

INSTITUTE OF BUILDING
AND URBAN DESIGN
School of the Built Environment

CONSTRUCTION MANAGEMENT
& INNOVATION

CONSTRUCTION MANAGEMENT AND INNOVATION RESEARCH AT THE SCHOOL OF THE BUILT ENVIRONMENT TAKES PLACE WITHIN THE INSTITUTE OF BUILDING AND URBAN DESIGN, ONE OF THREE MAIN RESEARCH INSTITUTES AT THE SCHOOL. THE OVERARCHING AIM OF OUR RESEARCH IN THIS AREA IS TO HELP CONSTRUCTION PROFESSIONALS IMPROVE BOTH THE EFFICIENCY OF THE PROJECT DELIVERY PROCESS AND THE QUALITY AND SUSTAINABILITY OF THE BUILT ENVIRONMENT.

Buildings and the built environment are fundamental to shaping our cities and towns and play a pivotal role in achieving a wealthier, fairer, healthier and safer society. The provision of well-designed, functional and energy-efficient buildings is now an essential pre-requisite within today's society. The construction process is a complex one, which requires collaboration of multiple organisations and specialists over the whole life cycle of buildings and structures. It is influenced by client requirements and expectations, government policies and regulations, the development of new technologies, economic and social trends, as well as the demands of sustainable development. The challenge for construction management and innovation research is to come up with new solutions to problems facing the construction sector.

Our research team consists of 13 academic staff, including three professors, funded researchers and 36 PhD students. Their expertise spans a wide range of areas, including management, procurement, ICT applications, sustainability, training and skills, construction materials, and building technology. They carry out industry relevant research in the following five themes:

- Construction Project Management
- ICT in Construction
- People and Organisation
- Procurement
- Sustainability, Building Resilience & Climate Change.



Example projects

Managing change and dependency in construction projects.

This project investigated the rework problem caused by changes during construction projects. It developed a change dependency framework and a change and dependency management toolkit, consisting of change prediction and workflow tools. The framework defines a standard procedure for managing changes and the change prediction tool is capable of simulating different scenarios of change by predicting and evaluating the impact of different options. It can be used during the project planning or project execution stages. The workflow tool helps project teams adjust workflows when change events occur. It also assists individual team members in identifying the impact of change on their particular tasks.

Funded by EPSRC.

Improving NEC contract management with Contract Change Management system.

Contract Change Management (CCM) is an online collaboration system, which supports the implementation of NEC contract change management processes. It has been used on hundreds of building and engineering projects in the UK. This research investigated the benefits of the system from a user perspective. It further developed methods to measure both tangible and intangible benefits.

Funded by Technology Strategy Board and MPS Ltd.

People

Prof Ming Sun, Prof Stephen Ogunlana, Dr Ibrahim Motawa, Dr Graeme Bowles

CONSTRUCTION PROJECT MANAGEMENT

The project management process aims to ensure that projects are delivered on time, within budget and to the satisfaction of clients. A number of unique characteristics of the construction industry pose particular challenges to the management of construction projects: they are usually "one offs"; they are diverse and vary in size, type, and complexity; and they are often carried out by temporary teams under the influence of many internal and external uncertain factors. As a result, in practice many construction projects suffer from delays and cost overruns.

Our researchers are active in investigating key issues of construction project management, such as: the causes and effects of project change; project change management; cost and time control practice; project control models; risk management; supply chain relationships; and project team capability.

Our expertise can help project managers to improve the project delivery process by reducing risks through anticipating problems and managing them effectively when problems do occur.

INSTITUTE OF BUILDING AND URBAN DESIGN

Our Institute aims to advance scientific understanding in building and urban design by addressing the problems posed by climate change, sustainable development, infrastructure deterioration, and personal and national security.

We undertake cutting-edge research aimed at delivering technological advances and informing government policy on topics relevant to these problems.



ICT IN CONSTRUCTION

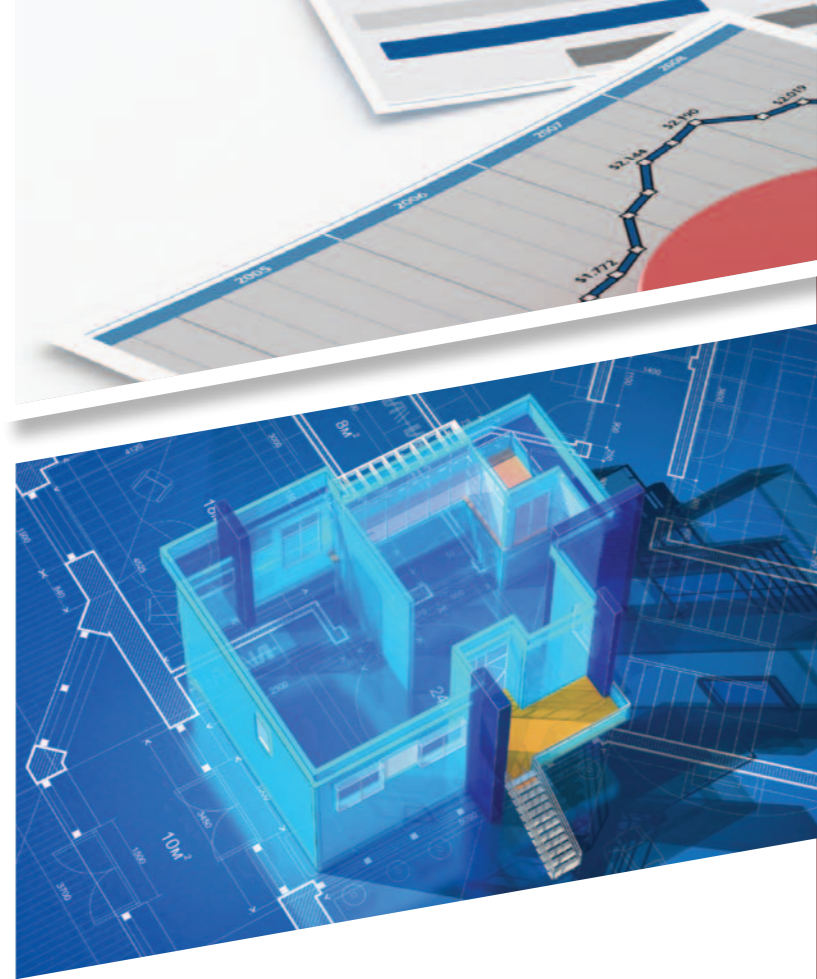
Rapid advances in Information and Communication Technologies (ICTs) have been transforming business practice and service delivery in many economic sectors. The construction industry needs to embrace ICTs and explore their potential in tackling problems for efficient and effective project delivery.

Our researchers are actively contributing to the development and assessment of ICTs in construction in the following areas: Data and Information Capturing (2D/3D imaging, photo/videogrammetry, RFID and positioning technologies); Integrated Information Management (information modelling, Building Information Modelling (BIM), database management, process modelling, stochastic decision making and risk assessment technologies); Information Communication (3D-4D-5D model visualization, Virtual Reality and Augmented Reality); Digital Collaboration (strategic IT adoption, implementation of technological innovations and organisational change management for collaborative working); and ICT Benefit Measurement.

Example projects

A system for rapid and accurate post-disaster damage and needs assessment of built assets. Natural calamities frequently cause massive damage to buildings and infrastructures and a huge amount of insurance claims across the world. Delay in Damage and Needs Assessment (DNA) has always impeded timely decision making on rescue, compensation and reconstruction. This research focuses on developing a novel system, based on innovative techniques for geospatial data analysis, to support rapid and accurate post-disaster built assets DNA on a large scale.

Fund by EPSRC



Vision-only -based AR system for immersive BIM information communication.

This collaborative project developed a novel markerless and vision-only -based Augmented Reality (AR) system, with a focus on applications within structured environments like urban sceneries. This system was demonstrated to provide value to the planning and design stages of construction developments, when any stakeholder can visualize and analyse the impact of the proposed developments directly within their real environments.

Funded by Swiss SNF

People

Dr Frédéric Bosché, Dr Zhen Chen, Dr Bilge Erdogan, Dr Ibrahim Motawa, Prof Ming Sun



PROCUREMENT

Modern approaches to construction procurement are complex and multi-faceted as the focus shifts from lowest capital cost to Value for Money and effective service delivery for clients and end users. Internationally, the industry is still coming to terms with concepts and practices including whole life based decision making, supply chain integration, sustainability and risk management that collectively exemplify modern collaborative procurement. This presents challenges for the academic and practitioner communities in developing and implementing effective procurement strategies. In particular, there is a need to recognise that measures of success and Value for Money are wide ranging, involve numerous stakeholders and are often ill defined.

Our research team is engaged in procurement related research that is internationally based and related to procurement of built assets as well as the services they deliver. The diversity of research being undertaken ranges from evaluating Value for Money and procurement efficiency in the social housing sector for public sector clients, Quantity Surveying, through to developing effective and efficient contractual frameworks for disaster-driven reconstruction projects.

Example projects

Devanha Phase 2 Monitoring and Evaluation Framework. Monitoring and evaluating the extent to which Value for Money is achieved from a £150M innovative procurement programme for social housing in Scotland. The research project involves advising the Scottish Government through an analysis of cost savings and quality improvements that may be realised through novel procurement approaches.

Funded by the Scottish Government

Life Cycle Cost modelling.

One of the challenges of PFI procurement is for companies to develop the skills for running and managing assets effectively in order to remain competitive and profitable. The procurement theme team led a two year Knowledge Transfer Partnership project to develop a life cycle cost modelling package for a major facilities management company. The project delivered a software based model and training package to enhance their life cycle costing capability for more efficient management of their assets.

Funded by Technology Strategy Board and FES FM Ltd.

People

Prof Stephen Ogunlana, Dr Graeme Bowles, Dr Ade Oyegoke, Dr Roshani Palliyaguru, Dr Zhen Chen, Dr Ibrahim Motawa

PEOPLE AND ORGANISATION

This research theme involves the consideration of people management issues in the construction industry. The industry is largely regarded as labour-intensive and so it is important to ensure that people have the appropriate skills, and are supported by adequate organisation systems, in order to deliver successful projects. Our research staff can offer advice and expertise in the following areas: project performance and management; workforce productivity; skills and training; leadership and motivation; construction education; and government skills policies (such as levy/grant schemes).

We have an extensive track record of research and publications as well as engagements in construction projects and consultations internationally. Our work also has a strong connection to government skills policy and was cited four times by the UK Commission for Employment and Skills (UK CES). The overriding aim of our research is to better understand and support the development of the people and organisation management in the construction sector.

Example project

A Virtual training system.

We are collaborating with ConstructionSkills to develop an innovative system to support current apprenticeship training. The technology would allow existing apprentices to perform real life tasks such as bricklaying and roofing in a Controlled Immersive Environment (CIE) and it will be hosted at Edinburgh's Telford College. This is the first time that CIE will be used specifically for supporting apprenticeship training in Europe. Not only can the CIE support the future skills development of the construction industry but also it has the potential to enhance workers' performance in terms of health and safety, and productivity.

Funded by ConstructionSkills

People

Dr Mohamed Abdel-Wahab, Dr Fiona Grant, Prof Stephen Ogunlana, Dr Adekunle Oyegoke, Dr Roshani Palliyaguru



SUSTAINABILITY, BUILDING RESILIENCE & CLIMATE CHANGE

Climate change predictions suggest that the frequency and severity of extreme weather events are increasing. UK and international policy requires deep cuts in greenhouse gas emissions to mitigate future climate change, while the built environment must also adapt. Our research has developed a strong track record in the broad aspects of sustainability, climate change and building resilience and adaptation. Our work links disaster risk reduction and infrastructure renewal and aims to ensure sustainable socio-economic development. Our expertise serves broad strategy decision making and has led to solutions for the societal, economic and technical issues that climate change poses.

Our research into adaption of existing buildings has contributed to understanding the behaviour of traditional low carbon materials and technologies. Research since 1997 into low carbon alternative binders and geo-materials has facilitated their wider use. Traditional and historic buildings are considered 'hard to treat' in terms of achieving carbon and energy savings due to their limited retrofitting capabilities. Our research explores novel mechanisms for overcoming these issues.

Example projects

An assessment of binder leaching in traditional mortars for mass masonry.

This project is investigating the impact of climate change on traditionally built masonry structures and more specifically, establishing the rate of soluble binder leaching in various lime mortar types commonly used in their construction.

Technology Assessment for Radically Improving the Built Asset baSE (TARBASE).

This project developed a model for assessing the efficacy and cost of CO2 reducing refurbishment measures on existing buildings. This then led to the development of game software called From Concrete to Cookers, which was based on the model. This software was aimed at school pupils and allowed them to understand the environmental impact of buildings and explore ways to reduce emissions. The model was further developed for solid wall dwellings by the Consumer-Appealing Low Energy Technologies for Building Retrofitting (CALEBRE) project with a focus on the order in which measures are carried out.

Decision support for building adaptation in a low-carbon climate change future.

This project made the UKCP09 climate projections accessible to designers of buildings that are resilient to overheating and will underpin the Adaptation and Resilience In Energy Systems (ARIES) project in assessing the resilience of energy supply systems in a low carbon climate change future. ARIES will also exploit the methods developed in projects monitoring energy consumption in schools, offices and industrial premises.

All projects are funded by EPSRC, PPE, ARCC

People

Prof Phil Banfill, Dr Zhen Chen, Dr Alan M Forster, Dr Roshani Palliyaguru

PEOPLE

Dr Mohamed Abdel-Wahab

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Research interests: people management, performance, labour market issues, application of construction technologies.

Professor Phil Banfill

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Research interests: Sustainability, energy use and CO2 emissions from buildings; building conservation and education; rheology of cement based materials; processing of concrete; chemistry of admixtures and their interactions with cement; special cements and cement blending agents.

Dr Frédéric Boshé

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Research interests: As-built dimensional sensing (2D/3D/4D/5D Data acquisition and information extraction); BIM; as-built modelling; dimensional control; Construction project management; visualization; VR and AR.

Dr Graeme Bowles

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Research interests: Whole Life Costing; value for Money and procurement efficiency.

Dr Zhen Chen

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Research interests: Construction engineering and management; facilities management; multiple criteria decision making; and ICT applications.

Dr Bilge Erdogan

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Research interests: Construction IT; strategic IT management and IT adoption; visualization and mobile technologies in construction; collaboration and collaboration environments; quality management; organizational change management; scenario planning and vision development.

Dr Alan Forster

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Research interests: Low energy materials; impact of climate change on traditional buildings; construction technology & design; sustainable construction and green materials; building conservation philosophy & repair of traditional structures; building maintenance; building pathology and inspection.

Dr Fiona Grant

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Research interests: Professional practice of surveyors; training and skills; teaching, learning and assessment.

Dr Ibrahim Motawa

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Research interests: Construction IT and management; construction simulation and optimisation; modelling complexity in Built Environment; energy efficient construction; knowledge management; risk management.

Professor Stephen Ogunlana

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Research interests: Project management in a global context; organisational learning through simulation of construction processes; public private partnerships for infrastructure delivery; social and environmental impacts management; people in organisations; construction industry development.

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Research interests: Construction procurement, quantity surveying; construction transparency; construction economics and management.

Dr Roshani Palliyaguru

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Research interests: Disaster risk management; impact of climate mitigation and adaptation on economic of construction; effectiveness of incentive based payments for construction contractors.

Professor Ming Sun

Phone: 0131 4514649 | Email: m.sun@hw.ac.uk
Research interests: Integrated building design systems; Building Information Modelling (BIM) and integration; IT benefit measurement; project change management; project cost and time control; construction supply chain relationships; value for money of PFI projects; low carbon house design and sustainable homes.

PHD PROGRAMME

We currently have 36 research students on our PhD programme. We provide supervision on a wide range of topics across all five research themes.

- Construction Project Management
- ICT in Construction
- People and Organisation
- Procurement
- Sustainability, Building Resilience & Climate Change.

More information can be found at:

www.sbe.hw.ac.uk/research/postgraduate-research.htm

TAUGHT POSTGRADUATE PROGRAMMES

We offer the following taught postgraduate courses:

- Construction Project Management, MSc, Diploma, Certificate
- Quantity Surveying, MSc, Diploma, Certificate
- Architectural Project Management (Distance Learning Only), MSc, Diploma, Certificate
- Building Conservation (Technology And Management) Distance Learning Only, MSc, Diploma, Certificate

More information can be found at:

www.postgraduate.hw.ac.uk/sbe/ibud/courses/

