Developing Framework for Managing Building Information Modelling Processes

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Abstract

The processes of BIM require a team approach and put a great deal of responsibilities on the participants. A coordinator or manager is required to ensure that these huge responsibilities and expectations are delivered by the participants. The potential benefits of BIM cannot be fully realized without the management of BIM processes. This paper attempts to develop a framework for BIM management with a view to describing the principles of BIM management and duties of a BIM manager at various stages of a project. Theories on roles of a BIM manager and the information contents of a BIM Implementation Programme were analysed in order to determine the concepts of BIM management. These information contents were summarized into BIM protocol plan, change management plan, collaboration and communication plan, and database management plan. The conceptual framework for managing BIM processes was developed from the findings in the theoretical framework. Three phases of work, that is, conceptual design stage, planning and construction stage, and operation and maintenance stage, were identified for projects. The study concludes that BIM management should centre on BIM implementation programme which should be composed of BIM protocols plan, change management plan, collaboration and communication plan, and database management plan.

Keywords: Building Information Modelling, BIM Implementation Programme, BIM Management, BIM protocols plan, change management plan, collaboration and communication plan, database management plan.

1. Introduction

Building Information Modelling (BIM) management is the process of facilitating BIM and it is vital to the achievement of objectives of BIM and the realization of the benefits of BIM. BIM management entails the management of the BIM process and it is the way to achieve BIM goals and benefits (Quigley, 2013). The processes of BIM require a team approach and put a great deal of responsibilities and expectations on the participants. A coordinator or manager is required to ensure that these huge responsibilities and expectations are delivered by the participants (the Commonwealth of Massachusetts, 2013).

Collaboration and interoperability are the hallmark of BIM; however, they cannot happen by mere adoption of BIM. Also, in a BIM-based project, team members must speak a common language, and roles and responsibilities must be assigned to specific individuals or organizations (Quigley, 2013). Hence, the management of BIM processes becomes imperative.

Currently, builders and construction managers are taking a lead role in the management of BIM processes because they have the most immediate need for the information models (The Association of General Contractors in America, 2013). Quigley (2013) suggested that BIM management role may be incorporated into the roles of the project manager or any other construction professionals with the knowledge of construction project management. Renato and

Eduardo (2011) noted that BIM management should be the responsibilities of the construction manager or client's representative so as not to overburden the project manager.

The potential benefits of BIM cannot be fully realized without the management of BIM processes. Even in the midst of controversies surrounding who should function as the BIM manager among the Architecture, Engineering and Construction professionals, the concept of BIM and the responsibilities of a BIM manager need to be well-defined. Therefore, this paper attempts to develop a framework for BIM management with a view to describing the principles of BIM management and duties of a BIM manager at various stages of a project.

2. Theoretical framework for creating a BIM environment

Theories on roles of a BIM manager and the information contents of a BIM Implementation Programme (BIP) were analysed in order to determine the concepts of BIM management. The information contents of BIP were summarized into BIM protocol plan, change management plan, collaboration and communication plan, and database management plan.

As stated by the University of Southern California (2012), a BIM manager is responsible for ensuring that all the project team members are delivering and updating BIM according to delivery schedule, ensuring that they use the correct file format, ensuring that the models comply with requirements, coordinating and reviewing the information models, providing clash feedback, facilitating coordination meeting, and ensuring that the common reference point is used. Holzer (2016) observed that BIM managers are expected to set up a support infrastructure for BIM, coordinate and lead BIM efforts, select BIM technology, manage day-to-day BIM processes, and manage change in information models. City College of San-Francisco (2011) noted that the BIM manager is required to direct and oversee the process of BIM during design and construction stages. As identified by the University of South Florida (2015), the duties of the BIM manager are to integrate the information models, develop a composite BIM, develop BIM folder structure, run clash detection and create viewpoints of identified issues, and engage the team members on review and assessment of identified issues. In his own observations, AbdulKader (2013) maintained that the main function of a BIM manager is to manage people in the implementation of BIM process, set design templates, coordinate the integration of information models and access to the models, determines and evaluates the goals of the BIM process, and guide decision-making in BIM process. Similarly, Joseph (2011) and New York City Department of Design and Construction (2012) stated that a BIM manager is the key point of contact in BIM implementation, and its responsibilities include: management of the creation of BIM content, coordination of BIM meetings, providing specifications for BIM coordination, management of coordination process, facilitation of the proper export and data extraction, and ensuring that deliverables are met and provided in the specified format.

The duties of a BIM manager can then be summarized as creating a BIM environment and controlling the BIM processes. These two duties require a well-detailed plan which is commonly known as BIM implementation plan or BIM execution or implementation programme (BIP). BIP is prepared to define the execution, monitoring and control of BIM for a project or in an organization (NATSPEC, 2012). It is useful in implementing and controlling the BIM processes. The series of plans contained in a BIP can be summarized as BIM protocols plan, change management plan, collaboration and communication plan, database management plan, and conceptual framework for creating a BIM environment.

2.1 BIM Protocols Plan

A BIM protocols plan should define the project stages at which building information models will be developed, modified and reviewed; determine intellectual property right provisions for the discipline-specific information models by specifying the obligations, liabilities and limitations on the use of the information models for the project; establish project reference points; and identify the potential uses of building information models. the following information should also be specified in the plan: the BIM authoring software technologies to be used by the project team members or the participating organizations; the BIM standards and model quality applicable to the project; the layering conventions and file naming conventions; the folder organization and file version control; the organization or person to create certain information models and where the models will be submitted; the level of details of the discipline-specific information models to be created by the organizations or project team members; project spatial coordination; and the file naming system such as naming systems for room and space, elements, mechanical-electrical-and-plumbing, equipment, fixtures, furniture, materials, and object parameters. Examples of the uses of building information models to be identified in a BIM protocol plan are: site analysis, facilities management, space and equipment, architectural (spatial and material) design model, functional analysis, code checking, sustainability evaluation, structural modelling and analysis, energy analysis, virtual testing and balancing, lighting analysis, quantity take-off and cost planning, clash coordination, security assessment and planning, construction system design, digital fabrication, planning construction scheduling and sequencing, site utilization plan, and lift planning (Collaborative Working Group, 2015; NATSPEC, 2012; New York City Department of Design and Construction, 2012; The American Institute of Architects, 2013).

2.2 Change Management Plan

The purpose of Change Management plan is to develop a system for interoperability and coordination of information models; develop procedures for addressing design questions and requesting for output information; set up a process of identifying and resolving conflicts between information models; select the clash detection and interoperability tools to be used for the project; specify time for coordination and review meeting; and develop the process of clash resolution for the various types of clashes such as hard, time and soft clash (NATSPEC, 2012).

2.3 Collaboration and Communication Plan

As explained by Collaborative Working Group (2015), NATSPEC (2012), and The American Institute of Architects (2013), a collaboration and communication plan should identify the organizations or team members that are to develop output information; determine the input information required by each organization or team members from the others; specify when the collaboration (data exchange) will take place; determine how the data will be exchanged and how the exchange will be documented; specify the data format for each discipline-specific model; specify the means of communication required for the project and the file exchange protocol standard; specify the period for submission and exchange of information models, and create a proposed table of collaboration meetings and model exchange schedule such as meetings between architects and building services engineers, architects and structural engineers, or architects and builders. The American Institute of Architects (2013) recommended web-based collaboration for large and complex projects because it gives real-time access to all project data and information, accountability, and information management.

2.4 Database Management Plan

A Building Information Model, also known as the master model or composite model is usually developed by integrating various discipline-specific information models. The master model serves as the database for the project. According to NATSPEC (2012), the form of the master model should be planned, either as a whole project or as project subsets such as levels, sectors or zones. Quigley (2013) and University of South Florida (2015) observed that the systems to be adopted for organizing the information models according to discipline, trades and phases of construction process; extracting information models required for digital fabrication, bill of materials, and operation and maintenance; documenting the information models in COBie format; and developing a master model and as-built construction model, should be highlighted in the database management plan.

3. Conceptual framework for creating a BIM environment

The conceptual framework for managing BIM processes (Figure 1) was developed from the findings in the theoretical framework. Three phases of work, that is, conceptual design stage, planning and construction stage, and operation and maintenance stage, were identified for projects; and the BIP was taken to cover all the three phases of work. Four distinct plans viz. BIM protocol plan, change management plan, collaboration and communication plan, and database management plan, were identified from the BIP. This agrees with the observations of New Zealand BIM Handbook (2014) and City College of San Francisco (2011). According to New Zealand BIM Handbook (2014), the BIM manager must prepare BIP for the BIM process which should consist of plans on quality control, model sharing, model authoring, model location and orientation, level of development, coordination, model handovers, transition of model ownership, and final BIM deliverables. Similarly, City College of San Francisco (2011) observed that for BIM processes, the following should be planned: BIM requirements, BIM authoring software to be used, BIM standards, file formats to be used for project submitted and file exchange, file exchange protocol, strategy for managing shared file server, strategy for COBie integration, and strategy for coordinating clash detection.

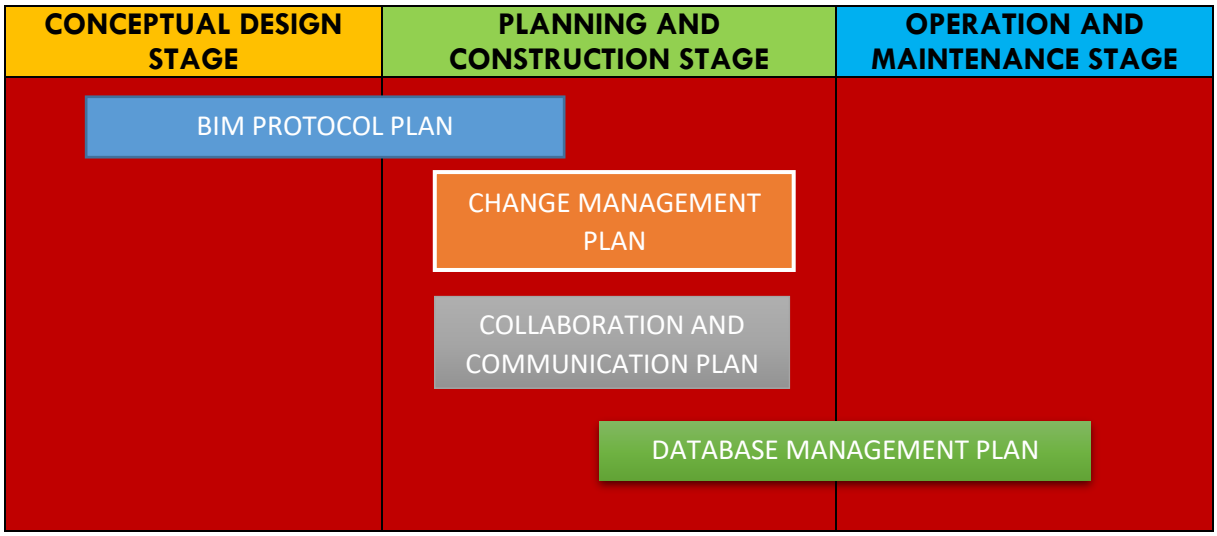

Figure 1: Conceptual framework for Managing BIM Processes.

The BIM protocol plan covers both the conceptual design stage and planning and construction stage; while database management plans will start from planning and construction stage and terminate at the operation and maintenance stage. This is validated by the studies of

AbdulKader (2013) and Collaborate Working Group (2015), which observed that the management of BIM should cover the entire lifespan of projects and that the management of BIM during the conceptual stage should be different from the other stages. Also, Collaborative Working Group (2015) argued that BIM management at the design stage should entail the development and documentation of the processes and workflows between each contributing members of the design team; while BIM management at the construction stage should entail the development and documentation of the processes and workflows between each contributing members of the construction team. This argument can be interpreted and extended to mean that during the conceptual stage of a project, BIM protocol plan should be prepared to control the BIM processes and workflows. As these processes and workflows will overlap into the design and construction stage, the use of BIM protocol plan should also extend into the design and construction stage. During the design and construction stage, the control and documentation of BIM processes and workflows as suggested by Collaborative Working Group (2015), can effectively be managed change management plan, collaboration and communication plan, and database management plan.

4. Conclusion

The study aimed to develop a framework for managing BIM processes by examining the duties of a BIM manager and the principles of BIM management. BIM management should commence from the conceptual design stage to the operation and maintenance stage. The sole duty of a BIM manager is to ensure the success of BIM processes; and this requires the BIM manager to create the BIM environment and control the BIM workflows among the project team members.

The principles of BIM management centres on BIM implementation programme which should be composed of BIM protocols plan, change management plan, collaboration and communication plan, and database management plan.

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