UNIVERSITY OF CAMBRIDGE

Construction Engineering Masters

# Construction Engineering Masters Dissertation Conference

11 July 2025

www.construction.cam.ac.uk/education/cem

Construction Engineering Masters

The CEM programme was launched in 2011 with industry partner Laing O'Rourke to fulfil a shared vision of transforming the construction industry through innovation, education and technology.

# Table of Contents

UNIVERSITY OF CAMBRIDGE

Construction Engineering Masters

## Welcome

A warm welcome to current students, lecturers, supervisors, colleagues, alumni and special guests to the 2025 Construction Engineering Masters (CEM) Dissertation Conference. Today is an important event in the CEM calendar. It provides the opportunity for us to share with you the insights emerging from the latest research conducted as part of the CEM over the past year. As you will see from today's schedule, a wide range of thought-provoking topics will be covered.

The CEM programme is in a unique position to support research that is highly relevant to industry. Our students—who are experienced practitioners—draw on their own knowledge and experience of professions connected to construction to shape a relevant topic for enquiry. We connect students with academic supervisors from a range of disciplines (including engineering, sociology, finance, law and management) to provide guidance. We very much encourage this mixing of disciplines; what results is an insightful blend of subject areas and findings, all of which can help improve the construction sector in a meaningful way.

Today you will be hearing from the thirteenth cohort of the CEM programme who are nearing the end of their research journey and are due to submit their dissertations at the end of July. This cohort have the opportunity today to present and test their findings with a wider audience as they enter the final stage of completing their research.

We have allocated some time for questions after each presentation, and we encourage you to engage with the speakers to find out more about their research and its implications for the construction sector.

I hope that you enjoy the day and make the most of the opportunity to learn and network.

Thank you for joining us.

**Dr Gavin Davies**
**CEM Director**
**June 2025**

# How the conference will work

## In-person Participation

The conference is being held at the Institute for Manufacturing, Alan Reece Building, 17 Charles Babbage Road, Cambridge, CB3 0FS, and also online. If you have requested parking, you will be sent details separately.

The venue will open at 08:30 for registration, and the conference will commence at 09:00. The day is split into four sessions – each session containing five to six presentation slots. Each presentation slot is 15 minutes (10 minutes for the student presentation, followed by 5 minutes of Q&A), with two minutes between each speaker to allow time for AV set up.

22 students from the thirteenth cohort of the Construction Engineering Masters will deliver presentations on their dissertation research, which span a wide range of topics and themes. Questions from the audience are encouraged during the Q&A sessions.

## Online Participation

If you are attending the conference online via Zoom, please use the details below.

- **To join:** https://cam-ac-uk.zoom.us/j/87142528069?pwd=8dkuH8i6Uoz1xNT1MOxf8akaWw9gcT.1
- **Meeting ID:** 871 4252 8069
- **Passcode:** CEMDC2025

## Procedure for Online Guests

- *WHEN TO JOIN*
  Please consult the timetable provided to ensure that you **join the room during the allotted joining times** (during the start-of-day introduction and/or during the breaks between sessions) - attendees will not be admitted into a room once a session has started. Guests may leave during a session, but they will not be allowed to re-join until the start of the next session.

- *HOW TO JOIN*
  Using the joining details above, you will enter a waiting room. Please set your Zoom name to **display your full name including your last name** so that you can be matched against the RSVP list and admitted into the conference room.

- *VIDEO AND MICROPHONE*
  By default, all attendees will enter the conference rooms with their **video off and microphone muted**. Please keep your microphone muted for the duration of the conference.

- *ASKING A QUESTION*
  During presentation slots you may use the chat function to submit your questions, privately, to the assigned marker (who will have 'host' after their name). Please ensure that you use the drop-down menu to change the recipient from 'everyone' to '…(host)'. Time permitting, the host will then read your question on your behalf.

# Schedule – Morning sessions

UNIVERSITY OF CAMBRIDGE
Construction Engineering Masters

**Venue:**
**Institute for Manufacturing, Alan Reece Building,**
**17 Charles Babbage Road, Cambridge CB3 0FS**

**Zoom**
**Meeting ID: 871 4252 8069**
**Passcode: CEMDC2025**

## 13th Annual Construction Engineering Masters Dissertation Conference

Friday, 11 July 2025 - In person and online

| | | | | | |
|---|---|---|---|---|---|
| | 08:30 | - | 09:00 | Registration (Atrium, Lower Ground Floor)/ Enter Zoom Room | |
| | 09:00 | - | 09:10 | **Dr Gavin Davies -** CEM Director<br>Welcome | Lecture Theatre 1 |
| Session A1 | 09:10 | - | 09:25 | **Michael Staunton** - Engineering Manager, Acciona<br>*Developing a Strategic Innovation Framework to Assess the Readiness of IBAA as a Low-Carbon Material* | Lecture Theatre 1 |
| | | | | Turnover time for next student to prepare | |
| | 09:27 | - | 09:42 | **Waleed Mohamed** - Senior Digital Engineering Manager, New Murabba Development Company<br>*Temporary Construction Roads Layout Planning in Mega Construction Projects* | |
| | | | | Turnover time for next student to prepare | |
| | 09:44 | - | 09:59 | **Joe Willock** - Engineering Leader, Laing O'Rourke<br>*A Framework for Utilising Activity-level Site Data During the Construction Phase of Projects* | |
| | | | | Turnover time for next student to prepare | |
| | 10:01 | - | 10:16 | **Ausra Vadapolaite** - Project Engineer, Expanded (Laing O'Rourke)<br>*Off-Site, On Point: Rethinking Reinforced Concrete Productivity* | |
| | | | | Turnover time for next student to prepare | |
| | 10:18 | - | 10:33 | **Callum Alderton** - Project Engineer, Laing O'Rourke<br>*Building Better Meetings: Examining Behaviours and Characteristics for Effective Meetings in Construction* | |
| | | | | Turnover time for next student to prepare | |
| | 10:35 | - | 10:50 | **Tiago Freire** - Associate, Civils and Bridges Engineering, WSP<br>*Corporate Growth in the Engineering Consultancy Sector: A Focus on the Environmental Sector* | |
| | 10:50 | - | 11:10 | COFFEE & TEA BREAK (Atrium, Lower Ground Floor)/ Enter Zoom Room | |
| Session A2 | 11:10 | - | 11:25 | **Riley Smith** - Director, Trimble<br>*Surveying the Future: Business Model Innovation in a Changing Land Surveying Profession* | Lecture Theatre 1 |
| | | | | Turnover time for next student to prepare | |
| | 11:27 | - | 11:42 | **David Robson** - Delivery Assurance Manager, BAM<br>*Temporal Dynamics of Relational Contracting in Strategic Construction Partnerships: An Antarctic Case Study* | |
| | | | | Turnover time for next student to prepare | |
| | 11:44 | - | 11:59 | **Janne Peltonen** - Associate Director, WSP<br>*Designer Incentives on Construction Projects* | |
| | | | | Turnover time for next student to prepare | |
| | 12:01 | - | 12:16 | **Sarah Levett** - Control Room Lead, Project Management Office, Laing O'Rourke<br>*Early Integration of Contractor Expertise in Complex Construction Projects: Client and Contractor Perspectives* | |
| | | | | Turnover time for next student to prepare | |
| | 12:18 | - | 12:33 | **James Turner** - Digital Leader, Explore Manufacturing (Laing O'Rourke)<br>*Advancing Offsite Manufacturing: Industry 4.0 and Smart Factories in the UK and Ireland* | |
| | | | | Turnover time for next student to prepare | |
| | 12:35 | - | 12:50 | **John Hopkins** - Digital Development Manager, Laing O'Rourke<br>*Assessing the Potential of CFA Piling Rig Telemetry Data for Stratigraphic Profiling and Optimised Pile Installation* | |
| | 12:50 | - | 13:30 | LUNCH (Common Room, First Floor)/ Enter Zoom Room | |

**The Conference Abstracts can be found at www.construction.cam.ac.uk/dissertation-conference-2025**

# Schedule – Afternoon sessions

UNIVERSITY OF CAMBRIDGE
Construction Engineering Masters

**Venue:**
**Institute for Manufacturing, Alan Reece Building,**
**17 Charles Babbage Road, Cambridge CB3 0FS**

**Zoom**
**Meeting ID: 871 4252 8069**
**Passcode: CEMDC2025**

## 13th Annual Construction Engineering Masters Dissertation Conference

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| | | | | | |
|---|---|---|---|---|---|
| | 12:50 | - | 13:30 | LUNCH (Common Room, First Floor)/ Enter Zoom Room | |
| Session A3 | 13:30 | - | 13:45 | **Fenella Ross** - Senior Civil Engineer, AtkinsRéalis<br>*The Impact of Technology on the Development of Technical Skills in Civil Engineers: A Case Study into the Risk of Deskilling* | Lecture Theatre 1 |
| | | | | Turnover time for next student to prepare | |
| | 13:47 | - | 14:02 | **Iradj Matboui** - Civil Engineer, Amentum (formerly Jacobs)<br>*Exploration and Improvement of the Onboarding and Integration Process for a Construction Project Design Team* | |
| | | | | Turnover time for next student to prepare | |
| | 14:04 | - | 14:19 | **Cormac McLean** - Managing Director, PDC Explosives Engineering<br>*A Novel, Hybrid Multi-Criteria Decision Making Framework for Risk Based Method Selection in Construction* | |
| | | | | Turnover time for next student to prepare | |
| | 14:21 | - | 14:36 | **Alexandra Walker** - Senior Design Manager, Laing O'Rourke<br>*Sailing Through Design: Navigating Best Practices from Shipyards to Construction Sites* | |
| | | | | Turnover time for next student to prepare | |
| | 14:38 | - | 14:53 | **Francis Eni** - Technical Director, JRL Group<br>*Is Bigger Better? Can the Use of High-strength Concrete in Reinforced Concrete Structures be Further Optimised to Reduce Embodied Carbon and Overall Costs, Particularly in Cases where Precast Elements are Utilised?* | |
| | 14:55 | - | 15:05 | COFFEE & TEA BREAK (Atrium, Lower Ground Floor)/ Enter Zoom Room | |
| Session A4 | 15:05 | - | 15:20 | **Robert Cleary** - Senior Project Manager, Laing O'Rourke<br>*The Impact of Procurement on Project Performance* | Lecture Theatre 1 |
| | | | | Turnover time for next student to prepare | |
| | 15:22 | - | 15:37 | **Bart Drazyk** - Project Engineer, Laing O'Rourke<br>*The Effects of Introducing Automation of Rebar Placement on the Construction Workforce* | |
| | | | | Turnover time for next student to prepare | |
| | 15:39 | - | 15:54 | **Arya Ambujakshan** - Design Manager, Laing O Rourke (Middle East)<br>*Perceptions of Psychological Safety in Construction* | |
| | | | | Turnover time for next student to prepare | |
| | 15:56 | - | 16:11 | **Nicholas Berg** - Asset and Operational Performance Manager, E.ON<br>*How can Risk-Based Asset Management Influence Asset Prioritisation* | |
| | | | | | |
| | 16:13 | - | 16:20 | **Dr Gavin Davies -** CEM Director<br>Closing address | |
| | 16:20 | - | 17:00 | DRINKS RECEPTION AND NETWORKING (Common Room, First Floor) | |

**The Conference Abstracts can be found at www.construction.cam.ac.uk/dissertation-conference-2025**

# Dissertation Research Abstracts

This section presents the abstracts of the dissertation presentations featured in this year's conference, presented in alphabetical order. These Dissertation Abstracts can also be found at www.construction.cam.ac.uk/dissertation-conference-2025 in presentation order.

# Developing a Strategic Innovation Framework to Assess the Readiness of IBAA as a Low-Carbon Material


## Michael Staunton

Engineering Manager

Acciona


The global push for decarbonisation is driving urgent demand for scalable, low-carbon material innovations. However, many technically viable solutions remain commercially or systemically unadopted. This dissertation addresses that challenge by developing a strategic innovation readiness framework that integrates technological and commercial maturity with systemic adoption dynamics.

The framework combines two established maturity models, Technology Readiness Levels (TRL) and Commercial Readiness Index (CRI), into a novel matrix designed to support clearer navigation of innovation pathways. This is further enhanced by systemic functions drawn from Technological Innovation Systems (TIS) theory. The Innovation Readiness Framework has been developed for low-carbon material innovation and introduces maturity zones, diagnostic navigation zones and strategic "bridges" to highlight both barriers and opportunities for progress.

The focus of this research is Incinerator Bottom Ash Aggregate (IBAA), trialled as a supplementary cementitious material (SCM) in concrete applications. IBAA serves as the embedded case study through which the framework is grounded and tested, although the resulting model is designed to be transferable across innovation types and sectors, beyond low-carbon materials.

The framework was applied to the IBAA case to test its clarity, strategic value and alignment with the current state of research and industry observations. IBAA was positioned at a readiness of TRL 5 and CRI 2, revealing a gap between proven technical performance and early-stage commercial recognition. This gap highlights systemic barriers relating to policy acceptance, certification pathways and market uptake. These insights informed a revised commercialisation strategy targeting key bridging actions, including social perception and market fit. By establishing a common language for evaluation and readiness, the framework enhances collaboration and expands the strategic toolkit available to those supporting innovation adoption.

The study uses a design-oriented, mixed-methods approach, drawing upon industry survey, expert interviews and user evaluations with low-carbon material startups to ensure the model is empirically grounded and practically useful. The resulting framework enables stakeholders, including innovators, funders and policymakers, to position an innovation, understand the system-level challenges it faces and to plan informed, strategic interventions.

Initiated through the case of IBAA, this work contributes a generalisable tool for assessing and accelerating innovation adoption across sectors in support of the low-carbon transition.

# Temporary Construction Roads Layout Planning in Mega Construction Projects


## Waleed Mohamed

Senior Digital Engineering Manager
New Murabba Development Company


Mega construction projects, due to their complexity and large scale, require robust and adaptive logistics strategies to ensure the timely and cost-effective delivery of construction activities. One of the most critical components of site logistics is the planning and placement of Temporary Construction Roads (TCRs). TCRs, due to their dynamic nature and critical function, can have significant impacts on safety, cost, execution time, and other aspects if not planned properly. TCR layout planning has received less attention in academic literature compared to broader Construction Site Layout Planning (CSLP) topics. This dissertation studies the feasibility of developing a decision-support solution tailored specifically for temporary road planning in large-scale construction environments.

The aim of this research is to understand the decision-making processes of logistics professionals on actual construction sites and to identify the specific factors that consistently influence TCR layout planning such as road safety, cost of operation, terrain condition and others. A secondary aim is to critically examine how these factors are addressed in existing academic and computational solutions, highlighting any gaps between theory and practice.

This exploratory research adopts a mixed-methods approach, combining surveys and semi-structured interviews with construction and logistics experts working on a range of mega construction projects across diverse geographical regions, followed by a thematic analysis providing insights into the decision-making constraints and drivers.

The literature on computational solutions in Construction Site Layout Planning (CSLP) and Temporary Construction Road (TCR) planning reveals a wide range of methodologies and solutions. However, most of these solutions show limitations in addressing some of the practical decision-making factors highlighted by logistics experts in this study.

The findings highlight some gaps between the factors identified by the experts and those considered in academic models. Road durability/longevity and safety emerged as critical concerns and were cited as primary constraints for logistics experts, but they were found to be inadequately addressed in the reviewed research.

In conclusion, while each construction site presents unique challenges, there is a core set of factors that repeatedly influence TCR planning decisions. Recognizing and formally integrating these factors into a planning tool has the potential to support the development of automated solutions, as some models require initial input values to identify optimal solutions. This can lead to more resilient, efficient, and safer road layouts. This dissertation contributes to both academic and practical knowledge by outlining the most relevant real-world factors for TCR layout decisions, identifying the limitations of existing solutions, and recommending directions for future development.

# A Framework for Utilising Activity-level Site Data During the Construction Phase of Projects


## Joe Willock

Engineering Leader
Laing O'Rourke


The construction industry faces significant challenges, including low productivity, a lack of research and development, and slow technology advancements. Construction productivity can be defined from both macro and micro perspectives. Macro-level productivity data fails to provide sufficient insights required for productivity improvements. Productivity improvements require analysis of micro-data of the actual performance of specific projects at the activity level. Collecting activity level data often relies on manual, time-consuming methods, with the data often not effectively utilised within the construction phase of projects. Data is required to inform effective, accurate and timely decision-making. This study focuses on utilising field data at the activity level to enhance productivity through informed decision-making.

Literature highlights how technology can be utilised to assist data capture, which is required for decision-making; however, there are challenges to the adoption of these systems. This research aims to develop a framework based on the DIKW (Data, Information, Knowledge, Wisdom) hierarchy, with wisdom being the accurate, timely, and informed decisions that will improve construction project productivity. The framework looks to assist construction projects in implementing digital tools in collecting and utilising site data effectively and overcoming the barriers to implementation.

Primary data was collected through a mixed-methods approach. An exploratory investigation within a Tier 1 construction organisation was followed by a survey of 160 construction professionals from this organisation across a range of projects. The survey determined how site data, implementation of digital tools and dashboards were currently being used for the purpose of decision-making and challenges and barriers. Based on these results, a series of interviews was conducted with project decision-makers to provide insights into improving adoption and identifying potential metrics for measuring site data.

The survey identified a positive relationship between the use of digital tools and where individuals perceived productivity benefits, and improved decision-making at a site level, however site, section and senior engineer roles showed the lowest engagement in the use of site data. The interviews revealed that current barriers for this engagement included insufficient time in their role due to conflicting priorities, a lack of understanding of the value of the data, a project culture that prioritises data for management reporting over production improvement, and limited resources available to support implementation. For the use of metrics and dashboards in improving activity-level decision-making, the themes included the need for a feedback loop for data forecasting, a single source of truth, access to data across projects and sectors, and automation of data systems. A key area for improvement metrics was around quality.

These insights are incorporated into the DIKW hierarchy to provide a framework that identifies steps and challenges that need to be addressed to realise the business value (wisdom) of site data through informed decision-making. This is a preliminary study that identifies new lines of enquiry for evaluation on live projects to develop digital strategies, ensuring project team engagement and overcoming implementation barriers.

# Off-Site, On Point: Rethinking Reinforced Concrete Productivity


## Ausra Vadapolaite

Project Engineer

Expanded, Laing O'Rourke


This dissertation investigates how modern methods of construction (MMC), specifically off-site manufacturing (OSM), influence labour productivity in reinforced concrete frame buildings. The problem addressed is the persistent productivity gap within the construction industry compared to other sectors like manufacturing, where productivity has steadily increased. Construction, by contrast, has seen an 8% global decline in productivity between 2020 and 2022. This gap is critical because improving construction productivity is essential for meeting future infrastructure demands, achieving economic growth, and enhancing sustainability.

The significance of this research lies in its potential to demonstrate measurable productivity improvements through the adoption of off-site manufacturing, particularly in labour-intensive tasks such as reinforcement installation. Despite the recognised benefits of OSM—including reduced time, improved safety, and higher quality—its implementation in the UK construction sector remains limited due to design complexity, lack of standardisation, and cultural resistance to change.

To answer the research problem, a quantitative methodology was employed, using case study analysis of two projects: Project A (a large infrastructure construction site) and Project B (an off-site manufacturing facility). Data collection included primary and secondary sources, such as design documentation, non-conformance reports (NCRs), and direct productivity tracking of prefabricated reinforcement cages. Metrics such as hours per tonne, number of loose bars, and complexity levels were analysed to assess correlations and productivity outcomes.

The research concludes that off-site manufacturing significantly enhances labour productivity, particularly when product standardisation is high and complexity is minimised. For example, the prefabrication of reinforcement cages led to improved efficiency and reduced on-site labour hours. However, high cage complexity and variability in design led to significant productivity inefficiencies, with complexity Level 4 cages requiring up to 17 more hours than Level 1 equivalents. The study also found a direct correlation between design standardisation and quality outcomes, with more complex designs resulting in a higher number of NCRs.

Ultimately, the dissertation confirms the hypothesis that implementing off-site manufacturing enhances productivity in reinforced concrete construction. However, this improvement is most evident in cases involving simpler reinforcement arrangements with limited loose bars. Where cage complexity increases, the advantages of OSM are significantly reduced due to rising labour demands and coordination challenges. The research identifies key barriers, such as a lack of design standardisation and resistance to automation, that must be addressed to fully realise the benefits of OSM. The findings offer a data-driven foundation for advocating broader adoption of off-site methods in construction to bridge the sector's longstanding productivity gap.

# Building Better Meetings: Examining Behaviours and Characteristics for Effective Meetings in Construction


## Callum Alderton

Project Engineer

Laing O'Rourke



Meetings are essential for teams and organisations to function effectively, especially in knowledge-intensive sectors like construction, where they facilitate critical information sharing, creative discussions, and project management. However, persistent issues such as unclear objectives, poor structure, and counterproductive behaviours frequently undermine their effectiveness and satisfaction, leading to wasted resources and disengaged participants.

This research investigates meeting practices within a single contracting organisation, focusing specifically on project delivery meetings including design team, project management, contract, and programme meetings. Employing a mixed-methods approach, the study first used a structured survey of 163 construction professionals to identify the prevalence and impact of both effective and ineffective meeting practices on meeting satisfaction and effectiveness. Subsequent qualitative exploration through two focus groups provided rich context and deeper insights into survey responses.

The research found that construction professionals spent an average of 16.5 hours per week in meetings, exceeding averages reported in existing literature. Good practices were found to be inconsistently applied, with counterproductive behaviours prevalent across various meeting types. Survey results indicated moderate effectiveness and satisfaction, with clear areas for improvement. Specifically, statistical analysis demonstrated that meeting agendas and facilitator effectiveness significantly influenced meeting outcomes whilst certain counterproductive behaviours were found not to have the expected impact on meeting outcomes.

Focus group discussions further revealed that although participants were generally aware of good practices, inconsistent application was common due to heavy workloads, back-to-back scheduling, and poorly structured and defined agendas. These pressures lead to less productive meetings, leading participants to normalise counterproductive behaviours such as late attendance, poor time management and participants becoming distracted during meetings. The research highlights that these items are interconnected and compounding.

To overcome these challenges, the research recommends systemic interventions such as clearly defined organisational guidelines and targeted training in facilitation, agenda management, and meeting etiquette, promising meaningful improvements in meeting effectiveness, satisfaction, and overall project delivery.

# Corporate Growth in the Engineering Consultancy Sector: A Focus on the Environmental Sector


## Tiago Freire

Associate Director

WSP


According to industry reports in 2010, the environmental sector was described as “the third disruptive change in consulting, after computerisation and globalisation”. The sector has undergone rapid transformation, driven by increasing mergers and acquisitions (M&A) activity, quadrupling in volume since 2012. As a result, engineering consultancies have evolved into integrated ‘one-stop shops’ for environmental services, an ambition once considered unfeasible due to the sector’s complex and diverse service offerings. Today, these firms operate alongside management consultancies in areas such as ESG, providing similar services within the environmental and sustainability space. However, the changes in the engineering consulting sector in the context of corporate growth are under-explored.

This dissertation begins by defining the environmental sector and the wide array of services it encompasses, then explores the role of consultancies and how this has been shaped by policy, regulation, innovation, and historical context. It then focuses on the corporate growth strategies of consultancies within the sector, before turning to an in-depth analysis of M&A trends and their implications for the future of environmental consulting. Based on quantitative methods applied to data of the top 35 engineering consultancies in the environmental sector, this study examines the correlations between ownership models, acquiring history profiles, and financial performance.

In the consultancy context, the environmental services translate in 200 services, categorised as either technical or advisory, and grouped in 6 main activity areas. Whereas other engineering sectors can be identified as either being market or state driven, the environmental sector can additionally be identified as international and regulation-driven, with approximately one third of all services directly tied to legislative requirements, agreed at state or international level.

Over the past two decades, engineering consultancies have responded to rising demand for environmental services by expanding their environmental divisions. The analysis of the study of the top 5 firms shows that this sector now comprises a third of their global staff however, the overall staffing levels fluctuate cyclically. Growth has been largely inorganic, by means of M&A, with publicly listed companies (PLCs) pursuing faster expansion via M&A, while private equity-backed firms and alliances, favour organic growth. Among the 400 acquisitions by the top 35 engineering consultancies in the environmental sector, half of the acquired firms had fewer than 50 employees and were under 25 years old, with a quarter made up of pure-play environmental services. The trend highlights the risk the companies are willing to take in an industry that relies on human capital, an intangible asset, where deal value often hinges on staff retention. With global spending on sustainability and climate-related consulting projected to continue a steady growth for the coming years, further consolidation through M&A appears likely. However, the success of the ‘bigger is better’ model in the consulting and engineering space remains uncertain.

# Surveying the Future: Business Model Innovation in a Changing Land Surveying Profession


## Riley Smith

Director

Trimble


Land surveying firms face increasing pressure to adapt their business models due to technology disruption, market consolidation, and skilled professional shortage to remain competitive. While land surveying is a well-established and profitable profession, there is a lack of research available for companies looking to improve their business operations for longevity. These firms are crucial to the development and management of our built environment, and their ability to evolve directly impacts infrastructure and societal needs. Despite the recognised importance of business models across many industries there's a clear lack of research on how it applies to specialized fields like land surveying.

To investigate this problem, this research followed a two-step approach. First, a review of existing academic literature on business model innovation in the adjacent industries of manufacturing, construction, and agriculture was performed. Second, a set of semi-structured interviews was conducted with land surveying professionals experienced in ownership and decision-making roles. These participants came from firms across different geographic regions and specialties, allowing the study to capture diverse insights into their operations, the challenges they face, and their strategic approaches. A thematic analysis was performed to identify recurring patterns in business practices and challenges and highlight unique approaches to business model innovation.

The findings show that land surveying businesses often operate with distinct business models depending on their size, geographic coverage, and services. Larger firms frequently integrate surveying as a supportive function within broader engineering or construction services, while smaller firms tend to focus on specialized industries or geographic areas. Technology emerged as a complex factor, driving efficiency and new service opportunities but also introducing high startup costs and leading to the commoditization of basic measurement tasks. A recurring theme is the "workforce crisis," characterized by an aging professional base, declining enrolment in academic programs, and a noticeable reduction in traditional mentorship due in part to technological shifts. Furthermore, many firms struggle to effectively communicate and monetize the value of their specialized expertise, which often results in intense price competition. In conclusion, this study emphasizes that for land surveying businesses to achieve long-term success, they must strategically adapt their service models, invest in developing their human capital, and rethink how they present and capture the value they provide in an ever-changing market.

# Temporal Dynamics of Relational Contracting in Strategic Construction Partnerships: An Antarctic Case Study


## David Robson

Delivery Assurance Manager
BAM


The UK construction sector faces mounting technical, regulatory, and commercial complexity resulting in highly dynamic environments and often, sub-optimal outcomes. Consequently, focus on relational contracting, implemented through collaborative delivery methods such as partnering, is growing as a means to better manage multi-faceted challenges. By aligning under a framework that prescribes the quality of interactions rather than a set of exhaustive rules, these arrangements offer greater adaptability than traditional, transactionally-focused contracts.

However, empirical insight into how these partnerships evolve in a multi-project context remains limited. Most existing literature focuses on time-bound partnering at a project level, ignoring strategic partnering and implicitly treating relationship dynamics as static. Where multi-project contexts are explored, temporal change is rarely considered, with researchers typically assuming that the configuration established at inception remains appropriate for its full lifecycle. This omission contributes to inconsistent results in practice and impedes broader uptake of strategic partnering as a tool for managing construction complexity.

This dissertation adopts a case-study strategy to investigate the temporal dynamics of a long-running strategic partnership between the British Antarctic Survey and BAM. Using a sequential mixed-methods design, a cross-sectional census attempt captured perspectives on key relational drivers and Macneil's contractual norms which can be used to evaluate behavioural characteristics of relational contracts. Semi-structured interviews were subsequently conducted with senior leaders providing contextualisation and nuance to supplement the survey data.

The analysis indicates that the strategic partnership became more relational on nine of Macneil's ten contractual norms despite several headline drivers such as trust, leadership support, and goal alignment plateauing or declining. These findings suggest a threshold effect where if core drivers are sufficiently high, relational performance can continue improving via deepening interpersonal insight, even if drivers weaken. Conversely, the data revealed growing fragmentation between project and framework-level cultures. This was compounded by increasingly bespoke roles and diverging governance formality which threatened to erode a common sense of purpose.

This research contributes temporally-focused evidence that strategic partnerships behave as evolving relational systems rather than static contractual arrangements. By demonstrating that contractual norms can strengthen even while headline drivers such as trust decline, the work challenges steady-state assumptions and the notion of a simple linear relationship between key drivers and relational performance. For practitioners, the study provides actionable considerations such as the friction that emerges when formal governance is layered onto mature informal routines, the disproportionate disruption caused by staff turnover with highly bespoke roles, and the stabilising influence that understanding of partner motivations can exert, even when trust decreases. To confirm the generalisability of these findings, future research should track multiple strategic partnerships at varying temporal stages, particularly those nearing completion.

# Designer Incentives on Construction Projects


## Janne Peltonen

Associate Director

WSP



This dissertation explores how designers can be incentivised to better contribute to client objectives on construction projects. In current industry practice, designers are typically outsourced to an external organisation and appointed on contracts with limited linkage to wider project success. This presents a missed opportunity as designers can have a profound influence on project outcomes when the objectives are aligned.

The research addresses the question: How can designers be incentivised to contribute towards client objectives on construction projects? It aims to (1) collect data on the types of incentives currently applied to designer contracts; (2) identify which incentives are perceived to influence designer behaviours; and (3) evaluate the suitability of different incentives for designer appointments.

An online survey was conducted using purposive sampling, targeting construction professionals in designer roles. The survey combined quantitative analysis of closed-ended questions with thematic analysis of open-ended responses. This mixed-methods approach enabled the evaluation of both the types of incentives currently applied to designer contracts and those perceived to influence behaviour.

The findings indicate that formal incentives in designer contracts are rare and that clients do not consistently provide clear objectives for designers to pursue. Nevertheless, the respondents report high internal motivation, and not only care about the success of their projects but also show interest in contributing more meaningfully to project success. The apparent importance of values and meaning to respondents suggests that non-monetary incentives may be more effective than financial rewards in influencing their behaviour.

The high internal motivation amongst designers is an indication that the clients should prioritise setting designers clear objectives, which direct the designers towards the desired outcomes. Ideally, clients would invite designers to assist in defining the objectives, which could potentially unlock more optimal outcomes. Involving designers in collaborative decision-making could also contribute positively to their motivation by fostering trust. Trust could be cultivated further by offering designers praise and recognition for their contributions towards the set objectives.

# Early Integration of Contractor Expertise in Complex Construction Projects: Client and Contractor Perspectives


## Sarah Levett

Control Room Lead - Project Management Office

Laing O'Rourke


Academic literature and industry reports acknowledge the benefits of early contractor involvement (ECI) at the front end of the construction project life cycle. Constructability know-how, informed decision-making, relational links to the supply chain, better solutions, and early risk reduction are among the benefits reported. Despite widespread acknowledgement of the benefits and advocacy for ECI and collaboration by HM Government, the approach has not been widely adopted. Challenges to demonstrate value for money, maintain competition, and balance risk and reward remain barriers to the early integration of contractor expertise in construction projects. Fragmentation has continued to be a recurring theme in academic literature for the past three decades. Whilst the benefits and challenges are acknowledged, perceptions and motivational drivers appear to influence a contractor's early engagement, alongside the situational complexities of multi-party, multi-system interfaces prominent in modern complex construction projects.

The study explores the following research question: *How does the interplay of perceptions, motivations and complexities influence how contractor expertise is integrated at the front end of UK construction projects?* A qualitative research design, underpinned by a social constructivist worldview, was chosen to explore interpretations from lived experience as a lens to address a gap in understanding the interplay between themes of perceptions, motivations and complexities. This insight is critical to support how projects are set up from the outset to realise the intended value of ECI. Twenty-five semi-structured interviews were conducted with directors and senior leaders across nineteen major client and tier one contractor organisations, with experience spanning thirteen sectors. Interview transcripts were coded and analysed using reflexive thematic analysis.

The findings showed an inconsistency in how contractor expertise is integrated at the front end, with no one-size-fits-all approach for ECI. It was found that certain project conditions appear to intensify the case for early contractor inputs. Important enablers to integration were identified, including shared incentives, cultural alignment, process clarity and trusted relationships. Behavioural interactions were found to play a key role in the interplay of perceptions, motivations and complexities influencing the early integration of contractor expertise. Reflexive empathy was seen from consideration of the other party's perspective, suggesting a mindset position which contrasts with traditional industry stereotypes.

A distinctive strength of the study is the richness of qualitative data, which is grounded in lived experience and synthesised with literature. Practical implications of the study contribute to a deeper understanding of how clients and contractors can position themselves effectively at the front end to integrate contractor expertise at a suitable time aligned with value objectives and project complexities. Overall, the study highlights a systems-thinking maturity and a shared drive towards collaboration, long-term relationships, fairness in risk-sharing and best-for-project outcomes at the front end.

# Advancing Offsite Manufacturing: Industry 4.0 and Smart Factories in the UK and Ireland


## James Turner

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The UK construction industry continues to face longstanding productivity challenges, falling behind sectors like manufacturing, where digital technologies and smart factory approaches have helped drive greater efficiency. This research examines how Industry 4.0 technologies might help close this gap, particularly within offsite construction, where factory-based methods offer stronger alignment with digital manufacturing practices.

Despite increased policy attention, such as the Construction Playbook and the Modern Methods of Construction (MMC) definition framework, many off-site facilities in the UK still rely on traditional workflows. This raises the question: To what extent is the transformative potential of Industry 4.0 being realised in off-site manufacturing facilities, given the potential challenges around digital integration, skills, and organisational readiness?

The study investigates how Industry 4.0 is being adopted, its impacts, and the common enablers and barriers to its implementation. A mixed-methods research design was used to address this question. The sector-wide survey, though modest in scale, served as a valuable exploratory tool, providing early insights into patterns of technology uptake and helping to shape the direction of the qualitative phase. These survey findings were complemented by semi-structured interviews with industry professionals, which offered a deeper understanding of implementation practices and cultural dynamics.

Three established frameworks—the Diffusion of Innovation (DOI), the Technology Acceptance Model (TAM), and the Technology-Organisation-Environment (TOE) model—guided the analysis, offering a multi-layered view of adoption dynamics.

Findings show growing use of core Industry 4.0 technologies, including cloud platforms, IoT, and big data analytics. BIM, while not a core Industry 4.0 tool, emerged as a key sector-specific enabler, supporting more integrated workflows between design and manufacturing. However, more advanced tools like digital twins and AI remain limited in use, often due to concerns about complexity, unclear value, and integration barriers.

Some organisations are using digital tools to improve efficiency, develop new services, and reposition themselves in the market. Yet broader adoption is still held back by cultural resistance, legacy systems, uncertain returns, and limited digital awareness—challenges made more difficult by fragmented knowledge sharing across the industry.

# Assessing the Potential of CFA Piling Rig Telemetry Data for Stratigraphic Profiling and Optimised Pile Installation


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Continuous Flight Auger (CFA) piling is widely adopted due to its speed, cost-effectiveness, and minimal environmental disruption. However, a key limitation is that operators have no direct visibility of what is being drilled, making it difficult to determine when critical strata, particularly rock, are encountered in real time. This leads to conservative designs with excessive socket lengths and increased material use. This research addresses that challenge by exploring whether machine learning (ML) can identify the boundary between superficial materials and rock using high-frequency CFA rig telemetry data. Real-time predictions will allow contractors to terminate drilling more precisely, enabling optimised designs that remain safe while delivering significant commercial and environmental savings. A comprehensive methodology was developed based on literature from the construction and subsurface drilling industries. Time-series telemetry data was gathered from over 2,000 CFA piles across three UK sites. Various supervised learning models were tested, with Random Forests proving most effective when trained on manually labelled strata transitions. K-means clustering was the most successful unsupervised method, demonstrating the potential for large-scale analysis of historic data, where labelling would be impractical due to the dataset size. Feature selection techniques such as mutual information were used to reduce model complexity and improve interpretability. Boundary detection, error analysis and spatial smoothing were applied to ensure accurate practical deployment, providing safety nets for potential anomalous predictions. The results demonstrate that supervised ML approaches can reliably identify rock levels with minimal risk of under-prediction, making them suitable for use on live projects. Unsupervised approaches, while less precise, are valuable for gaining insights from historical project archives. A straightforward workflow is proposed for implementation on live projects, and a collaborative framework between contractors is suggested to enhance the model's predictive capabilities, especially if combined with other collaborative datasets containing pile load test results or sensor measurements within working piles. This research demonstrates a clear opportunity for the foundation industry to evolve its use of telemetry data, shifting from quality assurance alone to smarter, data-informed decision-making across design and construction.

# The Impact of Technology on the Development of Technical Skills in Civil Engineers: A Case Study into the Risk of Deskilling


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Civil engineers require a wide range of technical skills to solve complex problems in construction. The fourth industrial revolution (including artificial intelligence and machine learning) is expected to significantly impact the profession by replacing manual tasks, leading to improvements in quality and efficiency. However, this shift may also hinder skill development, risking professional deskilling. While such effects are documented in fields like medicine and accountancy, no known studies explore this impact in civil engineering.

This study investigates the influence of technology on the development of fundamental technical skills among civil engineers within a case-study organisation. Design software was selected due to widespread industry use, with findings generalisable to the emerging fourth industrial revolution technologies. The Theory of Technology Dominance (Arnold and Sutton, 1998; Sutton, Arnold and Holt, 2023), which examines how intelligent decision aids and artificial intelligence impact human decision-making, serves as the framework for this mixed-methods study. It presents benefits over other models through its emphasis on the individual and professional relevance. Participants completed a technical assessment both independently and using design software to understand reliance and short-term effects, followed by interviews to explore long-term impacts on skill development.

Results showed that design software improved accuracy for all participants, whilst the interviews revealed added benefits such as efficiency and functionality. However, signs of deskilling emerged, with participants relying heavily on the software regardless of its accuracy. This reliance was significantly influenced by their experience and the task complexity, but not by prior use of software. In the interviews many participants acknowledged deskilling as a potential risk of increased technology use.

Concurrently, the interviews also highlighted behaviours that may help to protect against individuals' long-term deskilling which have not emerged in previous studies. Experienced engineers typically regarded the design software as a problem-solving aid, remaining engaged in decision-making. Validation of results emerged as a key theme among more experienced participants; they often validated results with hand calculations, reinforcing their technical skills. These protective measures may be crucial in reducing deskilling in the profession. However, when discussing their software use and technical development, less experienced participants did not discuss these protective measures.

This study offers initial insights into how design software influences the development of technical skills in civil engineers, addressing a critical gap in the literature. It contributes new insights into how experience shapes technology reliance and identifies protective behaviours that may mitigate long-term deskilling. These behaviours, observed primarily among experienced engineers, have not previously been identified in similar studies. The findings have important implications for professional development and training, suggesting that fostering reflective practices and validation habits could help preserve technical expertise in an increasingly digital profession.

# Exploration and Improvement of the Onboarding and Integration Process for a Construction Project Design Team


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AMENTUM


The construction industry makes a significant contribution to the economy. In the UK, in 2023, it generated more than £139 billion in value and employed over 1.4 million people. The construction industry is highly competitive, and globally, it has a lack of skilled staff. To thrive in this environment, knowledge and competence are important resources for sustaining a competitive advantage.

For large-scale projects, it can be difficult to recruit professionals with the necessary sector-specific knowledge, which adds to the already significant challenge of integrating new staff in an effective way into the roles for which they have been employed. Organisational socialisation, also known as onboarding, is used as a means of integrating new employees into the organisation, helping them understand its values, goals, roles and responsibilities, and introducing sector and organisation-specific knowledge and practices.

Effective onboarding is recognised as a key contributor to the performance of newcomers as well as their contribution to productivity. The design of the onboarding process is influenced by several factors such as the organisation, the project's context, the sector of activity, the country and the availability of skilled individuals in that sector. If the design is not done correctly, it will impact the effective implementation and operation of the onboarding process.

This research explores the onboarding process of a European multi-disciplinary megaproject in the energy sector, which is highly regulated, where engineering and construction firms require employees with a high level of knowledge, skills, and competence. The focus of the study is on the civil discipline of the site design team, examining its current onboarding process, knowledge-sharing practices, and challenges and shortfalls encountered during the operation of this process. It seeks to explore the effectiveness of the onboarding process.

The research adopted a qualitative methodology involving semi-structured interviews of the lead engineers responsible for delivering the onboarding process and engineers who had experienced it. Thematic analysis was used to explore interview transcripts and identify themes, which were interpreted in the context of the existing literature to enable the generation of findings and insights.

This study demonstrates that the sharing of knowledge and practice through conventional organisational onboarding processes may require adaptation to suit the environment of a megaproject in an industry seeking sector-specific knowledge and competence. This study contributes to the general understanding of the challenges of effective employee integration in such sectors.

# A Novel, Hybrid Multi-Criteria Decision Making Framework for Risk Based Method Selection in Construction


## Cormac MacLean

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Selecting a suitable construction method requires the consideration of several factors, including cost, safety, environmental performance and risk. Of these factors, risk is the most significant, as construction is inherently a hazardous activity. However, deciding on a method is complex, making structured Multi-Criteria Decision-Making (MCDM) approaches the optimal tool for this purpose. Techniques such as the Analytic Hierarchy Process (AHP), the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and the Preference Ranking Organisation Method for Enrichment Evaluations (PROMETHEE) provide solid frameworks for handling competing priorities. Despite their potential, these methods are not widely used in construction.

This research examines why these methods are not more widely adopted, with one reason being a reliance on professional experience. Whilst experience is key when assessing methods, it can cause bias towards familiar methods, and alternatives may be overlooked. The average age of the construction industry is increasing, and a significant number of workers may soon retire. However, age and reliance alone do not explain the slow adoption of formal decision-making models, given that the construction industry has embraced other technologies. The issues appear to arise from a combination of cultural resistance, inadequate training, and the perception that these tools are too complex or impractical for everyday use.

To fill this gap, the study suggests a hybrid MCDM model that blends the Decision-Making Trial and Evaluation Laboratory (DEMATEL), the Best-Worst Method (BWM), and the Complex Proportional Assessment (COPRAS) methods. These methods, rarely used in construction, were tested through a theoretical case study with two groups. One group used the model, while a control group relied on conventional decision-making methods. The group using the model showed better clarity in identifying and prioritising risks.

A significant challenge was getting decision-makers to quantify subjective criteria such as safety or cost when they are responsible for implementing the method and are legally accountable for its results. Despite this, participants reacted positively to the COPRAS method, particularly appreciating its ability to evaluate both the pros and cons of each alternative within a single framework. This contrasts with traditional risk assessments and MCDM methods such as AHP, which preferentially favour the reduction of risks over potential benefits. Interviewees were receptive to the evaluation of positive criteria and viewed the more balanced assessment of options as a strength of the proposed method. Participants noted that standard industry practice typically focuses on minimising risk, which can lead to overlooking alternatives that, although carrying slight increases in risk, offer significant improvements in areas such as quality, cost efficiency, or environmental performance.

Findings suggest that although professional judgement remains vital, structured MCDM models can benefit the industry when selecting construction methods. They enhance transparency, consistency and accountability, which is key as projects grow more complex and may face more scrutiny. Although risk assessments are already common, ranging from basic matrices to advanced quantitative models, the proposed hybrid approach gives a more integrated and multi-dimensional framework. Evaluating both positive and negative aspects promotes more holistic decision-making, particularly when balancing key project indicators.

# Sailing Through Design: Navigating Best Practices from Shipyards to Construction Sites


## Alexandra Walker

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The construction industry is frequently criticised for cost overruns and programme delays due to poor design coordination. These issues continue to compromise project delivery despite the availability of digital tools like building information modelling (BIM). While technological solutions exist, their implementation remains inconsistent. This dissertation investigates the potential for cross-industry learning from other comparable industries. This study demonstrates insights into how examining established practices in adjacent industries can generate fresh perspectives and inform improvements within construction design management.


The shipbuilding and construction industries share many characteristics, including large, complex, and low-volume projects, strong economic influence, and critical early-stage design decisions. However, shipbuilding has experienced quicker adoption of digital tools and collaborative design practices to address similar challenges faced by the construction industry. Exploring this contrast helps identify what conditions enable innovation to succeed and whether these can be replicated within the construction context. Given these persistent issues, this research examines whether design practices from the shipbuilding industry, particularly integrated design processes and the use of single 3D CAD models, could provide valuable insights for construction.

To address this, the study employed a qualitative methodology. Four focus groups were conducted with 27 experienced construction industry professionals from architecture, structural engineering, mechanical, electrical, public health engineering, design, and project management. Discussions in the focus groups centred on the feasibility, challenges, and opportunities of implementing current shipbuilding practices during the construction design phase. Thematic analysis was employed to analyse the data.

General cross-industry insights from the focus groups highlighted that some organisational and cultural conditions are key to success in one industry but may not be found in another. Other insights included that behavioural readiness is vital for adopting practices from other industries, and once this is in place, these practices can be adapted rather than replicated for use in a new industry.

The focus group findings revealed that while shipbuilding's integrated design process approaches and the use of a single 3D CAD model are viewed positively, significant barriers remain. Participants acknowledged that construction's temporary, short-term team structures, lack of design ownership, concerns about change management, and traditional contractual arrangements often inhibit collaboration and innovation. Nonetheless, there is optimism that with targeted education, standardised tools, and client support, practices from the shipbuilding industry could improve coordination, reduce rework, and enhance productivity. Participants noted that adopting cross-industry practices would require not only new tools but also a cultural shift in how design is managed and resourced throughout a project's lifecycle.

In conclusion, this study highlights both the challenges and opportunities of cross-industry learning. It suggests that while transferring practices from another industry is not without difficulty, carefully adapting practices rather than directly transplanting them could support improvements in construction design management.

# Is Bigger Better?: Can the Use of High-strength Concrete in Reinforced Concrete Structures be Further Optimised to Reduce Embodied Carbon and Overall Costs, Particularly in Cases where Precast Elements are Utilised?


## Francis Eni

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This dissertation challenges the assumption that using high-strength concrete (HSC) in precast construction automatically results in material efficiency and carbon savings. It presents a case study of The Octagon Tower, a 45-storey RC high-rise in Birmingham, where HSC was used in precast columns. Despite strength class reductions from C60/75 to C40/50, column dimensions remained constant, missing a key opportunity to reduce material volume, embodied carbon, and cost.

Using Tedds Tekla, the study models both the as-built design and theoretical optimised alternatives. It quantifies the structural, environmental, and financial impacts of failing to adjust element geometry in response to available material performance. The results show that significant savings in cost and $CO_2$ emissions could have been achieved through early design adaptation.

What sets this research apart is its focus on the disconnect between design specification and actual construction. Rather than proposing new technologies, it highlights missed opportunities within existing workflows, particularly at RIBA Stage 3. The study demonstrates that optimisation is not a technical limitation, but a coordination failure.

The findings provide practical guidance for engineers, contractors, and design managers seeking to achieve low-carbon goals without overhauling supply chains or specifications. By treating optimisation as a design responsibility, the research supports better use of precast HSC, delivering faster builds, leaner structures, and measurable carbon savings.

In doing so, it reframes sustainability not as a future innovation, but as a design decision that should be made today.

# The Impact of Procurement on Project Performance


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The UK construction industry faces a critical juncture, with many contractors financially unstable, despite a national infrastructure backlog and the government's rebuild plan. Projects often exceed budgets and timelines, highlighting the need for systemic improvements. Procurement is vital to project success, yet its potential is often unrealised. This research examines how procurement methods impact project performance and identifies practices that improve outcomes for clients and contractors.

Literature suggests transactional procurement leads to poor performance, while collaborative models offer solutions. Since the Latham Report (1994), collaboration has been discussed but rarely implemented effectively. Many studies generalise findings, lack quantitative evidence, and fail to distinguish between client and contractor perspectives—limiting actionable insight into procurement effectiveness.

To address this, the study uses a quantitative methodology based on fifty-nine UK projects delivered by a tier-one contractor between 2011 and 2025. Data was collected via a thirty-two-question survey sent to commercial leaders, addressing procurement methods, cost, and programme performance. Detailed quantitative data underpins the work, giving substance to survey responses and offering unique procurement insights.

Research questions:

RQ1: What is the impact of procurement on project performance?
RQ2: How does procurement affect clients and contractors, and what is their relationship?
RQ3: Which procurement metrics and factors improve performance across project types?

By analysing best and worst-performing projects, optimal procurement metrics and factors are identified. The primary contribution, however, lies in the dataset's dual perspective, which reveals how contractor and client metrics align or conflict. This dual lens enables analysis of win-lose, lose-lose, and win-win procurement outcomes. It evaluates the factors driving both parties' best and worst performance. A list of recommended procurement metrics is provided, highlighting what to embed or avoid.

Findings show win-lose metrics are embedded in most projects. Often unintentionally applied due to knowledge gaps, they initially appear dormant under superficial collaboration. Once exposed, collaboration erodes, and outcomes suffer.

The research encourages clients and contractors to adopt its proposed procurement approach. Each party should analyse its data to identify personal win and lose metrics, then co-develop procurement lists of win-lose, lose-lose, and win-win factors at project outset.

It concludes that collaboration, though widely promoted, must be evidence-based. A data-driven, win-win procurement model provides a replicable and practical path to real collaboration—unlocking sustainable industry growth.

# The Effects of Introducing Automation of Rebar Placement on the Construction Workforce


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The construction industry has traditionally relied on manual labour for reinforcement work, making it a prime candidate for automation as the sector seeks improvements in productivity, safety, and quality. However, the adoption of such technologies presents significant implications for the skilled operatives, especially those in physically demanding roles like steel fixing. This dissertation explores the potential impact of introducing automation in rebar placement on the construction workforce, focusing on perceptions, challenges, and opportunities associated with this technological shift.

The study addresses a key issue: how automation in reinforcement placement is perceived by the very workforce it stands to affect, and what role that workforce might play in shaping its implementation. This investigation is critical given the increasing pressure on the industry to modernise, alongside growing concerns about job security, skills obsolescence, and the readiness of the existing labour force to adapt to technological change.

A mixed-methods approach was employed, combining a structured questionnaire and a series of semi-structured interviews with steel fixers working on a major UK infrastructure project. The methodology was informed by a pragmatic research philosophy, allowing for both the quantification of general attitudes and the qualitative exploration of individual experiences and opinions. Data collection focused on workforce familiarity with automation, perceived risks and benefits, openness to upskilling, and concerns about future employment and safety.

The findings reveal a workforce that is generally aware of automation and its potential to transform construction practices. While there are clear concerns, particularly around job displacement, safety when working alongside machines, and the diminishing of traditional roles, many workers also expressed a willingness to engage with automation if supported by appropriate training and communication. The results suggest that workforce involvement, trust-building, and inclusive implementation strategies will be crucial to the successful adoption of automation in this context. This study concludes that automation in rebar placement is neither an outright threat nor an unqualified benefit; rather, its success depends on how it is introduced and managed. To ensure a positive transition, industry stakeholders must recognise the value of the workforce as partners in innovation.

Recommendations include structured retraining programmes, workforce consultation during implementation, and further research into the broader cultural and economic impacts of robotics and automation in construction. Such steps are essential to achieving a balance between technological advancement and workforce sustainability.

# Perceptions of Psychological Safety in Construction


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Psychological safety is defined as the shared belief where one can speak up without fear of negative consequences. It was first articulated by Amy Edmondson and is now recognised as a foundation for healthy, high-performing teams, fostering learning, innovation, and error reporting in safety-critical environments. Although organisations may formally embrace psychological safety, individual experiences often diverge across teams and settings, suggesting a gap between policy and practice. The construction industry, a human-centric sector characterised by high physical risk, transient crews, and rapidly evolving site conditions, is still largely overlooked in psychological safety research. Unvoiced concerns in this context can directly affect both worker well-being and project outcomes. Addressing this gap is therefore imperative for designing targeted interventions that enhance human and operational safety across global construction sites. To investigate these dynamics, a qualitative study within a multinational contractor's regional hubs in the United Kingdom, Australia, and the United Arab Emirates was undertaken. Using semi-structured interviews, three core questions were explored: (1) the extent to which formal psychological-safety policies translate into felt experiences on-site and in office environments; (2) the comparative influence of leadership behaviours versus individual agency in fostering psychological safety; and (3) the strategies employees employ to feel secure when voicing concerns.

Findings indicate that participants across all hubs share a clear and consistent definition of psychological safety at an organisational level. However, the translation of these policies into everyday practice was found to be more problematic on construction sites than in office contexts. Physical hazards, shifting team compositions, tight timelines, and hierarchical site structures appeared as significant barriers. Based on these insights, context-sensitive, leadership driven interventions, including embedding open-door policies, site inductions, integrating leadership quality metrics into recruitment and performance appraisals are recommended. While this study captures experiences at a single point in time, future research should adopt a longitudinal, project lifecycle design to examine how psychological safety evolves throughout project phases and to confirm the long-term efficacy of tailored practices. These efforts will be crucial for translating organisational intent into sustained, positive safety cultures on construction sites.

# How can Risk-Based Asset Management Influence Asset Prioritisation?


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E.ON


Infrastructure is critical to national economies. Well-maintained infrastructure supports economic growth and ensures the reliable delivery of essential services. Improved management of existing infrastructure is increasingly recognised as a cost-effective alternative to capital renewals. However, ageing infrastructure presents significant challenges in developed countries. Deteriorating assets cause service disruption and reduced reliability, with broad socio-economic consequences. These issues are compounded by a lack of funding for asset management and rising user demand. Such challenges are common across infrastructure sectors, including transport, utilities, and water.

In the transport sector, many bridges now exceed their design life. Managing these structures within constrained budgets has become increasingly difficult. In the UK, recent failures in both the highway and rail sectors illustrate the risks and challenges associated with maintenance prioritisation. Infrastructure operators across the sector are adopting various tools to improve asset management, with risk-based decision-making emerging as a leading approach.

This study explores how risk-based models can be developed while balancing the cumbersome data requirements often seen in academic frameworks. Through developing a unique approach to risk-based prioritisation, this study investigates whether advanced risk-based models using readily available data can still support intervention prioritisation. This study is tailored to the UK rail network. The approach integrates existing asset data with proxy risk factors, reducing the resource burden for implementation and ongoing use.

Quantitative analysis was completed on over 500 underbridges in Network Rail's North West & Central Region. The risk-based model incorporates asset condition, geographic context, and criticality metrics to develop a unique Bridge Risk Value. Outputs are assessed spatially and functionally across multiple line types to understand the broader impact of the model.

The study found that the development of a unique risk-based model was achievable with data made available for this study by the asset operator. The application of the risk-based model enabled prioritisation of assets, with an increased level of granularity when compared to those currently used in practice. Sensitivity analysis showed that bridge material, structural form, delay costs, and replacement costs influence risk outcomes at varying levels, with deck area having the most influence over the Bridge Risk Value. The model performed consistently across urban and rural contexts and various line types, showing that outputs were prioritised based on asset characteristics rather than the setting of the asset. The outputs presented risk in financial terms which may enhance communication with stakeholders when outlining decisions.

In conclusion, this study presents a scalable, data-informed tool to support infrastructure operators in making more proactive and transparent maintenance decisions. The model was able to make use of existing data and enhance the granularity and prioritisation of the data set. The model was able to support asset prioritisation even with reduced computational and resource intensive techniques when compared to similar approaches. It contributes to the growing evidence base for integrating tailored, risk-based approaches into infrastructure planning, to help manage common asset management challenges seen across infrastructure sectors.