Research at the Digital Construction Research Unit
This handbook has been produced by

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Digital Construction Research Unit (DiCRU)

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innovativeconstructiontechnologiesbuildinginformationmanagement/
Digital Construction Research Unit (DiCRU)
Our vision for Digital Construction is that Technologies cannot work spontaneously, there are enormous complex interdependent processes; and people with conflicting interests who will make these technologies effective and efficient.

The Digital Construction Research Unit at the University of Strathclyde evaluates and develops advanced technologies, methodologies and approaches for cutting-edge Information and Communication Technologies (ICT) to improve the performance of construction industry. The Unit also aims to model the relationships between technologies, processes, and people. The team is committed to research and knowledge exchange in addition to research-led teaching.

Our goal is to develop quality research and to maximise impact through dissemination, research-led teaching, while influencing policy and decision-making. We seek to extend knowledge of Digital Integrated practices and innovative trans-disciplinary solutions.

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RESEARCH AT DICRU

About us

The DiCRU is a newly established research unit with two members of staff and currently nine PhD students. Dr Ibrahim Motawa is a Senior Lecturer in Building Information Modelling and director of the MSc course ‘Advanced Construction Technologies & BIM’. Dr Motawa has been the principle investigator of research projects related to BIM development and energy efficiency in buildings. Dr Zhen Chen is a Lecturer in Construction Management. He has an academic and professional career for dependable built environment through working for companies, professional bodies, and universities worldwide.

Our research

The research group addresses a strategic priority of the Department of Architecture to explore and develop advanced ICT methodologies and systems in response to the UK (and the global) interests of digital transformation of the construction industry. Implementation of BIM level 2, prospective BIM Level 3/4, Industry 4.0, and Digital Twin are key concepts in our research. In collaboration with industry partners, we act as a knowledge hub and a conduit for facilitating a paradigm shift within the industry.

We encourage PhD applications on a variety of topics

In addition to the topics of the current research projects, topics of interest include:

- Building Information Modelling/Management
- Big Data in construction and for Smart Buildings and Cities
- Applied informatics and artificial intelligence
- Energy Efficiency Simulation and Building performance
- Optioneering and process reengineering
- Megaproject management
KEY RESEARCH AREAS

BIM, Big Data, and IoT for Intelligent Buildings
The Built Environment is rapidly changing with the move towards a resource efficient circular economy and the drive for more efficient, agile and customisable manufacturing through Industry 4.0. Our work in this area aims to integrate intelligent smart systems in conjunction with big-data concepts to improve construction performance.

Intelligent Decision Support Systems for Construction and in Megaprojects
Our work involves development and validation of decision support systems for construction problems and for managing megaprojects. We examine the impact of qualitative/quantitative and static/dynamic measures on design/construction/operation stages. We study the interdependency among technologies; processes; and people to develop integrated interfaces.

Sustainable and Energy Efficient buildings
Industrial informatics for smart and energy efficient buildings have huge potential to make significant contributions to sustainable systems. Our work within this area covers applications for communication and control infrastructures; systems dynamic, predictive analytics; energy control, optimization, and demand response.

These research topics are also covered to some extent in our MSc in Advanced Construction Technologies & BIM. Students in this course develop industrial solutions while researching on the principles and techniques related to the above areas.
PHD TOPICS WE SUPERVISE

Current PhD topics

A Framework for Improving Business and Technical Operations within Timber Frame Self-Build Housing Sector by Applying Integrated VR/AR and BIM Technologies
Lilia Potseluyko Amobi

The Application of Heritage Building Information Modelling (HBIM) Processes for Building Conservation Works
Saiful Fazli Bin Ramli

BIM integrated building code checking system for Chiang Mai, Thailand
Silpa Singharajwarapan

Social sustainability and BIM
Soukaina Elaouad

An Integrated Risk Management Decision Support System for Oil and Gas Construction Projects
Mohammed Almhdawi

Using immersive technologies for architectural applications
Andrew Graham

Hybrid Optical Fibre Based Daylighting & LED High Power Source for Buildings
Seyedmohammadsale Seyedzadeh Kharazi

An analytic approach to adopting BIM overlay in Libya
Ambark Bareka

A framework of BIM education in Libya
Ozaer Zaed
Improving Operations within Timber Frame Self-Build Housing Sector through VR/AR and BIM

Thanks to the advent of Virtual and Augmented Reality (VR and AR) technologies, companies can improve their competitiveness by enhancing their clients’ spatial understanding, simplifying communications, provide customisation options and consolidate quantification and support interoperability. This research seeks to provide technical recommendations for the development of a prototype framework to support the adoption of BIM and VR/AR technologies within the UK housing industry.
INTERNATIONAL EVENTS & FORUMS

2018

16th International Operations and Maintenance Conference in the Arab Countries - OMAINTEC 2018, Cairo, Egypt
“Managing Maintenance within Industry 4.0”, Ibrahim Motawa, Keynote Speaker

Future of FM & Building Operations, Glasgow, UK
Zhen Chen, seminar organiser with BAM FM Ltd and BAM Energy Ltd

Engineering for the Sustainable Built Environment, Glasgow, UK
Zhen Chen, seminar organiser with AECOM

15th International Operations and Maintenance Conference in the Arab Countries - OMAINTEC 2017, Beirut, Lebanon
“Smart maintenance” - Workshop on Digital Transformation in the Operation and Maintenance of the Construction and Building Industry
Ibrahim Motawa, Workshop organiser and Keynote Lecture

Laser Scanning Solutions for Building Projects
Zhen Chen, seminar organiser with BIM/CIM North UK

International Multi-Disciplinary Mega-Projects, Glasgow, UK
Zhen Chen, seminar organiser with AECOM

2017

The British Council ‘Science Collaboration Symposium: Smart Cities’, Abu Dhabi, United Arab of Emirates
Ibrahim Motawa, Invited Lecturer

The EU COST action ‘Mining the European Anthroposphere (MINEA)’, Vienna, Austria
“WG 1: Modelling the stocks and flows of the built environment for construction and demolition waste management”
Ibrahim Motawa, Invited Lecturer
The British Council ‘Science Collaboration Symposium - Smart Cities’
The event, hosted at the Masdar Institute, Abu Dhabi, United Arab of Emirates, 26-27 March 2017 is part of the UK/UAE 2017 Year of Creative Collaboration. Its aim is to encourage scientific researchers to present their stimulating work and ideas for knowledge transfer related to Smart cities. The event was attended by scientists and innovators from research institutions and start-up companies from the Gulf countries, as well as the UK.
KNOWLEDGE EXCHANGE

Consultancy

The DiCRU offers consultancy to industry partners and government agencies in the UK - and particularly in Scotland - on a number of key areas, including BIM implementation. One of our most recent works with industry was for the Royal Liverpool University Hospital, where we conducted a sustainability-oriented assessment of redevelopment plans using ANP approach.

Teaching

The Unit is delivering the MSc course in Advanced Construction Technologies & BIM. As a research-led teaching approach, the course covers many related areas to digital construction and benefits from strong links with many professional and governmental bodies such as: Scottish Future Trust and Construction Scotland Innovation Centre. We also contribute to undergraduate teaching in the area of Architecture Informatics and organise and deliver CPD and training programmes for professionals and prospective technology learners.

Knowledge Dissemination and Exchange Events

The Unit engages in national and international events for knowledge exchange related to digital construction and BIM. Examples of recent activities include research engagement sessions with students and staff of the Department of Architecture at the University of Seville (Spain), an Erasmus+ funded agreement. We have had several KE activities with industry partners, including:

- Development of BIM models for existing buildings – case of Lochbrae Court, with Cairn Housing Association, Edinburgh.
- BIM and QR coding for Passivhoos with John Gilbert Architects Ltd, Glasgow.
- Design of Add-Ons for Flex Series with Neat (UK) Ltd, Construction Scotland Innovation centre, Blantyre.
Advanced Construction Technologies & BIM

The construction industry stakeholders are in need of high-calibre and highly-competitive candidates with knowledge and skills in construction disciplines, Advanced Construction Technologies and Building Information Modelling. Our multidisciplinary course aims to develop the knowledge, practical, and personal skills of graduates to work in the Architecture/Engineering/Construction (AEC) industry and to develop further research skills related to AEC fields.
RESEARCH GRANTS & PROJECTS

Development of a BIM-Integrated Virtual Showroom for Offsite Manufactured Production
Knowledge Transfer Partnerships (KTP) with Norscot Joinery LTD

The effective design and delivery of megaprojects in the European Union
COST Action TU1003, funded by the European Cooperation in Science and Technology (COST), Horizon 2020, European Union.

A sustainability-oriented assessment of redevelopment plans for the Royal Liverpool University Hospital using ANP

A consultation report was submitted to the Royal Liverpool and Broadgreen University Hospitals NHS Trust with regard to the redevelopment of the Royal Liverpool University Hospital. The analytic network process (ANP) method was adopted to evaluate two proposed redevelopment plans under a whole range of requirements on hospital sustainability in relation to social, technical, economic, ecological, and political (STEEP) issues. The recommended plan from this report matches the final decision made by the NHS Trust.
PUBLICATIONS BY RESEARCH AREA

**BIM, Big Data, and IoT for Intelligent Buildings**


**Intelligent Decision Support Systems for Construction and in Megaprojects**


**Sustainable and Energy Efficient buildings**


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