BIM Implementation Practices of Construction Organizations in the UK AEC Industry [1, 2]

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ABSTRACT

The aim of this research was to investigate the implementation practices and application of BIM technology by construction organisations through the project phases from inception to operational use in the United Kingdom. The aim and objectives of the study were achieved using qualitative methodology. Semi-structured interview was used for collecting data. Secondary source of data collection included a comprehensive literature review on past and current work on BIM implementation and application across the project lifecycle. To achieve the overall aim fully, a generic Process Map was deemed best to illustrate the BIM implementation practices of construction organisations through the project phases in the UK. The BIM functions or sub-processes at each project phases of the construction process were highlighted from the interviews. Then the generic process map above linking all the BIM activities in the project was developed. The information outputs at the end of each project stage were illustrated in the Process Map. The information inputs feeding into the BIM functions at the project phases were also examined from the interviews and illustrated in the process map. The information inputs feeding into the BIM functions at the project phases were also examined from the interviews and illustrated in the Process Map.

***Keywords**: Building Information Modelling (BIM), BIM Implementation Practices, BIM Implementation Process Map, UK AEC Industry, 2013 RIBA Plan of Work*

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1. INTRODUCTION

Research has shown that the construction industry is a complex and dynamic one; hence, making construction projects one of the most complex endeavours there is. The complexity of projects in the industry is increasing rapidly and is seen as a major failure factor in construction in construction project management. This is due to the construction industry being regarded as a "loosely-coupled system" or fragmented industry. Research has also shown that the industry has been slow in adopting management techniques and technological innovations that have enhanced productivity and performance in other industries. These new electronic commerce applications or Business Process Re-engineering (BPR) models such as CALIBER (used for measuring onsite performance), Value Management, Benchmarking, Lean Thinking, Just-In-Time, Concurrent Engineering, Cost Reduction Initiative for the New Era (CRINE), Standardised Process Improvement for Construction Enterprises (SPICE), Total Quality Management, Strategic Project Management, Planning applications tools (such as Microsoft Project, Primavera, RIBA Plan of Work, British Property Federation Manual, Generic Design and Construction Process Protocol, Building Information Modelling (BIM), etc., produce 'strategic, operational, and opportunity benefits to its users in the construction supply chain', as it can overcome most of the current challenges that reduces the capacity for effective management of the construction processes. According to Akintoye, Goulding and Zawdie (2012), construction practitioners advocate that the Building Information Modelling (BIM) can be used to ease the complexity of the partnering or collaborative process in the delivery of a project. This can be achieved by adopting the BIM technology or business process application as a collaborative platform to "bridge the information loss associated with handling a project from the design team, to the construction team, and the building owner", such that each group contributes and refers back to information developed during the lifecycle of a project.

2. LITERATURE REVIEW

The RIBA Plan of Work appears to be the most widely used Plan of Work in the UK, although, the UK Government's PAS 1192 and the CIC's Digital Plan of Work are also very much in use in the AEC industry. The RIBA Outline Plan of Work published in 2007 is only applicable to the DBB procurement route.

2.1 The 2013 RIBA Plan of Work

The new RIBA Outline Plan of Work, published in 2013 incorporates the principles of sustainability, provides the platform to support and facilitate the BIM processes and technology; enhances effective collaboration amongst project participants; provides a template for the adoption of all forms of procurement routes (DBB, DB, CM@R, IPD, etc.); and gives room for adjustments in the timing and application of municipal planning procedures (RIBA, 2013).

According to Sinclair and Eynon (2013), the RIBA Plan of Work is the most widely used Plan of Work or Construction Process Model in the UK. The UK Government Construction Strategy document published in 2011 was an impetus for the evolution of the RIBA Plan of Work. This evolution was made possible by the joint action of RIBA and the CIC's BIM task group, which gave rise to unified project stages synonymous with the PAS 1192 and the CIC's digital Plan of Work.

One of the sweeping changes the RIBA Plan of Work 2013 brought is the paradigm shift from design team functions to project team functions that incorporates the Client, the construction team and the design team (Sinclair and Eynon, 2013). In line with the UK Government Strategy, the RIBA Plan of Work supports the exchange of information at the end of each stage, noting that the deliverable at the project stages will be 3D models for the purpose of town planning application, Client approval, or for a Contractor to begin construction work.

The new RIBA Plan of Work sets out to constitute a collaborative project team by deciding from the outset stakeholders' responsibilities during the project lifecycle. The Project Manager endeavours to make sure that the right information is conveyed to the right participant at the right time, involving all stakeholders and ensuring that the project objectives of time, cost, quality, and sustainability are achieved (Sinclair and Eynon, 2013).

The overall process flow of the RIBA Plan of Work, like the CIC Digital Plan of Work, and the PAS 1192 – Part 2 Plan of Work is: PREPARE→ DESIGN → CONSTRUCT→ USE, which is broken down into 8 project stages (RIBA, 2013).

Stage 0 – the Strategic Definition stage, involves identifying the Client's business case and strategic brief, together with other project requirements.

Stage 1 – the Preparation and Brief stage, involves developing Project Objectives, Project Outcomes, Project Budget, Feasibility Studies and review Site Information.

Stage 2 – the Concept Design stage, involves Outline Proposals, Outline Specifications, Preliminary Cost Information; the Final Project Brief is issued at this stage.

Stage 3 – the Developed Design stage, involves preparing the Developed Design with completed proposals for the structural design, building services, Cost Information and Project Strategies.

Stage 4 – the Technical Design stage, involves preparing the Technical Design in line with Design Responsibility Matrix and Project Strategies to incorporate all architectural, structural, building services information, Subcontractor design and specifications.

Stage 5 – the Construction stage, entails offsite production and onsite construction in tandem with the Programme of Works and resolution of queries as they crop up on site.

Stage 6 – the Handover and Close Out stage, entails the handover of the project facility, and termination of the building contract. This closeout involves defect inspection as they are refurbished.

2.2 Building Information Modelling (BIM)

Miettinen and Paavola (2014) noted that there is no singly satisfactory definition of what BIM is; instead there is a need to analyse it as a "multi-dimensional, historically evolving, complex phenomenon." Miettinen and Paavola affirmed that the various definitions in the literature contain and replicate the following elements:

- All relevant information regarding the design and construction of a facility are included in a single model or is accessible with BIM tools, via common database system.

- The interoperability of data-sharing (enabled with open standards like Industry Foundation Classes - IFC) between several BIM design tools facilities better integrated ways of collaborating on a project.
  BIM is usually utilised and maintained throughout the life span of a project from inception through construction to deconstruction/decommissioning.

- BIM increases appreciably the effectiveness, efficiency and overall productivity of the AEC industry.

Miettinen and Paavola (2014) defined BIM as "a digital representation of a building, an object-oriented three-dimensional model, or a repository of project information to facilitate interoperability and exchange of information with related software applications." BIM is not just a software tool, but a technology and a process, which is embedded into a Plan of Work, chosen by the Client, to meet project requirements throughout the preparation, design, construction, and operational phases of a facility.

3. METHODOLOGY

3.1 Interview and Case Study methods

Interview method was adopted for this research for the following reasons: In-depth information was easily obtainable; there was greater flexibility than the questionnaire method to rephrase questions for better clarity and information; non-response of interviewees was much lower, hence cases were controlled more easily; the interviewer had access to additional information about the interviewee's personal information and work environment that may greatly enrich the interpretation of results (Kothari, 2004).

A case study design was adopted for this study because the focus of the research is to answer the "how" and "why" questions, and to cover contextual conditions relevant to the phenomenon in question (Yin, 2009). A multiple-case study (2 or more cases) was adopted for this research to enable the researcher to explore differences between and within cases. For this research work, a literal replication of 2 cases was required to achieve similar research outcomes (based on literature review) and to achieve a greater degree of certainty and validation of the research study.

The target population for this research work are companies involved in architecture, engineering, project management, and construction, and who have had involvements in BIM project environments. The choice of respondents in these organisations was made in gathering relevant data because these BIM Experts were directly involved in the supply chain for the delivery of BIM-driven projects across the UK. The respondents were drawn from Construction Organisations in the North West and Central London regions of England.

Since, it is practically impossible to collect data from all construction organisations or all professionals; the non-probabilistic sampling technique was used, also known as deliberate or purposive sampling. Hence, a sampling size of 2 Case Studies was purposively selected in the North West and Central London regions of England, which were later used to represent the research findings for the United Kingdom.

4. RESULTS AND DISCUSSION

To achieve the overall objective, a generic Process Map would best describe the BIM implementation practices of construction organisations through the project phases in the UK. Hence, the Process Map incorporating the case studies was developed and illustrated below:

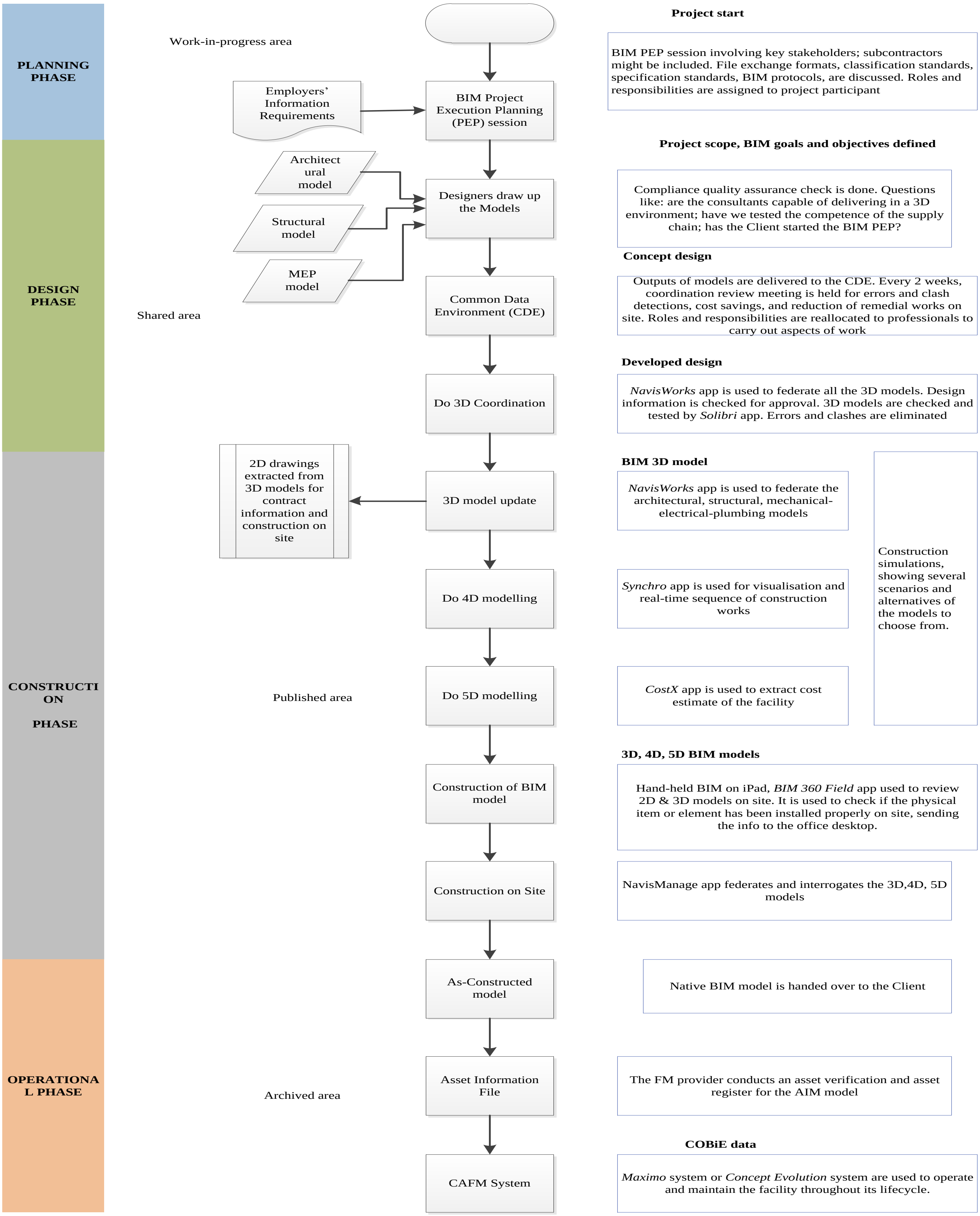

Fig. 1. Process Map Showing BIM Implementation through the Project Phases. *Source Author*

5. CONCLUSION

The BIM functions or sub-processes at each project phases of the construction process were highlighted from the interviews. Then the generic process map above linking all the BIM activities in the project was developed. The information outputs at the end of each project stage were illustrated in the process map. The information inputs feeding into the BIM functions at the project phases were also examined from the interviews and illustrated in the process map. The information inputs feeding into the BIM functions at the project phases were also examined from the interviews and illustrated in the process map. The Process Map formalises the BIM implementation practice in construction organisations so that people can work more collaboratively, thereby improving the process of planning and implementing BIM across the project lifecycle.

6. REFERENCES

Akintoye, A., Goulding, J. and Zawdie, G., 2012. Construction Innovation and Process Improvement. London: Wiley-Blackwell.

Kothari, C.R., 2004. Research Methodology: Methods and Techniques. 2nd ed. New Delhi: New Age International Publishers Ltd.

Miettinen, R. and Paavola, S., 2014. Beyond the BIM Utopia: Approaches to the Development and Implementation of Building Information Modelling. Automation in Construction, 43, pp.84-91.

Royal Institute of British Architects, RIBA, 2013. RIBA Plan of Work 2013: Overview, ed.: Dale Sinclair. London: RIBA Publishers.

Sinclair, D. and Eynon, J., 2013. RIBA Plan of Work – 50 years old and It's Time to Change [online] Available at http://www.construction-manager.co.uk/management/riba-plan-work-moving-stages/

Yin, R., 2009. Case Study Research: Design and Methods. 3rd ed. Thousand Oaks, California: Sage Publications.

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Adedotun (Adey) Ojo is a result-oriented construction professional and researcher. A keen and meticulous individual possessing a strong research analysis experience in collating and evaluating data with the aid of advanced research approaches, techniques, and statistical packages for dissemination of evidence-based housing research insights in oral or written formats. A self-motivated individual with a solid background in Quantity Surveying & Cost Estimating, Construction Project Management, possessing excellent leadership, verbal, written, problem-solving and relationship-building skills, required for a collaborative and creative environment. His areas of industry and research interest include Housing Policy Analysis & Evaluation, Affordable Housing Studies, BIM Adoption for Regulatory Compliance, BIM for Construction Management of Residential Buildings, etc. He can be contacted at adedotun.ojo@outlook.com

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Chris Pye is a lecturer in construction technology in the School of Science Engineering & Environment. Chris lectures in the topics of building surveying and civil engineering and his areas of specialism include low and high-rise construction technology and building pathology combined with maintenance management. Chris is research active in the area of built environment and sustainability and his research interests include building life cycle analysis, the application of building information modelling to listed buildings and the conservation of military structures and war memorials.

Prior to joining the University of Salford, Chris was a senior lecturer in building surveying at the University of Central Lancashire within the Construction and Civil Engineering (CCE) unit of the School of Engineering and was course leader for the BSc. (Hons.) Facilities Management degree in both the UK and in Oman and Hong Kong. Chris also led the FdSc Construction degree and was link tutor responsible for franchised construction related HNC's and Foundation Degrees delivered by college partners.

Chris has seventeen years of industrial experience as a civil engineer and also as a building surveyor and has worked in both local government and private practice. Chris has experience of managing projects for both public and private clients in commercial and domestic construction projects and his industrial experience ranges from sea defence and highway engineering projects to building conservation of historic buildings, facilities management of offices and new build construction of schools, offices and houses.

Chris has published research papers on topics such as building information modelling, building energy efficiency and life cycle costing for sustainable buildings and has completed pedagogic research into the use of mobile devices by students as part of their learning approach. He can be contacted at c.j.pye@salford.ac.uk