their ROI represents a gap in the governance of the delivery of infrastructure projects overall.

8.2 Limitations

This study is based on three cases that have been purposefully selected for this study and cannot provide statistical generalization from the results of this study. Furthermore, all of the data that has been collected is secondary data from published research and cannot account for undocumented activities of these practitioners. The lack of a governance system or case for the benefits of these bridges and highways is only based on the published research of these case studies rather than the actual practice of these practitioners that may be documented but not yet published. The application of the various models, including BRM, OPM3, Kotter, ADKAR, and EGIT were based upon interpreting the cases studies rather than applying any primary data to verify the stages of maturity that are proposed in Section 6.1 of this article.

8.3 Future Research

Three bounded directions for future research follow. First, performing primary research in the form of interviews with the project directors, asset managers, or the PMO leads for each of the organizations (National Highways, Network Rail, and HS2) could reveal whether the readings of OPM3 and EGIT that are proposed in this article match those of the organizations themselves. Second, performing research into the long-term ROI and benefits that have been realized from the Digital Twin investments into these post-occupancy management organizations is a research topic that could be pursued, as there were no public disclosures on such ROI in this article. Third, investigating whether the UK's new cyber-resilience regulations are being incorporated into the BIM and ISO 19650

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

practices of these organizations would be a research topic that could extend the discussion on cybersecurity within Section 6.3 of the article beyond what is currently published in public communications from the organizations.

References

Al-Ali, A.R., Beheiry, S., Alnabulsi, A., Obaid, S., Mansoor, N., Odeh, N. and Mostafa, A., 2024. An IoT-based road bridge health monitoring and warning system. Sensors, 24(2), p.469.

Alberola, R. and Ruff, P., 2020. Towards a Digital Blueprint: data, technology and collaboration at the core of HS2.

Centre for Digital Built Britain, 2021. Digital Twin Journeys: Understanding the information need, a bridge to better information management.

De Haes, S., Van Grembergen, W., Joshi, A. and Huygh, T., 2020. Enterprise Governance of Information Technology: Achieving Alignment and Value in Digital Organizations. 3rd ed. Cham: Springer.

Engineering Council, 2020. UK Standard for Professional Engineering Competence and Commitment (UK-SPEC). 4th ed. London: Engineering Council.

Fancourt, S., Redfern, V., Thompson, D. and Whitehorne, D., 2020. Soils, Landscape and Woodland: How HS2 is using integrated asset information management in a BIM environment.

HS2 Ltd, n.d. Digital Engineering and BIM.

International Organization for Standardization, 2024. ISO 55000:2024. Asset management - Vocabulary, overview and principles. Geneva: ISO.

International Organization for Standardization/International Electrotechnical Commission, 2022. ISO/IEC 27001:2022. Information security, cybersecurity and privacy protection - Information security management systems — Requirements. Geneva: ISO/IEC.

Jiang, F., Ma, L., Broyd, T., Chen, W. and Luo, H., 2022. Building digital twins of existing highways using map data based on engineering expertise. Automation in Construction, 134, article 104081.

Kotter, J.P., 1996. Leading Change. Boston, MA: Harvard Business School Press.

Love, P.E.D., Matthews, J., Simpson, I., Hill, A. and Olatunji, O.A., 2014. A benefits realization management building information modeling framework for asset owners. Automation in Construction, 37, pp.1-10.

Mohammed, B.Y., Khalifa, N.A., Seyed Hakim, S.J., Shahidan, S.B. and Ali, S., 2025. Bibliometric analysis of GIS studies for bridge management: Trends, challenges, and future directions. Applied Geomatics, 18, article 35.

National Highways, 2021. Vision set out for a once-in-a-lifetime digital revolution that will fundamentally change National Highways' roads.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

National Highways, 2024. Design Manual for Roads and Bridges (DMRB).

Nhamage, I.A., Horas, C.S., Dang, N.S., Campos e Matos, J.A. and Poças Martins, J., 2025. Strategies for maximising the value of digital twins for bridge management and structural monitoring: a systematic review. Archives of Computational Methods in Engineering, 32(7), pp.4555-4586.

Office of Rail and Road, 2023. Periodic Review 2023 (PR23): Final Determination. London: Office of Rail and Road.

Office of Rail and Road, 2024. A review of the delivery and impact of National Highways' digital, data and technology (DDaT) strategy and progress against its Digital Roads Roadmap. [pdf] London: Office of Rail and Road.

Papadonikolaki, E., Krystallis, I. and Morgan, B., 2022. Digital technologies in built environment projects: review and future directions. Project Management Journal, 53(5), pp.501-519.

Project Management Institute, 2003. Organizational Project Management Maturity Model (OPM3). Newtown Square, PA: Project Management Institute.

Project Management Institute, 2016. Benefits Realization Management Framework. Newtown Square, PA: Project Management Institute.

Project Management Institute, 2021. The Standard for Project Management and A Guide to the Project Management Body of Knowledge (PMBOK Guide). 7th ed. Newtown Square, PA: Project Management Institute.

Saunders, M.N.K., Lewis, P. and Thornhill, A., 2023. Research Methods for Business Students. 9th ed. Harlow: Pearson.

UK BIM Framework, 2020. Information management according to BS EN ISO 19650: Guidance Part 2 - Processes for project delivery. 4th ed. [pdf] London: UK BIM Framework.

UK Parliament, 2025. Cyber Security and Resilience (Network and Information Systems) Bill 2024-26.

Van Grembergen, W. and De Haes, S., 2009. Enterprise Governance of Information Technology: Achieving Strategic Alignment and Value. New York: Springer.

Zhou, D., Pei, B., Li, X., Jiang, D. and Wen, L., 2024. Innovative BIM technology application in the construction management of highway. Scientific Reports, 14(1), p.15298.

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi

About the Authors

Reda Al-Baldawi

Sunderland, United Kingdom.

Reda Al-Baldawi holds a BSc in Civil Engineering from the University of Technology, Iraq and is currently MSc student in Engineering Management at the University of Sunderland, United Kingdom. Interested and 4 years' experience in civil site engineering, planning, construction and engineering management fields such as project risk, quality management, asset management and project delivery. Completed additional training in project management, Agile methodologies, strategic planning, and occupational health and safety. He can be contacted at Redaalbaldawi11@gmail.com

Khamis Salim Al-Romaimi, PhD

Sunderland, United Kingdom

Dr Khamis Salim Al-Romaimi is lecturer in Engineering, Faculty of Business and Technology, School of Computer Science and Engineering, Sunderland, United Kingdom. He completed his PhD from University of Sunderland. He received MSc degree in Electrical Utility Engineering from Curtin University of Technology, Australia. He received Bachelor of engineering in Automatic and Control System Engineering from University of Sheffield, UK. He published various publications in electrical engineering, project management and asset management. His employment experience in electricity and water sectors in operation, maintenance, data analysis, strategic planning, program management, asset planning, economics, system studies, design, projects management, load dispatch center, risk management, asset management and business continuity development.
He can be contacted at Khamis.al-romaimi@sunderland.ac.uk

© 2026 Reda Al-Baldawi and Khamis Al-Romaimi