



UNIVERSITY OF
CAMBRIDGE

Construction Engineering Masters

Construction Engineering Masters Dissertation Conference

5 July 2024



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@CEMCambridge



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.

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Welcome

A warm welcome to current students, lecturers, supervisors, colleagues, alumni and special guests to the 2024 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 12th 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 Course Director
June 2024

How the conference will work

In-person Participation

The conference is being held at the [Institute for Manufacturing](#), 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 09:00 for registration, and the conference will commence at 09:30. The day is split into three sessions – each session containing 3 presentation slots. Each presentation slot is 15 minutes (10 minutes for the student presentation, each followed by 5 minutes of Q&A), with 5 minutes between each speaker to allow time for AV set up and for guests to change rooms if they wish.

24 students from the twelfth cohort of the Construction Engineering Masters will be delivering presentations on their dissertation research, which spans a wide range of topics and themes. Audience questions are encouraged.

Online Participation

If you are joining the conference via Zoom please use the details below

Room East 1 (opening address, keynote and closing address)

- **To join:**
<https://cam-ac-uk.zoom.us/j/81305869365?pwd=bnTpm8ln7UgEs4mXQnmAx7GBunYJV5.1>
- **Meeting ID:** 813 0586 9365
Passcode: CEMDC2024

Room East 2

- **To join:**
<https://cam-ac-uk.zoom.us/j/81667163933?pwd=y9uATVQJ7febdNWAeyqVfPlgPxFl7A.1>
- **Meeting ID:** 816 6716 3933
Passcode: CEMDC2024

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 with 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 mute 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.

DISSERTATION CONFERENCE

Friday 5th July 2024: In person and online

09:00 - 09:30 Registration (Atrium, Lower Ground Floor)/ Enter Zoom Room				Lecture Theatre 1
09:30 - 09:40 Dr Gavin Davies - CEM Course Director Welcome				
Session A1	09:45 - 10:00	Sameer Jamaa - Senior Civil Engineer, AtkinsRéalis <i>Narrative Encounters: A temporal examination of Megaproject narratives mobilised by project promoters and protestors.</i>		Lecture Theatre 1
	10:00 - 10:05	Turnover time for next student to prepare		
	10:05 - 10:20	Jonathan Young-Pugh - Senior Engineer, AtkinsRéalis <i>Media selection for communication between onshore and offshore engineering teams, a case study.</i>		
	10:20 - 10:25	Turnover time for next student to prepare		
	10:25 - 10:40	Daniele Costantini - Principal Engineer, WSP <i>The Impact of Open Innovation on the Adoption of Automation in Civil Engineering Design.</i>		
	10:40 - 10:45	Turnover time for next student to prepare		
	10:45 - 11:00	James Bark - Project Engineer, Laing O'Rourke <i>Digital Twin Construction for productivity improvement: From off-site manufacturing to on-site installation.</i>		
	11:00 - 11:25 COFFEE & TEA BREAK (Atrium, Lower Ground Floor)			
Session A2	11:30 - 11:45	Graham Brierley - Head of Digital Delivery, Laing O'Rourke <i>How do we measure the 'workload' on our people?</i>		Lecture Theatre 1
	11:45 - 11:50	Turnover time for next student to prepare		
	11:50 - 12:05	Jack Brooke - Engineering Systems Lead, Scottish Power/Iberdrola Renewables Offshore <i>Managing Complexity in the Offshore Wind sector.</i>		
	12:05 - 12:10	Turnover time for next student to prepare		
	12:10 - 12:25	Andrew Bell - Project Technical Lead, Laing O'Rourke <i>Beyond 2D drawings: Exploring the benefits and barriers to model-based construction in the UK.</i>		
	12:25 - 12:30	Turnover time for next student to prepare		
	12:30 - 12:45	Helen Read - Project Engineer, Laing O'Rourke <i>Empowerment for Sustainability in Construction.</i>		
12:45 - 13:55 LUNCH (Common Room, First Floor)				
Session A3	14:00 - 14:15	Sonia Duarte - Senior Consultant, Arup <i>Exploring the impact of hybrid work on engineering consultancy and the perceptions of how this is influencing the development of early careers engineers.</i>		Lecture Theatre 1
	14:15 - 14:20	Turnover time for next student to prepare		
	14:20 - 14:35	Mohamed Rizwan Khan - Assistant Manager - Infrastructure Projects, Red Sea Global <i>From Sandcastles to Lush Oases: Analysing Barriers and Factors Influencing the Implementation of Blue-Green Infrastructure and Nature-Based Solutions in the Arabian Gulf.</i>		
	14:35 - 14:40	Turnover time for next student to prepare		
	14:40 - 14:55	Andrew Hunt - Principal Engineer, Laing O'Rourke <i>Open Teaming and its Place in the UK Construction Industry.</i>		
	14:55 - 15:00	Turnover time for next student to prepare		
	15:00 - 15:15	Jonathan Laddy - Principal Engineer, AtkinsRéalis <i>A Bridge Over Troubled Waters: The UK Water Sector and The Sustainable Development Goals.</i>		
	15:15 - 15:20	Examiner adjudication time		
	15:15 - 16:30	DRINKS RECEPTION AND NETWORKING (Common Room, First Floor)		
Closing address				Common Room

DISSERTATION CONFERENCE

Friday 5th July 2024: In person and online

09:00 - 09:30 Registration (Atrium, Lower Ground Floor) / Enter Zoom Room				Lecture Theatre 2
09:30 - 09:40	Dr Gavin Davies - CEM Course Director Welcome			
Session B1	09:45 - 10:00	Matt Paradise - Senior Commercial Manager, BYLOR (Laing O’Rourke) Perceptions of Empowerment and Management Productivity in Construction.		Lecture Theatre 2
	10:00 - 10:05	Turnover time for next student to prepare		
	10:05 - 10:20	Ian Seabrook - Health & Safety Leader, Laing O'Rourke How does funding private construction with debt influence the allocation of risk?		
	10:20 - 10:25	Turnover time for next student to prepare		
	10:25 - 10:40	Pratish Vedhappudi - Managing Director, VGN Projects Estates Limited, India India’s Urban Housing Shortage Crisis: An Overview on Government Policy.		
	10:40 - 10:45	Turnover time for next student to prepare		
	10:45 - 11:00	Sanchay Singhal - OLE Practice Manager, AtkinsRéalis Dissociate design and drawings to inform design efficiency through example of electrification projects.		
11:00 - 11:25 COFFEE & TEA BREAK (Atrium, Lower Ground Floor)				
Session B2	11:30 - 11:45	Thomas Larsson - Senior Director of Marketing, Trimble Inc. Business benefits of adopting model-based construction projects.		Lecture Theatre 2
	11:45 - 11:50	Turnover time for next student to prepare		
	11:50 - 12:05	Gavin Miller - Principal Planner, Laing O’Rourke Driving improvements within the design phase of construction projects: The implementation of lean design management.		
	12:05 - 12:10	Turnover time for next student to prepare		
	12:10 - 12:25	Marshall Maphosa - Project Director, Sesani Projects Common Data Environment (CDE) Adoption for Project Management Collaboration and Communication: A Case Study of Afreximbank Trade Centre Project in Harare.		
	12:25 - 12:30	Turnover time for next student to prepare		
	12:30 - 12:45	Tsz Ngo (Oka) Chan - Project Engineer, Laing O'Rourke Addressing Gender Imbalance in the Construction Industry.		
	12:45 - 13:55 LUNCH (Common Room, First Floor)			
Session B3	14:00 - 14:15	Nicholas Woodbridge - Head of Northern Powerhouse Rail Cross-Cutting Policy and Development, Department for Transport Stakeholder Perspectives of Complexity In Rail Projects: A Pre-Mortem.		Lecture Theatre 2
	14:15 - 14:20	Turnover time for next student to prepare		
	14:20 - 14:35	Alice Liddell - Environmental Sustainability Manager, Sizewell C, Laing O'Rourke Further Enabling Circular Economy principles in the UK Nuclear Industry.		
	14:35 - 14:40	Turnover time for next student to prepare		
	14:40 - 14:55	Thiago Rocha - Project Manager, Worley Unlocking the Potential of Renewable Hydrogen: Recommendations for Engineering and Construction Organisations to Deliver Renewable Hydrogen Faster.		
	14:55 - 15:00	Turnover time for next student to prepare		
	15:00 - 15:15	Christopher Rose - Principal Engineer, Laing O'Rourke Dodgy Wi-Fi and a room full of noise - A study of temporary construction site office facilities.		
	15:15 - 15:20	Examiner adjudication time		
15:15 - 16:30 DRINKS RECEPTION AND NETWORKING (Common Room, First Floor)				Common Room
Closing address				

Digital Twin Construction for productivity improvement: From off-site manufacturing to on-site installation.



James Bark

Project Engineer
Laing O'Rourke

Modern Methods of Construction (MMC) is widely regarded as a theoretically appropriate solution to improve the UK construction industry's poor productivity. However, early adopters report that the expected commercial benefits from leveraging off-site manufacturing (OSM) of precast concrete products have not yet materialised. While productivity gains in manufacturing and on-site construction are well-established, the emerging OSM supply chain presents significant opportunities, should new technologies like Digital Twin Construction be adopted. This research aims to address the data silos and workflow fragmentation identified across the OSM supply chain, which hinder a true understanding of productivity within this modern approach.

Employing a quantitative approach, the research utilises Bluetooth Low Energy (BLE) beacons to track 2,335 precast concrete products from manufacture to site installation. Each beacon provides geospatial timestamps of every movement and crane interaction from manufacture to storage, then delivery to final site installation. Descriptive analytics reveal critical inefficiencies in current processes, marked by significant variability in installation durations, storage times, and crane utilisation. Ultimately, variability has a negative impact on project programmes. Further analysis found inefficient storage strategies and excessive over-handling with restacking of units during installation, indicating a misalignment between planned manufacturing and installation sequences. Lack of unit order continuity throughout the entire workflow greatly impacts site productivity.

This study highlights the critical impact of variability on construction productivity and suggests that real-time data tracking can enhance decision-making and operational efficiency. Integrating digital twin technology into the OSM supply chain could create a transparent, dynamic product sequencing tool for all key stakeholders across design, manufacture, and installation. This therefore, provides an opportunity to improve workflow effectiveness and efficiency. The research provides a proof of concept for using advanced data collection tools to optimise the OSM lifecycle, paving the way for future innovations in construction management. Using this study as a benchmark for comparison, further research could focus on implementing a transparent product sequencing tool with an aim to reduce variability on future projects.

Beyond 2D drawings: Exploring the benefits and barriers to model-based construction in the UK.



Andrew Bell

Project Technical Lead
Laing O'Rourke

Despite significant advances in the adoption of Building Information Modelling (BIM) and 3D design in the construction industry in recent years, 2D drawings largely remain the baseline for the communication of construction design information. Producing and processing significant numbers of 2D drawings imposes an administrative burden on projects and represents a major hurdle in the industry's strive for increased digitalisation. Furthermore, as developing automation, artificial intelligence and augmented reality technologies are embraced by the construction industry, the demand for 3D design is increasing. This research paper firstly establishes the perceived barriers to Model-Based Construction (MBC) through a series of interviews with experienced industry professionals who have had little exposure to its implementation, and secondly, uses two case studies to explore the extent to which MBC is being implemented on early-adopter UK projects, examining the benefits and challenges that were experienced. The perceived barriers from the interviews are compared to the findings of the case studies and to a review of existing literature.

The interviews revealed that the perceived barriers fall into five key themes – commercial & contractual, level of detail, review & approvals, skillset, and industry-wide adoption. The case study findings revealed that MBC adoption is in its infancy and is so far only being implemented in relation to certain aspects of construction, predominantly the installation of concrete reinforcement, with drawings still being used extensively for other tasks. The reasons for this are explored in the study and criteria are developed to assess the suitability of a construction task to the application of MBC. Most of the perceived barriers from the interviews did materialise in some form on the case study projects but were relatively easily overcome. However, ensuring a suitable level of detail in the model and determining critical dimensional information were residual challenges on both projects. Investment in the development of software tools to improve the practicalities of on-site dimensioning from 3D models is a key recommendation of the study.

How do we measure the ‘workload’ on our people?



Graham Brierley

Head of Digital Delivery
Laing O'Rourke

The UK Construction Industry has a poor reputation, and reports over a twenty-five-year period share common themes contributing to a fragmented, adversarial, and challenging environment. This takes its toll on those working across the industry. Whilst the recognition of the importance of health and wellbeing continues to improve, support is often a reactive intervention only once an individual's physical, emotional, or mental health has been compromised.

Research by the Chartered Institute of Building (CIOB) in 2019 and the Construction Industry Training Board (CITB) in 2021 describe determinates of poor health and wellbeing in the UK Construction Industry. However, research by these bodies found little evidence of programs measuring employee health and wellbeing, or the effectiveness of existing interventions. Another gap included a lack of consistent health and wellbeing key performance indicators. To try and address these gaps in measurement of health and wellbeing, this dissertation explores an alternate industry, sport, where balancing high performance alongside health and wellbeing is fundamental to taking part at elite level. The evidence base suggests sport science can provide significant insights for fields, such as construction, which are characterised by high-pressure environments, and where employee health and wellbeing is paramount to deliver on outcomes.

The research explores how sports science underpins ‘athlete workload monitoring’, a measurable and planned preventative approach towards health and wellbeing. Parallels are drawn with construction, leading to the development of a proposed translation ‘construction workload monitoring’. The proposal brings together converging themes from research by CIOB and CITB with established practises in sport science.

The proposal was reviewed in three parts. Part one, provides context by comparing CIOB and CITB health and wellbeing research findings with existing data from a UK Tier One Main Contractor, (the Contractor). Part two, provides critical appraisal of the proposed translation from interviews with subject matter experts from health and wellbeing, sport, and construction. Part three, provides reaction to the proposed translation from a survey of staff at the Contractor.

A key finding from existing data at the Contractors was that younger age groups had scored lower to health and wellbeing questions in a recent staff engagement survey. However, survey feedback across the converging themes of the proposed translation was consistent for all age groups. Whilst survey feedback supported the determinates described by CIOB and CITB, it highlighted key areas to recognise independently for effective measurement of health and wellbeing, and additional areas such as the impact of meetings, working relationships, and physical workplace. Subject matter experts shared valuable insights on which measures to prioritise, the frequency of measurement and the importance of key relationships.

Participants shared a positive reaction to the proposed translation. This research recommends this collective feedback be included in its development, alongside further research in the form of live testing. This testing should set out to assess its potential to support a planned preventative approach to health and wellbeing in construction.

Managing Complexity in the Offshore Wind sector.



Jack Brooke

Engineering Systems Lead

Scottish Power/Iberdrola Renewables Offshore

Offshore wind farms are systems integrating discrete technical elements (turbines, foundations, substations, and cables). This system shares socio-economic interfaces with its operating environment. For example:

- Wind farms rely on supply chains and economic infrastructure such as ports and harbours to support operations.
- They must be maintained and operated in a way which generates revenue for the operator, while not exposing people who work in or around them to risk.
- Wind farm infrastructure must interface with local communities and the ecosystem in its immediate environment.

These interfaces influence how decisions are made throughout development and operation. With several decades of experience these interfaces are well known and understood by the sector, however, significant change is on the horizon. Over the next decade, the sector must respond to the following challenges:

- Increasingly competitive markets.
- Introduction of new technologies such as floating wind and offshore hydrogen.
- Commercial scale decommissioning and end-of-life management.

These changes will reconfigure socio-economic relationships, introducing uncertainty and risk which must be managed. To design and plan systems which are resilient to these risks, projects should be evaluated at the socio-economic level to recognise uncertainties.

Complex systems and systems safety theory are well-established fields of study, which offer tools and techniques to evaluate risk and uncertainty within complex socio-economic-technical systems. These could help the sector understand new or changed socio-economic relationships and dependencies and recognise and plan for the uncertainty they present. However, these approaches require new ways of thinking which are inconsistent with current practice.

This study examines the adoption of systemic risk management approaches in design and planning, applying an evolutionary model to evaluate the adoption process in offshore wind. This model suggests that adoption of new practice occurs along two planes: horizontally between academia and industry, and vertically between technical and managerial layers of the organisation. A series of semi-structured interviews were conducted with participants from both horizontal and vertical adoption pathways and thematic analysis applied to examine key barriers and enabling factors influencing each adoption pathway.

Key findings highlight several factors perceived as critical to the management of better, safer complex socio-economic-technical systems. Firstly, systemic design and planning requires engineers to become conversant in the principles of systems thinking and understand how it applies to them and their role. It was considered necessary for the industry to consider how engineers are educated and trained within their professions. Additionally, organisations should be structured and exhibit appropriate cultural characteristics to allow exposure to, and experimentation with new practice. Finally, the industry must be regulated in a way which offers developers and operators sufficient agency to trial and adopt new practice.

Addressing Gender Imbalance in the Construction Industry.



Tsz Ngo (Oka) Chan

Project Engineer

Laing O'Rourke

The construction industry is notably characterised by a significant gender imbalance, with females making up less than 15% of its employees. The persistent underrepresentation of females in the construction sector limits the industry's innovation and inclusive growth potential. To tackle the gender imbalance issue, it is important to look at adolescent determinants. The reason is that career interests and choices often start in adolescence, and are shaped, to a significant degree, by the education system.

First, consultations with five education representatives and twelve stakeholders from the construction industry were carried out. These consultations provided insights into the problems females in the construction sector face, but also factors that help to attract and retain females in the field. A key focus area for the consultations related to the influence of adolescent education. The literature has highlighted low awareness levels about construction among schoolgirls. To overcome this, an intervention was rolled out in a secondary school in Somerset to increase schoolgirls' perceptions and attitudes towards the construction industry. The program included an interactive session conducted by two female construction industry professionals, who showcased their roles on-site. Following the intervention, twenty-one schoolgirls and ten schoolboys were interviewed to assess the impact of the intervention on their awareness levels and interest in construction careers. These interviews were then transcribed, coded, and analysed for themes using NVivo software.

One of the key findings of the stakeholder consultations is that the macho, masculine environment may be a deterrent for females when it comes to joining the construction field. However, education campaigns and adolescent awareness programs can help address this. Furthermore, the consultations showed that school-based interventions are needed and effective in increasing females' interest in the field from an early age. Analysis of the students' interviews (following the intervention) brought to light key themes. One of the themes showed that the intervention had a positive impact on participants' attitudes towards construction careers in participants. Other themes suggested that exposure to real-world construction roles and female role models significantly enhanced schoolgirls' interest and confidence in pursuing construction-related careers.

This research highlights the critical role of targeted educational programs in promoting schoolgirls' interest in construction, thus providing a starting point for similar initiatives aimed at bridging the gender gap in the field. Recommendations for future research include expanding the intervention undertaken for this dissertation to the national careers curriculum and exploring the long-term impact of such an intervention on gender equity in construction.

The Impact of Open Innovation on the Adoption of Automation in Civil Engineering Design.



Daniele Costantini

Principal Engineer
WSP

The UK government has identified a lack of innovation and collaboration in the construction industry as a key challenge, contributing to productivity stagnation that has persisted for 50 years. Professional bodies highlight the growing importance of digital skills, which are becoming a critical addition to core engineering competencies, amidst an escalating skills and recruitment crisis compounding the productivity challenges.

The slow pace of innovation, skills gaps, and low digital absorption underscore the need for a fresh approach to invigorate the sector. Open innovation (OI), defined as leveraging internal and external knowledge flows to accelerate innovation, has emerged as an important concept in research and industry, fostering collaboration and knowledge sharing. While research has established a relationship between OI and the integration of digital processes for automation (Industry 4.0), OI's prevalence in civil engineering design has not received sufficient attention.

To address this gap, this research posits two research questions:

1. How are individual professionals engaging with OI practices to develop design automation capabilities?
2. What are the organisational drivers and challenges in embracing OI and design automation?

This research employs a mixed-methods approach using a single case study of WSP UK, a leading engineering professional services consulting firm. The study follows a sequential exploratory design consisting of two phases: a focus group targeting twelve individuals recognised for driving automation within the organisation, and seven individual interviews with leadership involved in innovation strategy, digital automation, or design. This design enables insights from those directly involved in automation, complemented by the perspectives of key decision-makers.

The findings reveal that the primary pathway of automation knowledge acquisition is through employee-driven, problem-based exploration, where individuals actively seek solutions to specific challenges they encounter in their work. Notably, over three-quarters of knowledge sources are derived from external sources, driven by intrinsic motivations such as a genuine interest in exploring new technologies and improving work processes. Moreover, the investigation highlights the impact of novel generative AI tools, such as ChatGPT, on programming knowledge implementation and its role in scaling project-based innovations.

While most automation activities within WSP currently operate at the single-loop learning level - where individuals acquire new skills and solve specific problems, scaffolded by internal communities of practice and personal networks - there is also evidence of double loop learning, involving the development of new strategies and roles targeting automation adoption from project inception. However, from an organisational perspective, the findings reveal a disconnect between the recognised importance of design automation and the level of commitment to developing the necessary skills, citing concerns of employee turnover to competitive industries.

This study demonstrates that professionals are embracing the principles of OI to bridge skills gaps through proactive engagement with external knowledge sources. Furthermore, the role of leadership is crucial for transferring individual initiatives from single to double-loop learning. This study contributes to the broader literature on OI, establishing its role in propelling the AEC industry into the age of Industry 4.0.

Exploring the impact of hybrid work on engineering consultancy and the perceptions of how this is influencing the development of early careers engineers.



Sonia Duarte

Senior Consultant
Arup

The Covid 19 pandemic accelerated the move for many industries to allow workers more flexibility in working hours and locations. Following initial periods of homeworking during national lockdowns, many organisations, including the consulting engineering industry, have introduced hybrid working policies. This has resulted in staff having the option to spend a proportion of their working time away from traditional office locations.

Existing literature exploring the advantages and disadvantages of working from home has been focussed on short-term impacts. Amongst the disadvantages noted are decreased collaboration opportunities and reduced transfer of tacit knowledge. Engineering consultancy is reliant on high levels of collaborative working and innovation. As such, hybrid working has the potential to result in longer-term impacts to the development of staff. This potential has resulted in strong views amongst staff of all levels and the basis for this is unclear.

This study has aimed to understand the views and experiences of senior engineers based in the UK on their experience of how the development pathway for early careers engineers (E.C.E.s) has changed as a result of hybrid working. The personal experience of managing and mentoring individuals, the underlying thought processes and views on the process of developing as a consultant engineer have been investigated by undertaking semi-structured interviews with twelve senior civil and structural engineers. Participant selection was based on convenience sampling, with U.K. based staff with mentoring, line management and project management responsibilities.

The findings from interviews indicate that hybrid working was not considered by most senior engineers to be a barrier to individual development or to chartership. However, they noted that maintaining relationships and information flow to a similar level to working full-time in an office required more effort from both senior and E.C.E.s. The mentoring process was noted to be a positive factor in allowing senior staff to develop better professional relationships with E.C.E.s. Many senior engineers expressed concerns that although E.C.E.s may be able to develop a basic level of engineering 'competency' through the chartership process, hybrid working led to fewer impromptu meetings and conversations. Technically and commercially, mentors reported concerns that this could lead to less depth and breadth of knowledge for E.C.E.s. Pastorally, concerns were expressed that senior engineers may not be able to provide support and guidance to E.C.E.s in a timely manner, leading to larger problems arising before an intervention is made.

From the outcomes of the interviews, it is clear within the U.K., that many senior engineers are concerned that hybrid working is adversely impacting the development of E.C.E.s through reduced interaction with other staff. The insights gained from the interviews has suggested that whilst this is unlikely to impact the chartership process, there is concern that the depth and breadth of knowledge of future engineers could be impacted by this.

Open Teaming and its Place in the UK Construction Industry.



Andrew Hunt

Principal Engineer

Laing O'Rourke

The UK construction industry faces persistent challenges in efficiency, productivity, and safety. Despite numerous reports and initiatives, issues such as poor project performance, cost overruns, and high injury rates continue to plague the sector. The research investigates how open teaming can be effectively implemented during the Pre-Construction Services Agreement (PCSA) phase, a critical stage involving early contractor involvement, design development, and cost planning, by addressing a critical question: Are the values of open teaming present during the PCSA phase of construction projects, such that the environment would facilitate implementation of a consistent open teaming framework? The PCSA phase is vital for sharing experiential learning and mitigating risks before project delivery, making it an ideal stage for adopting open teaming practices to enhance co-creation, cross-functional collaboration, and organisational learning. The importance of the PCSA phase has increased following the introduction of the Building Safety Act, which emphasises the need for rigorous planning and collaboration to ensure safety and compliance. Through qualitative analysis, including semi-structured interviews with senior industry leaders, this study investigates the presence of key values such as trust, commitment to a common goal, psychological safety, fluid information flows, and appropriate expertise. The findings reveal a positive correlation between these values and successful PCSA phases. This indicates that a framework for open teaming could significantly enhance the PCSA process, leading to better project outcomes and early adoption of experiential learning.

Implementing open teaming in the PCSA phase can foster a culture of collaboration and continuous improvement, addressing long-standing challenges in the construction industry. This study provides actionable insights and practical recommendations for industry practitioners and policymakers. The findings underscore the potential of open teaming to improve efficiency, safety, and overall project success in the construction industry, ultimately contributing to more sustainable and resilient construction practices.

Narrative Encounters: A temporal examination of Megaproject narratives mobilised by project promoters and protestors.



Sameer Jamaa

Senior Civil Engineer
AtkinsRéalis

Infrastructure megaprojects are transformational endeavours that impact society, the environment, and the political landscape. They involve a diverse array of external stakeholders who often control the necessary resources to deliver the project. Improper enfranchisement of these stakeholders can, therefore, threaten the fulfilment of delivery outcomes. These stakeholders are also heterogeneous and often possess varied perspectives on the intrinsic value that the megaproject will deliver.

Emerging research suggests that competing notions of project value are best understood through a narrative lens, where positive and negative perspectives are negotiated, contested, and shaped through discourse. However, despite the resurgence in new nuclear power developments, existing project management literature lacks insights from these kinds of megaprojects. Furthermore, the temporal and dynamic nature of megaproject narratives has received little attention, even though they invariably take significant time to be realised.

To that end, this research investigates the evolving narratives mobilised by promoters and protestors on the Hinkley Point C megaproject in the United Kingdom. This project is studied as an instrumental case owing to its scale, complexity, and the significant socio-economic and political interests involved. A thematic analysis of 241 newspaper articles spanning a 10-year period was undertaken to identify the value perspectives mobilised by promoter and protestor and assess the interaction and stability of these narratives through time.

Findings show that promoters mobilised narratives that emphasised the benefits of job creation, energy security, and the technology's low-carbon characteristics. Conversely, protestors constructed critical narratives concerning environmental safety and challenged the project's high cost. Narratives interacted through two distinct means: those in direct conflict, narrative battlegrounds, and those which negotiate the relative importance of competing perspectives, the narrative high ground. Environmental safety was identified as a key battleground while the contest between the project's cost and the merits of decarbonisation competed for the narrative high ground. Although both promoter and protestor narratives were largely stable throughout, promoter narratives were found to be more adaptive and responsive to external events, although this volatility often threatened narrative coherence.

This study contributes to the current literature by integrating the narrative effects of amplification and credibility within existing theoretical frameworks of megaproject narrative creation. It is novel in exploring the identities these narratives help construct.

Practically, the findings from this study are potentially instructive for how megaproject practitioners manage external stakeholders over time. Understanding that megaproject narratives are mobilised when they are amplified and are credible enables managers to craft more effective project narratives. The study also provides a basis for megaproject managers to meaningfully address counter-narratives that threaten to destabilise the megaproject mission.

From Sandcastles to Lush Oases: Analysing Barriers and Factors Influencing the Implementation of Blue-Green Infrastructure and Nature-Based Solutions in the Arabian Gulf.



Mohamed Rizwan Khan

Assistant Manager- Infrastructure Projects
Red Sea Global

The Arabian Gulf, encompassing the Gulf Cooperation Council (GCC) countries, is grappling with significant environmental and climatic challenges. The region, known for its arid climate and limited water resources, is increasingly vulnerable to climate-driven issues such as desertification, heat waves, sea level rise, and extreme weather events. While the region continues to prosper through its ambitious plans and delivering mega-scale developments, the frequent nature of these events necessitates an urgent need for innovative, sustainable infrastructure solutions to withstand these pressures.

Blue-Green Infrastructure (BGI) and Nature-Based Solutions (NBS) emerge as sustainable approaches to enhancing resilience and adapting infrastructure to address these climate-driven challenges. They have gained recognition over the last few years and have been widely discussed in policies and initiatives announced within the region, recommending mainstreaming their application across the region's urban and rural landscapes. However, despite the endorsement, their implementation remains limited and faces numerous barriers to adoption that have not been thoroughly studied in the region.

This research acknowledges the existing gap and delves into the prevalent barriers, influences, and impacts of implementing these strategies in the region. It adopts a mixed-methods approach, leveraging data from quantitative surveys and qualitative interviews to uncover the influence of these barriers within the GCC. The study categorises these barriers into seven thematic typologies: institutional and policy, financial, environmental, socio-cultural, technical, procurement, and performance. Each typology encompasses several critical obstacles identified during the study, evaluated based on their prevalence and influences and analysed through graphs and heatmaps. The study further explores the relationships between these typologies and their influences through a network diagram.

The key findings from this study emphasise the need for robust policy frameworks, guidelines and governance structure, financial schemes and incentives, limited stakeholder collaboration, and training initiatives as prevailing critical barriers within the region. Through its findings, the study highlights the weak points, gaps, and interrelationships that hinder the implementation of these strategies, providing foundations for further research on finding viable solutions and strategies that can help alleviate them.

By analysing the barriers to implementing BGI and NBS, this research contributes valuable insights into understanding these barriers, opening doors for future research to utilise its findings and develop strategies to mitigate them within and beyond the Arabian Gulf, enhancing the global discourse on climate adaptation and sustainable infrastructure.

Business benefits of adopting model-based construction projects.



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This dissertation explores the problem of slow adoption of digital models in the construction industry. The construction sector struggles with productivity and efficiency issues and an unnecessarily large carbon footprint. There are strategies being deployed to address these issues, among them, the adoption of innovative technologies like digital models, although the pace of such adoption remains slow

A literature review in the field revealed three main themes. First it confirmed that the adoption of digital models in construction, beyond the design phase, is slow, directing the focus of this study towards the construction and maintenance phases. Second, the literature explores barriers in more depth than benefits, suggesting that a focus on the merits of adoption would be beneficial. Third, most research has been done through the lens of contractors and builders, directing the attention of this research towards the returns for clients and owners.

Owner and client organizations are key stakeholders in the construction process. They fund investments in technologies and increasing their understanding of the returns might incline them to more frequently make the investment and start asking for the technology to be deployed on their projects. The objective of this study is to improve the understanding of the benefits of adopting digital models to owners and clients, specifically looking at the construction and maintenance/operation phases. This leads to the research question “What business benefits are observed by asset owner/client organizations adopting digital models in construction and maintenance and operations?”

Individuals representing owner and client organizations were interviewed, answering questions about what benefits their organizations had observed from adopting digital models throughout the asset lifecycle and about the understanding of these in the organizations they work in. A semi-structured format allowed the participants to expand and share their thoughts, as well as explain and share data they had that was relevant to the study.

The results indicate significant benefits in the design and construction phase. Digital models had been shown to drive a reduction of rework costs from 15 percent of total project costs to an average of 6 percent in digital projects in Norway. Participants close to the process were convinced, which is significant, but the novelty of the technology, and the duration of construction projects combined, result in objective evidence not being widely available, though this is poised to change through an ongoing focus on data collection. In maintenance both availability of articulated benefits and the understanding of the benefits of digital technologies appeared lacking, mostly because few digital projects had yet to reach that stage of the asset lifecycle. However, participants in the study in these departments were able to discuss potential benefits not yet fully realized.

This field would benefit from more metrics to improve understanding of the return as more data becomes available. To better prepare maintenance departments for the future, education about digital technologies and their benefits, could accelerate acceptance of these technologies in that phase of the asset lifecycle.

A Bridge Over Troubled Waters: The UK Water Sector and The Sustainable Development Goals.



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The United Nations (UN) unveiled the ambitious Sustainable Development Goals (SDGs) in 2015 to concentrate global efforts on sustainability. These goals strive to achieve a better, more sustainable future by 2030 by fostering global partnerships in tackling poverty and improving health, education, inequality, and climate change. Despite all 193 UN member states confirming agreement with the goals, progress in achieving them remains frustratingly slow. In 2023, the UN reported that half of the targets are severely off course, with some showing signs of stagnation or regression. With its inherent connection to these goals, the water sector holds significant potential to be a catalyst for sustainable development. However, research has highlighted that progress in delivering sustainability in the provision of water and sanitation is slow in the UK. Widely reported failures, such as the illegal spilling of untreated sewage, have caused environmental harm and reputational damage for water and sanitation providers and underscore existing tensions in the sector. Despite significant SDG research, there is little focus on how the UK water sector are engaging with these goals and striving to achieve them. This research seeks to understand the current level of engagement with the SDGs among key stakeholder groups in this sector and highlight challenges that may influence SDG achievement.

Through analysis of results obtained through semi-structured interviews with clients, contractors, and consultants, this research concludes that there is currently little engagement with the SDGs within these groups. For improvements to be achieved, this research suggests that a top-down, client-led approach is needed. Stakeholders should also seek better alignment in SDG policy, project plans, and procedures to achieve the goals. This research also suggests that other stakeholders can be influential in fulfilling the SDGs. In the case of the UK water sector, this included the client's operations teams and the UK regulator. Therefore, wider engagement and collaboration among all stakeholders is needed.

Overcoming perceived tensions and trade-offs in the sector could be helped by clearly articulating specific project SDG priorities, thus harmonising values among the groups. Establishing shared values around the goals would allow cohesive strategies to be developed and implemented, to help accelerate progress in achieving them.

Further Enabling Circular Economy principles in the Nuclear Industry.



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This study considers how circular economy (CE) principles can be further enabled in the nuclear industry. The research is undertaken through a UK lens, prompted by the ongoing construction of two new nuclear power stations in the UK, but the context is global in order to consider the whole nuclear lifecycle.

The IPCC's 6th climate change synthesis report states that humans are unequivocally causing climate change through unsustainable energy use, land use and land use change. In the UK, the Climate Change Act (2008) legislates that net greenhouse gas emissions must be reduced by at least 100% of 1990 (baseline) levels by 2050. The UK government has determined that increasing nuclear energy production is necessary for the UK to meet its net zero commitments, but the creation and disposal of radioactive waste remains a public concern when it comes to nuclear energy. Adopting circular economy principles to a further extent could reduce the quantity of radioactive waste that requires disposal and support the UK's net zero commitment by maximising the value of resources already in circulation within the economy and minimising land use change.

This study follows a mixed methods approach: a survey and semi-structured interviews. The semi-structured interviews were undertaken with key individuals from each part of the nuclear lifecycle: uranium mining, extraction and processing, nuclear new build, nuclear power plant operations, radioactive waste management, nuclear decommissioning, and regulation. The survey was disseminated to the following groups: the Society for Radiological Protection, the Australasian Radiation Protection Society, colleagues at Sellafield, colleagues at Sizewell B, the International Radiation Protection Association's Naturally Occurring Radiative Materials task group, the Atomic Energy Society of Japan, the Centre of Study on Evaluation of Nuclear Safety, the International Commission on Radiological Protection and the World Nuclear Association's Radiological Protection Working Group, Environmental Social and Governance group, and the decommissioning and waste group.

The results highlighted multiple barriers and opportunities which are generally echoed across different parts of the industry. The two pervasive themes were 'perception' and 'legislation': perception of the risks associated with low levels of ionising radiation is driving unsustainable practices and the legislation is written to encourage the minimisation of ionising radiation as low as possible, which is driving more waste to final disposal rather than reuse or recycling. There are some examples of good practice in the industry, such as the extension of the operational lifespan of nuclear power stations currently in operation, and the re-purposing of decommissioned nuclear power stations. However, these are limited examples rather than pervasive good practice.

The conclusion of this study is that there are further opportunities to implement circular economy principles in the nuclear industry, but a perception shift is needed, which could be driven by further education about ionising radiation outside of the industry, and alternative applications of radioactive waste legislation inside the industry. The industry will never be fully circular, there will always be inputs and waste requiring disposal, but these inputs and outputs could be reduced safely.

Common Data Environment (CDE) Adoption for Project Management Collaboration and Communication: A Case Study of Afreximbank Trade Centre Project in Harare.



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This research explores the transformative potential a Common Data Environment (CDE) offers in enhancing communication and collaboration in construction projects. With the advent of digital technologies and globalization, and the increasing complexity of projects, organizations are seeking efficient methods to manage, share, and collaborate on projects which generate a lot of data. The Common Data Environment emerges as a promising solution, offering an amalgamated platform for project stakeholders to communicate and collaborate project-related information in real-time.

Drawing from the experiences of stakeholders on a project in Harare, Zimbabwe, this research investigates the impact of adopting a CDE on sharing project related information and collaboration of geographical dispersed teams for a successful project outcome. Through a qualitative case study approach, via semi- structured interviews, this research examines the experiences, challenges and benefits encountered by project stakeholders in adopting a Common Data Environment based workflow.

Key themes addressed in this study include the integration of diverse data sources, sharing and exchange of information in real time to enhance decision making, as well as collaboration of geographical dispersed teams. Additionally, the study delves into the implications of CDE implementation on project performance, information storage, and decision-making. The study is important since both communication and collaboration are key requirements for successful project implementation.

The research found that by using a common data environment for communication and collaboration, project information was readily available to stakeholders and helped to manage project workflow processes mitigating against delays and disputes. The study also demonstrated that for developing countries, where there might be in country skills deficiencies, local projects can benefit from the global skills market by collaborating through digital tools such as a CDE. The research should also illuminate the opportunities and challenges associated with working via a Common Data Environment, informing the basis of whether it should be adopted industry wide in a developing environment like Zimbabwe.

Driving improvements within the design phase of construction projects: The implementation of lean design management.



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Although on-time completion is a key success factor for most construction projects in the UK, it is public knowledge that construction projects often finish late. Research suggests that issues during the design phase are a root cause for construction projects in the UK finishing late. Issues such as the late completion of design and inadequate design can delay the subsequent phases of a construction project, and lead to overall project delay.

Over the last decade, a significant amount of research has been undertaken on lean design management (LDM). Previous studies suggest that the implementation of LDM can help overcome common problems faced during the design phase and improve the design management process.

If, as research suggests, LDM has the potential to improve the design management phase, it is important to understand to what extent the principles of LDM have been adopted within industry. This led to the research question 'what are the perceptions of LDM within industry, and what are the main challenges to implementing LDM practices?' Understanding this is a crucial step in ensuring learning from research is applied within industry to drive improvements.

To answer this research question, a qualitative research methodology was deployed in the form of semi-structured interviews. Design professionals working for both consultants and contractors were selected as the main sample, supplemented with construction planners due to the focus LDM has on planning and control.

The findings suggest that although the term 'lean design management' is not commonly known within industry, the key practices associated with LDM are being implemented, and are considered among best practice. The interviews also identified several challenges to implementing key LDM practices, such as not having a standardised approach to client requirement management, and traditional procurement routes and contracts restricting the value construction projects get from early contractor involvement.

The findings from this study could be used to support the implementation of LDM and unlock its full potential within industry, to improve the chances of construction projects in the UK finishing on time.

Perceptions of Empowerment and Management Productivity in Construction.



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Construction productivity is in decline, with research in the US identifying that the decrease in management productivity is five times greater than that of on-site productivity. Given on-site output heavily depends on the effectiveness of management, this trend is concerning. The decline in productivity is an issue for the industry's long-term pipeline of work, because of the UK's significant investment into its green energy provision, projected to reach up to £375bn by 2035. The problem statement therefore is that there is a lack of employee productivity.

Enhancing productivity in the construction sector will contribute significantly to ensure any such investments are delivered efficiently, sustainably, and on time. Therefore, to support, this research explores management perception of productivity, unearthing insights of the enablers and constraints, through the theme of empowerment. The setting of this study is at Hinkley Point C (HPC), the only live nuclear construction project in the UK. At HPC, like many major-projects, regulation and large project teams are commonplace and procedures are complex and resource-intensive, making this a valuable case study for broader industry application and learning.

To address the problem statement, a mixed-methods research methodology was used. Results from a survey of 323 management employees working on HPC were obtained. The survey provided insights that conflicted against the outcomes of literature review, including the ability for employees to decide where they need to be to do their best work, whilst also implying the working environment impacted their ability to work productively. In addition to the survey, 17 semi-structured interviews were conducted across the project team. The interviewees were asked open ended questions, allowing the respondent to provide qualitative insights based on their real-world experiences. The interviews provided a line of inquiry into the examples underpinning some of the constraints and enablers to management empowerment and productivity at HPC with results including the use of authority matrices, mentoring systems, the impact of working in a JV, and the pipeline of future work.

The research found there was evidence of shortcomings through the volume and use of meetings, emails and communication options, all of which were seen to be a constraint to management productivity. The interviews identified that the HPC project and subsequent regulatory frameworks encourage empowerment, with the importance of the work environment and knowledge sharing identified as the enablers in support of both empowerment and productivity. The study recommends further research into the organisational and regulatory environments, both of which were found to contribute to the perceived positive aspects of unlocking management productivity, including the appropriate use of authority matrixes and communication procedures in the major project sector.

Empowerment for Sustainability in Construction.



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Roadmaps to net zero often rely on completing the low-hanging fruit first. As these easy wins are completed, and with deadlines edging ever closer, making further progress will require the accumulation of many more lower-impact solutions. Technical staff will need to take professional responsibility and suggest improvements that can only be identified by those close to the details to minimise the carbon impact of their organisations. So how can organisations empower employees to do this?

Current literature either focuses on individual green behaviours as a side issue to core activities, or on leadership styles to promote types of behaviours. The literature is often not specific to construction, which accounts for 10% of UK emissions, nor targeting technical professionals, who could all provide valuable contributions if suitably incentivised.

To investigate, this study surveyed technical staff and interviewed leaders in an organisation to establish if they felt empowered in relation to sustainability. While the organisation was found to have a feeling of empowerment through interpersonal relationships not all of the structural elements were found to be in place. Additionally, not all of the empowerment factors were found to be applied to sustainability.

The results found that to increase empowerment, organisations could internally increase knowledge tools and resources so motivated employees are guided in a productive direction. This can be complimented by progress monitoring weighted on par with cost and programme, to provide incentive for those less intrinsically motivated. Externally, organisations should strengthen collaboration with suppliers, designers, clients and policymakers to avoid over-specification and promote innovation.

Unlocking the Potential of Renewable Hydrogen: Recommendations for Engineering and Construction Organisations to Deliver Renewable Hydrogen Faster.



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Project Manager

Worley

The EU aims for net-zero GHG emissions by 2050. They focus on renewable energy and phasing out fossil fuels. Renewable hydrogen (RH2) is an important part of the net-zero roadmap, potentially having a central role in industrial decarbonisation and energy system flexibility. Despite ambitious hydrogen targets, progress is slow due to high costs, technical challenges, and regulatory and infrastructure gaps. Engineering and construction organisations (ECOs) could help overcome these barriers by influencing investment, speed, and scale of project development. This might be achieved through technical (e.g. increasing design standardisation, off-site construction, modularisation, etc) and/or cultural changes (e.g. becoming more collaborative and risk-tolerant). Organisational change would be an essential enabler to achieving these outcomes, but such initiatives often fail, making it even harder to deliver RH2 projects.

This study investigates the reasons and challenges within ECO when implementing technical and/or cultural organisational changes. Specifically, it examines barriers to increasing design standardisation and modern methods of construction (MMC) and shifts towards collaborative and risk-tolerant mindsets. The work was conducted through a series of semi-structured interviews with senior industry professionals from global engineering, procurement, and construction organisations. The interviewees were experienced in RH2 and/or in standardisation and MMC implementation. The analysis involved coding, theme development, and triangulation to propose sector-specific recommendations in a RH2 project development context. The author's direct involvement in energy transition projects helped frame the questions and conduct the discussions. However, the danger of introducing bias in interpreting and analysing the results was recognised and mitigated.

Initial findings suggest that participants believe ECOs must transform technical and cultural aspects to enhance RH2 project delivery, thus improving cost-competitiveness and addressing RH2 scale, speed, and technical challenges. ECOs should adopt a supply chain-driven, knowledge-based approach, functioning as systems integrators and applying platform thinking throughout the RH2 value chain to ensure long-term benefits, mitigate risks, and drive scale. Standardisation, design repeatability, and product-centric thinking are crucial for enhancing RH2 speed, requiring strategic leveraging of existing ECOs, supply chain, and customer experience. Increasing MMC can address logistical and scale challenges, especially within industrial clusters, provided less bespoke designs are used. A collaborative mindset is essential for achieving speed and scale, requiring long-term relationships with supply chain partners. Enhancing diversity in ECO human capital and fostering open-mindedness, entrepreneurial attitudes, resilience, and acceptance of failure can create a more risk-tolerant and agile learning environment. However, market features like short-term profit maximisation, resistance to change, and a fragmented supply chain hinder change.

The study has limitations due to the relatively small sample size (11 participants). However, the depth of knowledge and quality of industrial experience helped mitigate this problem. Seven participants had relevant RH2 experience and most participants had international experience. Overall, the study fills gaps in the literature regarding RH2 project delivery and ECO organisational challenges. It offers insights into barriers and factors affecting RH2 project execution. It provides recommendations for policymakers, industry stakeholders, and academics to facilitate the deployment of renewable hydrogen plants.

Dodgy Wi-Fi and a room full of noise - A study of temporary construction site office facilities.



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Previous research has shown that well-designed workplaces enhance employee satisfaction and productivity. However, in the construction industry, temporary office facilities provided during construction often follow a one-size-fits-all, cost-driven approach that neglects user's evolving needs. Users, typically knowledge workers such as engineers and managers, must balance collaboration with focused work as their roles increasingly shift towards a technology-driven environment.

This study investigates the relationship between leadership priorities in providing temporary office facilities on active construction projects and the experiences of the users operating in these facilities. Six key leaders from three similar projects, each featuring comparable temporary office facilities were interviewed. Additionally, 128 office users across the three projects were surveyed using the Building Use Studies (BUS) methodology.

Thematic analysis of the interviews and survey responses revealed three major themes: 'The working environment matters' describes the importance of internet data supply, meeting rooms, and environmental conditions.

'Background noise and its effect on focused work' describes the effect of distractions, the ability to focus, and the importance of collaboration. 'Lack of control' describes how the leadership defines the facility, how typical standards constrain it, and users' resignation to their environment.

The findings advance understanding in the understudied field of temporary office supply. The study reveals that although the project leadership recognise the importance of creating efficient, diverse spaces that offer users various work environments, they are often limited by traditional practices and budget constraints. Improving the process by which the facilities are specified could significantly enhance user satisfaction and productivity.

How does funding private construction with debt influence the allocation of risk? Can construction clients create the contractual conditions for collaboration, or does debt deny a different distribution of risk?



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The UK construction industry continues to struggle with projects that regularly run late or over budget. How construction is procured is recognised as having a key influence in the success, or failure, of construction projects. A fundamental part of procurement is agreeing who will manage specific risks. Contractors who feel this risk allocation is unfair are more likely to engage in defensive behaviours to 'redress the balance', increasing the likelihood of dispute and poor project performance. A review was completed of the current academic literature related to construction procurement and risk allocation, specifically in the private sector. This suggested that more collaboration, including equitable risk sharing, could lead to improved construction performance. However, clients were assumed to have a free hand in allocating risks and the literature did not adequately explore what influences their decisions. This led to this dissertation's research question: How does using debt to fund construction influence the allocation of risk?

Semi-structured interviews were held with 13 senior professionals who had extensive experience in providing private sector funding for construction. The results were coded, analysed, and compared with the relevant literature. This confirmed the widespread use of highly amended contracts that transfer maximum risk, and consequently invite opportunistic behaviour. It also revealed disagreement over the influence lenders play on risk allocation, and that empirical data is essential to encourage greater collaboration. The most novel findings were that key industry participants do not believe that fixed-price contracts are truly fixed; that their use may be driven by the needs of financiers for a simple format, rather than an accurate one. Finally, the dissertation found a resistance to changing the status quo, and recommends that future research should seek evidence of a link between more collaborative procurement and improved project performance.

Dissociate design and drawings to inform design efficiency through example of electrification projects.



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Railway electrification is central to the UK government's Net Zero commitments, necessitating the electrification of approximately 13,000 single track kilometres (STK) by 2050. Over the past 15 years, the implementation of electrification projects has consistently faced significant challenges, including budget overruns and delays. Current design processes, particularly those associated with 'Single Option Development' and 'Detailed Design,' typically require about one year to complete the design stages for a 1.5 km segment (3 STK) of a two-track railway, ready for on-site construction. To meet the Net Zero targets, the industry must design approximately 423 STK annually, a task that appears daunting given current capacities and posing a significant hindrance to these commitments.

This research explores design efficiencies by decoupling design from traditional drawings and examines the purpose of designs and drawings in electrification projects for various stakeholders in the UK. Through interviews with design, construction, maintenance, and assurance engineers, the study investigates how drawings are utilised in their roles and how relevant information can be conveyed more efficiently.

As understood traditionally, the aim of drawings is to communicate the value generated in design with information which can then be used to construct and maintain in a safe way. Findings reveal that stakeholders primarily use design drawings for visualisation of design, assurance, and record-keeping. In some instances, drawings are produced to bridge the trust gap between design and assurance engineers, or as a form of demonstration of due diligence. The production of drawings, often mandated by standards, lacks consideration of alternative communication methods. However, many stakeholders, including standards owners, are open to reducing the number of drawings if supported by credible alternative processes which does seem to be readily available. There appeared tensions in terms of the information needed on the drawings between designers, construction, and maintenance engineers.

The overall outcome of the research suggests that the industry equates drawings with designs, yet several efficiencies can be realized—such as fewer drawings per design stage and reducing repeated details on drawings—without compromising the current levels of design and assurance. The biggest challenge will be to build the trust between different stakeholders, cultural change in the client organisation to be open to this new approach which can then lead to significant savings to the tune of almost 25-30% in the overall design effort.

India's Urban Housing Shortage Crisis: An Overview on Government Policy.



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India is home to 1.4 billion people, constituting around 20% of the world's population. As of 2021, approximately 495 million people reside in India's urban areas, accounting for 30% of the country's population. The urban housing shortage in India was estimated at 18.78 million homes as of 2017, although civil society organizations put the number closer to 30 million. Notably, 95% of this shortage affects low-income households. This challenge is exacerbated by mass migration, with approximately 15 million people moving from rural to urban areas each year, further straining the housing deficit. Projections suggest that by 2047, 50% of India's population will dwell in urban areas, necessitating an additional 230 million housing units.

According to the United Nations Habitat, adequate housing is a fundamental human right enshrined in international human rights law. Urgent action is imperative to uphold dignity and survivability, particularly in a developing nation like India. Failure to address this crisis promptly risks leaving tens of millions either homeless or living in inadequate housing. The government holds both a moral and social responsibility to promote and facilitate the creation of sufficient housing.

Qualitative research was conducted to assess whether the government is implementing appropriate measures in key areas, including legislating the Right to Housing, Public-Private Partnerships, classifying Real Estate as an Industry, easing regulations on land funding, incentivizing financial institutions to fund affordable home loans, and reforms in Goods and Services Tax (GST). Stakeholders such as senior officials from banks, international property consultants, homebuyers, and other government departments participated in this research.

Given that the government is the largest landholder, it could proactively explore public-private partnerships with private developers to create a stock of affordable housing. Streamlining the approval process through a single window clearance system would reduce approval timelines, facilitating faster project completion and decreased project costs. These measures could enhance investor confidence. Additionally, allowing banks to fund land acquisition at lower interest rates (9%-12%) compared to non-banking financial companies (NBFCs) and alternative investment funds (AIFs), which charge between 18%-30%, could further incentivize affordable housing development. Establishing a framework to enable the real estate industry to avail input credit of GST, similar to other sectors, could potentially reduce home prices by 12%. Implementing these measures could significantly bridge the affordability gap and alleviate the shortage crisis.

Stakeholder perspectives of complexity in rail projects: A pre-mortem.



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Background: In the United Kingdom, the railway system is inherently complicated due to its extensive network, technical requirements, and operational needs. However, regionalisation, and fragmentation has introduced additional layers of complexity. Complexity is increasingly capturing the attention of academics and professionals alike due to its impact on project performance. However, the project management literature tends to concentrate on performance measures and seldom addresses the factors contributing to complexity, particularly in government sponsored infrastructure projects.

Objective: Rail projects are among the poorest performers in the construction sector, and recent initiatives continue to follow this pattern. This study aims to delve into the nuanced understandings of project complexities across various stakeholder groups within the context of improving the performance of government sponsored rail projects. By examining the question, 'how are the complexities of projects developed and understood differently across various stakeholder groups associated with government sponsored rail projects?' The study seeks to enhance policy makers, funders and clients' understanding the importance of complexity in rail projects in a challenging fiscal environment.

Method: This study employed a qualitative methodology that combined the theoretical insights of social constructivism with the Technology-Organisation-Environment (TOE) framework. This approach facilitated the identification, validation, and prioritisation of the most impactful factors influencing project performance. By adopting a multifaceted perspective on project complexity, informed by social constructivism, the study recognises that complexity is not simply an inherent feature; rather, it is co-constructed through the interactions and collective experiences of all stakeholders involved. Understanding the history, class, culture, and symbolism that shape how stakeholders gain their knowledge highlights the importance of viewing and managing complexity not as an innate property of projects but as a construct developed through the joint efforts and experiences of all stakeholders.

Results: The results of the study highlight that government-sponsored rail projects, when viewed through a social constructivist lens and integrated into the TOE framework, underscore the significance of social interactions, shared understandings, and the influence of cultural and environmental contexts in shaping the complexities of large-scale infrastructure projects. This approach promotes a more dynamic and context-sensitive handling of project delivery and reveals that the current fragmentation of the industry hinders project performance.

Originality/value: Integrating social constructivist principles with the Technology-Organisation-Environment (TOE) framework can feasibly develop and sustain relationships in large-scale railway projects amidst frequent personnel changes by embedding trust and value within the project's processes, culture, and technology, thereby enhancing project performance and outcomes. This research aims to fill a gap in existing project management literature by exploring the versatile nature of project complexity in UK Government-sponsored railway projects through the lens of social constructivism and the TOE framework. By examining how stakeholder interactions and perceptions shape project complexity, the study sheds light on how these dynamics ultimately influence project performance. Reflecting on the legacy and future prospects of government-sponsored railway projects, this study highlights the essential role of understanding and managing project complexity in promoting continual improvements in project performance.

Media selection for communication between onshore and offshore engineering teams, a case study.



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Advances in technology and an increasingly global workforce have enabled organisations to utilise virtual teams more extensively. This has led engineering firms to establish branch offices in lower-cost offshore jurisdictions to support onshore teams.

Project delivery by global engineering teams requires high levels of collaboration. Team members must use electronic media to communicate across time zones and continents while navigating language barriers and cultural differences. Unsurprisingly, communication challenges are often attributed to teams' underperformance.

The effect of media selection on communication performance has been widely studied. Theories on media synchronicity demonstrated how using specific media for particular situations can improve team performance. However, the relevance of these theories for integrated onshore-offshore global virtual teams is uncertain.

This research investigated the factors influencing onshore and offshore team members' choice of communication media for inter-team interactions. It also explored how an individual's choice of communication media may vary based on their team. This research may advance knowledge on media selection and influence the media that global teams adopt for inter-team communication.

A qualitative research approach using a case study research methodology was selected. The research considered two cases from an organisation: an offshore engineering team based in India and an onshore engineering team based in the United Kingdom. Multiple cases allowed the researcher to draw cross-case conclusions and explore team differences.

Data was collected through thirteen individual semi-structured interviews with engineering professionals in their local offices. The interviews were conducted in person to allow participants to express themselves freely. The interview transcripts were coded and thematically analysed. Code labels were standardised and based on theoretical concepts from the literature. Common and conflicting themes between the cases were examined to identify cross-case findings.

As identified in the literature, the media's physical capabilities were identified as influencing characteristics for both cases. These included media's ability to convey verbal and non-verbal cues, communicate with groups, provide immediate feedback, and create communication records. The extent to which media enabled the convergence on meaning and conveyance of information was also identified.

Cross-case findings showed that geographic limitations restricted communication to electronic media, and time zone differences limited the use of synchronous media to specific contact windows. Individual preferences and company protocols were also found to be important.

The offshore team recognised language barriers, culture, and seniority as key factors in media selection. Some individuals preferred verbal communication for immediate clarification, while others favoured written communication because it provided additional time to craft and review messaging. The onshore team emphasised the importance of

nonverbal cues for relationship-building and feedback while generally preferring more efficient and informal communication methods.

This research found that the capabilities of communication media identified in the literature influenced media selection for communication between integrated onshore-offshore teams. Other influencing factors led to increased adoption of asynchronous forms of communication media, which may result in suboptimal media selection and reduced communication performance. These findings may assist organisations in identifying and managing atypical factors influencing a team's media selection.