Workshop on:
Digital Transformation in the Operation and Maintenance of the Construction and Building Industry

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Innovative Construction Technologies and BIM research cluster
• Virtual, augmented & mixed reality
• Automated regulatory & design code checking
• Big data in construction
• BIM integrated assessment & modelling
• Green BIM
• Intelligent buildings

MSc course "Advanced Construction Technologies & BIM“
Aim and Objectives

The workshop aims to bring various industry and academic professionals to share the experience in the field of digital transformation in construction, operation, and maintenance of buildings. During the workshop, the lessons learnt from the ongoing efforts in the UK will be shared. With focus on the practices in the Arab countries, the workshop will cover:

1. Overview of digital construction, operation and maintenance data for product development, performance and reliability improvement (methods of data collection and analysis)
2. Strategic aims and technology road map to implement large data management
3. Opportunities and barriers of digital transformation in construction and building industry

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The agenda

• **Part 1: Concepts & Strategies**

• **Digital Transformation Survey**

• **Part 2: Implementation & Evaluation**
Part 1: Concepts & Strategies
Challenges to Built Environment

Urbanisation: Between 2015 and 2050 the world’s urban population is forecast to increase by over 60%, an increase of 2.5 billion. Need for more housing, schools, transportation, infrastructure, employment and shops and with the shift from rural to urban areas, the majority of this housing will need to be affordable.

There is a growing need to improve resource efficiency as part of a circular economy. Construction needs to be more sustainable, while continuing to improve social conditions and tackle human and natural disasters.

To meet the challenge, the design, construction, and operation can benefit from the shift from analogue to digital in order to enable more communication between the virtual and physical worlds, and to develop more smart assets.
Challenges to Construction

This slow pace of innovation matters, because of the great scope and scale of E&C:
• The construction industry serves almost all other industries, as all economic value creation occurs within or by means of buildings or other “constructed assets”.
• The industry accounts for about 6% of global GDP and is growing. (In parts of the developing world, such as India, it can account for more than 8% of GDP.)
• E&C is the largest consumer of raw materials and other resources, using about 50% of global steel production and more than 3 billion tonnes of raw materials.
• Constructed objects account for 25-40% of the world’s total carbon emissions.
• In the United States, for instance, people on average spend nearly 90% of their time indoors. So the building and the materials used in its construction and finishing have a major impact on the health and well-being of its occupants.
• Any improvement in productivity and successful adoption of modern innovative processes will have a major impact. For example, a 1% rise in productivity worldwide could save $100 billion a year.
Challenges to Construction

The question facing every manager in the sector is:
“Do we disrupt now? Or
do we wait to be disrupted?”

‘No one will innovate in isolation’
We have to share our own areas of expertise with third parties and combine them with new and non-core disciplines.
Operation and feedback

Need for action

Five trends will shape construction and capital projects.

1. Higher-definition surveying and geolocation
2. Next-generation 5-D building information modeling
3. Digital collaboration and mobility
4. The Internet of Things and advanced analytics
5. Future-proof design and construction

Digital construction organization

The construction industry is among the least digitized.

The McKinsey Global Institute industry digitization index; 2015 or latest available data

- Relatively low digitization
- Relatively high digitization
- Digital leaders within relatively undigitized sectors

Source: AppBrain; Bluewolf; Computer Economics; eMarketer; Gartner; IDC Research; LiveChat; US Bureau of Economic Analysis; US Bureau of Labor Statistics; US Census Bureau; McKinsey Global Institute analysis
Need for action (Industry Transformation Framework)
Disruptive technologies

• Disruptive technologies enabled by an analogue to digital shift

• ‘The information economy is transforming the way we live and work’

• Digital Economy - Smart city economy
  o Smart systems for transport, energy, health care, water and waste

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Disruptive technologies

- Drone monitoring and simulation
- Equipment/material connectivity and tracking
- Robotics and automated technology
- Mobile technology, platforms and reporting
- Project information encryption
- Integrated real-time data and analytics
- Building Information Modelling
- 3D printing
- Capital construction project lifecycle

2016 KPMG International Cooperative ("KPMG International")

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Initiatives and Studies

UK initiatives:
• The UK Government’s BIM (Building Information Modelling) strategy (2011)
• Construction 2025 strategy (2013)
• Digital Built Britain (2015)

Global studies:
• World Economic Forum (2016), Shaping the Future of Construction - A Breakthrough in Mindset and Technology
• Digitization in the construction industry – Building Europe’s road to “Construction 4.0”, Roland Berger GMBH (2016)
• The Manufacturer (2016): The Manufacturer Industry 4.0 UK Readiness Report
• PWC (2016) Industry 4.0 – Building the digital enterprise - Engineering and construction key findings
• Building a technology advantage, Global Construction Survey 2016, KPMG International
• IFS Digital Transformation Survey 2016 Infographic, IFSworld
• The McKinsey Global Institute (2016), Imagining construction’s digital future
“Cross Sector Collaboration Model”,
Digital Built Britain (2015)
The long term success of the strategy will be underpinned by:

- The digital infrastructure (both physical and regulatory) and the framework for cyber security, regulation, contracts and privacy necessary to support trust, growth, collaboration, innovation and excellence
- Sharing of technologies across many sectors to increase investment, value and collaboration across the market
- An effective education and change management programme to enable the industry to develop necessary skills and new ways of working
Recommendations on digital transformation

Recommendations from UK construction industry about digital transformation:

• Level 2 BIM programme’s successful delivery and significant construction costs savings of £840M in 2013/4, with several major EU nations including France and Germany announcing similar BIM programmes.

• The need for concerted joint action from Government, Industry and Academia working in partnership toward the success of the sector and ensuring that benefits are felt across the rest of the economy.

Modern digital technologies can help on:

• Delivering more capacity and better services from the economic and social infrastructure with less capital investment.
• Maximising the time that facilities are available to be used and continuously monitor the condition and operation of infrastructure and to intervene before problems arise.
• With the possibility of capturing in-use performance data, Traditional procurement methods and processes will change and the performance data will transform the way we manage and deliver our assets.

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Building Information Modelling

BIM uses advanced computer systems to build 3D models of infrastructure and hold large amounts of information about its design, operation and current condition.

At the planning stage it enables designers, owners and users to work together to produce the best possible designs and to test them in the computer before they are built.

In construction it enables engineers, contractors and suppliers to integrate complex components cutting out waste and reducing the risk of errors.

In operation it provides customers with real-time information about available services and maintainers with accurate assessments of the condition of assets.

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Building Information Modelling

The National BIM Standards

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Building Information Modelling

World Economic Forum (2016)
BIM Technologies

BIM for ‘x’ Abilities

Transportation_BIM
Infrastructure_BIM
Disaster Resilience_BIM
Labour Training_BIM
User Behaviour_BIM
Heritage_BIM
H/S_BIM

BIM-based Analytics tools

Knowledge-based BIM
Agent-based BIM
AI-based BIM
Socio-Tech BIM
Crowdsourcing BIM
Semantic interoperability BIM

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BIM level 2 and beyond

Publically Available Standards
PAS####.:#.:####

&
British Standards
BS ####.-#:####

to support the implementation of
BIM Level 2 programme

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The basis for Industry 4.0 is the availability of all relevant information in real time by connecting all instances involved in the value chain. The connection of people, things and systems creates dynamic, self-organising, real time optimised value-added connections within and across companies.
“Servitization is the concept of manufacturers offering services tightly coupled to their products. It’s about moving from a transactional (just sell a product) to a relationship based business model (delivering a capability) featuring long-term, incentivised, ‘pay-as you-go’ contracts.”

- Aston Business School
“We’re spending 80 percent of our time collecting data and 20 percent of our time analysing it”

Is that a right balance?

*Expected benefits from digitisation over the next five years*

- Additional revenue: 2.7% per annum
- Cost reduction: 3.4% per annum

*Only 19% of engineering and construction companies have advanced data analytics capabilities*

*Industry 4.0: Building the digital enterprise (Engineering and construction) (2016 PwC)*
A circular economy

The four key value drivers of a circular economy are identified by the World Economic Forum as:

- Increasing **UTILISATION** of an asset or resource
- **LOOPING / CASCADING** an asset through additional use cycles (using more than once)
- **EXTENDING** the use cycle length of an asset
- **REGENERATION** of natural capital

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Industry 4.0, Intelligent Assets and the Circular Economy

“The Future for Construction Product Manufacturing”,
The Construction Products Association (October 2016)
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Impact on business

This is a collaborative effort of many players who recommend:

The integration of sensors into products and materials, the ability to geolocate and to know how they are performing will become the norm.

Government and industry are recommended to explore certification of construction products and systems based on performance in use.
Digital Transformation Survey
Part 2: Implementation & Evaluation
Digital Transformation Strategy

• Is IT strategic for your organisation?

• The Strategic questions:
  • What business opportunities does this trigger?
  • What strategic aim or business opportunities is being met?
  • How does it fit within the current business plans?
  • How does it meet client needs?
  • What are the implications of not implementing?
  • What business processes are affected?
Digital Transformation Strategy

• A digital Strategy seeks principles to guide the development of large and complex Information Systems.

• The development of large systems requires the efforts of number of experts to suit various users over an extended period of time during which the requirements of the proposed system might be altered.

• Consequently, Information Systems Strategy includes topics that are more readily associated with business management than computer science.
Digital Transformation Strategy

Business & Feasibility Strategy

- Business Challenge
- Organisation
- Management
- Technology
- The Digital Solution

Planning Study

Business Process Re-Engineering

- Best Practice benchmarking
- Information Flows
- Design

Implementation

- Development
- Parallel operations
- Training
- Support
- Evaluation

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Digital Transformation Strategy

Feasibility study

Business Challenges
- Very tough competition
- Fickle customers
- Short product-to-market cycle

- Monitor quality
- Forecast demand and plant capacity more accurately

Business Solutions
- Reduce costs
- Increase revenue
- Improve customer service

Management
Organization
Technology
Information System
Digital Transformation Strategy

Feasibility study:
Techniques for evaluating the benefits and costs of IT investments

- Return-On-Investment (ROI)
- Net Present Value (NPV)
- Cost Benefit Analysis
- Multi-objectives Multi-criteria methods
- Ad hoc procedures
- etc
Benchmarking of digital Systems

- Benchmarking is about organisations comparing their practices and performance in key activities.
- It involves answering the questions:
  - Who is better, and why are they better?

  With the aim of using this information to make changes that will lead to real improvements in practices.

- How does Benchmarking work?
  - What to benchmark
  - Who to benchmark against
  - How to get information
  - How to analyse the results
Digital Transformation Strategy

Information flow:
(Current way of conducting the business function)
Digital Transformation Strategy

Design

Technology Requirements:

For example:
- Who are the potential users
- what inputs are needed
- what processing must take place
- what information needs to be output

- User Requirement Specification
  - Essential
  - Beneficial
  - Nice to have

Are systems to be integrated or interfaced?

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Digital Transformation Strategy

Implementation

Development

It involves the actual writing of programs, installation of ICT devices, creation of data files, development of databases, producing user documentation, etc.

Parallel operations methodology

• If the development phases will lead directly to the actual operations “Direct operations”, this will be too risky and not always the case.
• Parallel operations
• Pilot operations
Digital Transformation Strategy

Implementation

Training

• Ensure users have basic skills
  • Carry out skills audit
• Prepare training materials (and tailor to suit users)
• Identify Super user (Different training for different users)
• Prepare any data to be transferred for training purposes
• Agree any phasing
• Ensure an adequate period of time is set aside
Digital Transformation Strategy

Implementation

Testing

It occurs in two forms:

• **Validation testing** which involves confirming that the system as implemented conforms to the requirements and specifications identified during the original analysis.

• **Defect testing** which involves identifying and correcting errors. This may take longer and continue during the actual running of the system.
Digital Transformation Strategy

Implementation

Support

• Maintenance
• Ongoing support of the system
  • What is required?
    • 24/7
    • Opening Hours Only
  • Help desk Internal or External
  • User Group
    • Must be led by the users
• System Upgrades

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Digital Transformation Strategy

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Digital Transformation Strategy

Implementation

Evaluation

This checks that the system:

- has met the original requirements,
- is working properly and easy to use,
- does it need modifying, and
- can it be improved further.

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Thank you ......