A PRELIMINARY BIM IMPLEMENTATION FRAMEWORK FOR CONSULTANT QUANTITY SURVEYOR FIRMS IN A DEVELOPING COUNTRY

Soon, Lam Tatt[1], Leong, Boon Tik[2] and Ang, Fuey Lin[3] and Hasnanywati Hassan[4]

[1] *Associate Dean, Lecturer, Taylor's University, Kuala Lumpur, Malaysia, LamTatt.Soon@taylors.edu.my*
[2] *Senior Lecturer, Taylor's University, Kuala Lumpur, Malaysia, BoonTik.Leong@taylors.edu.my*
[3] *Programme Director, Taylor's University, Kuala Lumpur, Malaysia, FueyLin.Ang@taylors.edu.my*
[4] *Programme Chairs, Universiti Sains Malaysia, Penang Malaysia, hasnany@usm.my*

The benefits of Building Information Modelling (BIM) have been widely promoted but the implementation of BIM in developing country such as Malaysia is still at its infant stage. Quantity take-off or Measurement remained as one of the major consultant Quantity Surveyors' tasks in Malaysia as most of construction projects are still implementing traditional procurement and contract with quantities. With the implementation of BIM, most of the quantities can be easily abstracted from 3D models and several parties believed that Quantity Surveyors' profession in Malaysia will have to face challenges in future. Therefore, this paper aims to create a BIM implementation framework for consultant quantity surveyor firms based on identified BIM constraints via questionnaire survey. Online questionnaires were distributed to registered Quantity Surveyors in Malaysia based on the Board of Quantity Surveyors Malaysia (BQSM) official website company list to collect professional feedbacks from Quantity Surveyors in order to strengthen the research findings. Based on the questionnaire, it was found out that the software constraints, communication constraints and lack of standard & rules are significantly affecting the BIM implementation in Malaysia. Based on the questionnaire findings, a preliminary BIM implementation framework for consultant QS firms has been created to improve the current BIM implementation in Malaysia. Additionally, a semi-structure interview was conducted in purposing a preliminary framework for quantity surveyors in implementing BIM in Malaysia. This framework serves as a guidance for consultant Quantity Surveyors to enhance their BIM knowledge and business strategy in implementing BIM in future.

Keywords: BIM, Consultant, Quantity Surveyor, Software, Malaysia.

INTRODUCTION

Building Information Modelling (BIM) have been widely introduced recent years but the implementation of BIM in developing country such as Malaysia is still at its infant stage. Construction industry firms are accustomed to traditional way of leadership, responsibility and opportunity, and change is generally slow (Porwal and Hewage, 2013) AEC industry's reluctance to change existing work practice and hesitation to learn new concepts and technologies (Gu, N. and London, 2010) is a significant constraints in implementing BIM.

BIM implementation requires significant changes in the way construction businesses work at almost every level within the building process. (Arayici et al, 2011) A drastic changes are requested in term of

work practices, staff skills, relations with client and participants of project implementation team as well as contractual arrangements. (Migilinskas et al, 2013) Architects, engineers and designers need to prepare their drawings in a data rich 3D model instead of 2D Computer-aided design (CAD) which has been implemented more than 20 years in the construction industry. Additionally, BIM required collaboration, integration and interoperability between designers and engineers (Khosrowshahi and Arayici, 2012) to minimize the interoperability issues between different BIM software packages which are likely to be resolved over time by the IT companies supplying the packages (Bryde et al, 2013) or multi-disciplinary practice.

Based on registered quantity surveyor practice list in BQSM website, there are only 16 out 346 quantity surveyor practices are registered multi-disciplinary practice. Additionally, there are only 5 out 16 registered multi-disciplinary practice owned by architect, engineer and quantity surveyor. This data indicates that multi-disciplinary practice is not widely being implemented in Malaysia and this indirectly increase the difficulty of BIM implementation in Malaysia compared to other developed countries.

Measurement remained as one of the major consultant Quantity surveyors' tasks in Malaysia as most of construction projects are still implementing traditional procurement and contract with quantities. Quantity surveyors in Malaysia have to prepare bill of quantities with detail and accurate measurements but most BIM tools were developed for designers and not for nontechnical end-users. (Cerovsek, 2011) Designers and contractors tend to develop their own internal rules according to the specifications of their proprietary own internal rules according to the specifications of their proprietary standards and frameworks, instead of knowledge being shared. (Monteiro and Martins, 2013) In short, quantity surveyors in Malaysia have difficulty in abstracting the quantities directly from 3D models created by designers to prepare the bill of quantities with detail and accurate measurements which accordance to the standard method of measurement. (SMM2) In addition, many communication problems among construction team players are caused by insufficiently communicated design information resulting in incorrect model interpretation. (Cerovsek, 2011) Therefore, the accuracy of the auto quantification from BIM prepared by the BIM software will be affected.

In order to purpose a BIM implementation framework, it is significant to identify the interoperability constraints, communication constraints and other technical constraints that affecting the BIM implementation in Malaysia. Technical constraints such as software and constraints etc will be discussed and identified in this research to create a suitable BIM implementation framework for quantity surveyors in Malaysia.

TECHNICAL CONSTRAINTS

Software constraints

Software constraints are the most significant constraints in BIM implementation. BIM software relies on data in the BIM especially in auto-quantification for cost purposes. An element does not exist in the building model or a needed quantity cannot be calculated based on component properties. (Irizarry et al, 2013) For example, formwork which is not created directly from the model cannot be auto-calculated and there is not even a tool for modelling formwork (Monteiro and Martins, 2013) Additionally, measurement of MEP elements cannot be achieved directly by the assessed tools (Monteiro and Martins, 2013) and some BIM designer software can be used to design a structural model but it is not possible to represent the reinforced concrete elements' rebar (Monteiro and Martins, 2013)

Moreover, project participants are used to work with particular tools and often data transfer is limited due incompatibility and transmission of the consistent information to other participants. (Migilinskas et al, 2013) This interoperability issues between different BIM software packages, such as technical issues are likely to be resolved over time by the IT companies supplying the packages (Bryde et al, 2013) Additionally, some software is unable to handle large amounts of data (Bryde et al, 2013) and AEC experts is lack of knowledge and experience of software programming who manage to create a software to suit all construction professionals' responsibility. For instance, designer BIM software is lack the function to perform cost estimation, which is usually done using different software (Monteiro and Martins, 2013)

Lack of standard & rules constraints

The community or industry is still lack of a global standard regulation for design measurement (Monteiro and Martins, 2013) and absence of standard BIM contract documents (Porwal and Hewage, 2013) Additionally, no methodology, framework or analysis in public procurement with BIM is available in the published literature (Porwal and Hewage, 2013) Lack of information about the strict BIM implementation standards and rules for certain project participants, contract obligations in certain countries or unified documentation for regions (Migilinskas et al, 2013) are the technical constraints impeding the BIM implementation in AEC industry. Therefore, there is a need of standard and protocols with a common language, where the software packages are able to communicate with each other. (Porwal and Hewage, 2013)

Communication and People constraints

One of the significant factors affecting BIM implementation is the collaboration among consultant team members. Therefore, communication among the consultant team members remained an important success factor for BIM implementation. However, researcher found out that only a small portion of modelling results are communicated to other project stakeholders (Cerovsek, 2011) There is lack of understanding of interoperability of BIM system limitations and abilities (Bryde et al, 2013) and many communication problems are caused by insufficiently communicated design information resulting in incorrect model interpretation by receivers. (Cerovsek, 2011)

Additionally, industry is lack of information about the strict BIM implementation standards and rules which indirectly causing owners, designers and contractors to develop their own internal rules instead of knowledge being shared. (Monteiro and Martins, 2013) It brings difficulty to create a BIM-based quality assurance process and indirectly causing a lack of functionality in the automated quality checking system (Choi, 2014) Therefore, BIM-based QTO is a task assigned to BIM experts but the market is still lack of QTO experts who master the quantity take off (QTO) and cost estimation process via BIM. (Monteiro and Martins, 2013) It requires a comprehensive understanding of the input–output dynamics of the application since extracting the information according to the desired specifications depends on how the elements are modelled and the measurements parameterized. (Monteiro and Martins, 2013)

METHODOLOGY

Questionnaire surveys were employed as a major tool to identify the technical constraints of BIM implementation for this research. Respondents for this survey were selected from the list of registered quantity surveyors under Board of Quantity Surveyors Malaysia (BQSM) in Malaysia. Quantity surveyors were selected as respondents as they are generally expert on measurements in Malaysian construction industry. 346 registered quantity surveyor practices in Malaysia are listed in the BQSM website, the population were selected to ensure significant responses and representative results. This questionnaire allowed professional quantity surveyors to identify the technical constraints of BIM implementation and give suggestions based on to his or her experiences. This questionnaire survey was prepared by using Google form, a web-based survey tool. Likert-scale question method was used for all the technical constraints from literature in this questionnaire and the questions included an option 'Other' for respondents to provide comments or suggestions for other BIM technical constraints. Last by not least, a semi-structure interview was conducted in purposing a preliminary framework for quantity surveyors in implementing BIM in Malaysia.

RESULT AND DISCUSSION

Table 1: Average index of respondents' feedbacks on technical constraints

Technical constraints	Average Index	Result
Building elements which are not completely designed by consultant in the building model cannot be quantified	3.833	Agree
Lack of knowledge in Quantity Take Off in BIM software and cost estimation process for BIM	3.760	Agree
Lack of functionality in the automated quality checking system	3.719	Agree
Methodology, framework or tender analysis in public procurement with BIM is not available	3.594	Agree
Lack of Communication and understanding among the project team	3.510	Agree
Lack of a standard method of measurement (SMM) for BIM measurement	3.458	Neither agree or disagree
Absence of standard preambles, specifications and etc in BIM	3.281	Neither agree or disagree
Software unable to handle large amount of data	3.104	Neither agree or disagree

A total of three hundred and forty six (346) questionnaires were distributed to all the registered quantity surveyor firms in Malaysia yet sixteen (16) of them were unsuccessfully delivered due to invalid emails or security settings of the respondents. Out of 346 questionnaires, only ninety-six (96) questionnaires were collected after one month, contributing to the response rate of 27.75%

BIM implementation needs data sharing and collaboration among project teams throughout the construction process. Therefore, lack of communication and understanding among the project teams may cause interoperability issue or data missing of the BIM. In preparing cost estimation and bill of quantities, quantity surveyors will indirectly experience software constraint as building elements which are not designed in the BIM cannot be auto-abstracted by them. Additionally, methodology, framework

or tender analysis in public procurement with BIM is not available and this brings undesirable constraints for quantity surveyors to prepare the cost estimation via BIM.

QTO experts mastering the quantity take off (QTO) and cost estimation process via BIM require a comprehensive understanding of the input–output dynamics of the application since information extraction in accordance to desired specifications is dependent on how the elements are modelled. If the BIM 3D model is wrongly interpreted by the quantity taker-off, the accuracy of cost estimation will be affected. Furthermore, the condition worsens as the market is lacking of functionality in the automated quality checking system for BIM 3D model.

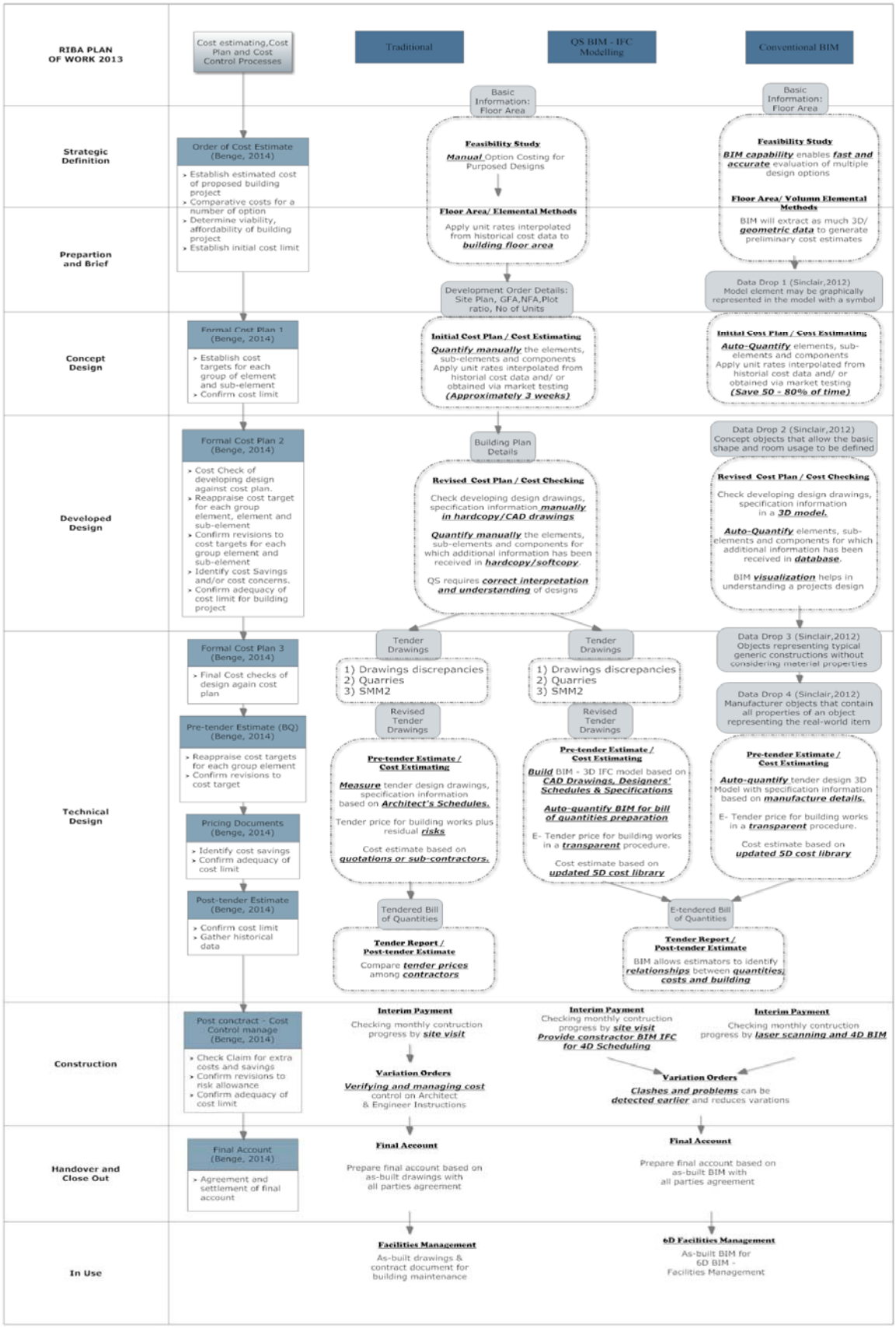
In short, questionnaire findings indicated that software constraints, lack of standard & rules and communication & people constraints are significantly affecting the BIM implementation in Malaysia. Additionally, 2D CAD which has been implemented more than 20 years in the construction industry and BIM platform is yet to be commonly implemented by construction designers in Malaysia. Extra time is needed to model the project due to the conversion of project from traditional CAD standards to a BIM platform (Bryde et al, 2013)

PRELIMINARY BIM IMPLEMENTATION FRAMEWORK

Based on questionnaire findings, a preliminary BIM implementation framework for consultant quantity surveyor firms based on RIBA plan of work 2013 was created to reduce the identified technical constraints of BIM implementation in Malaysia. BIM platform is yet to be commonly implemented by construction designers in Malaysia. Therefore, quantity surveyor should prepare measurement in CAD drawings based on standard method of measurement (SMM2) in Malaysia due to the absence of standard & rules for BIM measurement. In order to reduce software constraints and communication constraints, quantity surveyors are suggested to build up a 3D BIM model in IFC format based on architecture and structure CAD drawings.

In short, quantity surveyors in Malaysia are suggested to build up an IFC supported BIM based on architecture and structure CAD drawings which can auto-generate the quantities accordance to the standard method of measurement (SMM2) in Malaysia. A BuildingSMART certified software which supports the import and export of IFC2x3 files, Glodon TAS has been found fulfilling all these conditions. Therefore, a semi-structure interview was conducted to validate the functions of Glodon TAS in purposing a preliminary BIM implementation framework for consultant QS firms based on RIBA plan of work 2013 in Malaysia.

Figure 1: A preliminary BIM implementation framework for consultant QS firms based on RIBA plan of work 2013



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PERSONAL INTERVIEW & DISCUSSION

A personal interview was been conducted by General Manager of Glodon software Malaysian branch, Mr Qiu in preliminary framework design for BIM implementation in Malaysia. Mr Qiu commented that developer is the initiator for BIM implementation who sets up a BIM management team to handle the BIM collaboration among all consultant team members in the common practice of traditional procurement. Architect, engineer, quantity surveyor and other consultant team members have to collaborate among each other to prepare a BIM which is suitable for 4D scheduling and 5D costing.

In another way, Mr Qiu suggested that a quantity surveyor can be an initiator to build up 3D modelling in traditional procurement to commence and promote BIM implementation in Malaysia. In traditional procurement, contractors' responsibilities begin from the tendering stage and they commonly will not set up a team for BIM unless it is requested by government or local authorities. Therefore, quantity surveyor can build up a 3D BIM by software which has almost same workload compared to CAD measurement based on CAD drawings. Quantities can be auto-generated and auto-abstracted from the 3D BIM prepared by quantity surveyors for 5D BIM costing purposes. Additionally, the 3D BIM can be exported to an IFC format model which can be utilised for 4D BIM scheduling & other purposes. According to Mr Qiu, Glodon TAS is a BuildingSMART certified software which supports the import and export of IFC2x3 files. Although this is not a conventional BIM implementation method but the fundamental concept of BIM which concerning collaboration and information sharing can still be implemented from quantity surveyor's IFC supported BIM to contractors, subcontractors etc.

For design and built procurement, Mr Qiu suggested that main contractor should be the initiator for BIM implementation to utilise the advantages and benefits of BIM. Architect, engineer, quantity surveyor and other consultant members who are working under a main contractor are easier in BIM collaboration under design and built procurement.

CONCLUSIONS

Quantity take-off or Measurement remained as one of the major consultant Quantity Surveyors' tasks in Malaysia as most of construction projects are still implementing traditional procurement and contract with quantities. Therefore, this framework serves as a guidance for consultant Quantity Surveyors to enhance their business strategy through creating 3D BIM modelling to commence and promote BIM implementation in Malaysia. Even though this is not a conventional BIM implementation method but the fundamental concept of BIM which concerning collaboration and information sharing can still be implemented from quantity surveyor's IFC supported BIM to contractor and sub-contractor which can be utilised for 4D scheduling and other purposes.

REFERENCES

Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C. and O'Reilly, K., 2011. BIM adoption and implementation for architectural practices.*Structural Survey*, *29*(1), pp.7-25.

Bryde, D., Broquetas, M. and Volm, J.M., 2013. The project benefits of building information modelling (BIM). *International journal of project management*, *31*(7), pp.971-980.

Cerovsek, T., 2011. A review and outlook for a 'Building Information Model'(BIM): A multi-standpoint framework for technological development. Advanced engineering informatics, 25(2), pp.224-244.

Choi, J., Choi, J. and Kim, I., 2014. Development of BIM-based evacuation regulation checking system for high-rise and complex buildings. Automation in Construction, 46, pp.38-49.

Gu, N. and London, K., 2010. Understanding and facilitating BIM adoption in the AEC industry. *Automation in construction*, *19*(8), pp.988-999.

Irizarry, J., Karan, E.P. and Jalaei, F., 2013. Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. Automation in Construction, 31, pp.241-254.
Jung, J., Hong, S., Jeong, S., Kim, S., Cho, H., Hong, S. and Heo, J., 2014. Productive modeling for development of as-built BIM of existing indoor structures. Automation in Construction, 42, pp.68-77.

Khosrowshahi, F. and Arayici, Y., 2012. Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, *19*(6), pp.610-635.

Migilinskas, D., Popov, V., Juocevicius, V. and Ustinovichius, L., 2013. The benefits, obstacles and problems of practical bim implementation. *Procedia Engineering*, *57*, pp.767-774.

Monteiro, A. and Martins, J.P., 2013. A survey on modeling guidelines for quantity takeoff-oriented BIM-based design. Automation in Construction, 35, pp.238-253.

Porwal, A. and Hewage, K.N., 2013. Building Information Modeling (BIM) partnering framework for public construction projects. *Automation in Construction*, *31*, pp.204-214.