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COMPARATIVE EFFECTIVENESS OF QUANTITY SURVEYING IN BIM IMPLEMENTATION

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Abstract

Over the past eras, dawn of innovative technologies in construction industry intensified, where Building Information Modelling (BIM) has established as a collaborative tool. Although construction industry is deemed to be conservative, the adoption of BIM redefined traditional professional boundaries. Quantity Surveyor (QS) is one prominent role which needs to compete with aforesaid challenge, where the history provides substantial evidences to its amenability. However, this conversion may influence in either way, where it can upgrade or downgrade the profession since unwieldiness may adhere to the situation, it's being used. Hence, this paper aimed at identifying comparative effectiveness of BIM in performing QSs' tasks. Through an extensive literature study features of BIM, QSs' practices, and the competency of performing BIM adhered QSs' tasks were discovered. A documentary survey utilized for the identification of potential capabilities of performing QSs' tasks through BIM tools finally, a content analysis was conducted to analyse the data using a qualitative approach. It was revealed that when executing traditional QSs' tasks, BIM has proven a great adeptness and contrariwise for modern tasks. Tasks directly linked with numerals experience splendid benefits through BIM. Thus, it was concluded it is advantageous to perform traditional QSs' tasks through BIM tools.

Keywords: *Building Information Modelling (BIM); Quantity Surveyor (QS); Tasks*

1. Introduction

The dramatic evolvement of Information Technology (IT) intensively upgraded the construction industry's performance, where Building Information Modelling (BIM) has developed into one such reputable collaboration procedure. The BIM itself has a greater stimulation on everyone's profession which redefined the professional boundaries. Quantity Surveyor (QS) is appeared to be one of the significant professions in this occurrence, which needed to be amended with the adoption of BIM. The paper explores how the accustomed behavior of a QS is being influenced by BIM and comparative effectiveness of BIM tools against quantity surveying approaches.

2. Background

Over the past decades, the construction industry merged with innovative systems which upgraded the productivity, performance and established new customs of managing and organizing by the evolvement of the IT (Kim, 2003). Among those, BIM is one such newest technology in the built environment which is currently utilising data models (Gee, 2010). Succar (2008) defines, BIM as a "set of interacting policies, processes and technologies generating a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle (p.29)", while Smith (2007), expresses BIM as, build a building virtually prior to building it physically, in order to work out problems and simulate and analyse potential impacts. However, it is arguable whether BIM is an anathema for current professionals in the industry, since BIM proved its capability of alleviating some of the foremost tasks of disciplines. Supplementary, Gu, Olatunji, and Sher (2009) justified that, BIM is a major challenge to the services conventionally provided by QSs and other construction disciplines. Moreover, as argued by Ashworth and Hogg (as cited in Gee, 2010) the QSs' profession, like many other professions, is an evolving discipline that needs to continue to change to meet the ever changing conditions of the building industry. Similarly, Baldwin and Jellings (2009b) highlighted that multiple computer applications have already been developed to automate certain QS responsibilities in order to alleviate some of the pressures caused by time constraints and competitiveness. Therefore, all the aforementioned findings mutually agreed that the adoption of BIM may redefine traditional professional boundaries explicitly for QSs.

However, Gee (2010) exemplified that, BIM's capabilities of automating the production of Bills of Quantities (BOQ), which is one of the QSs' fundamental tasks, which will have both positive and negative effects in the field of quantity surveying. In opposition, Ogunsemi, Olatunji, and Sher (2010) claimed that, there is a second line of thought within the construction industry which suggests that, BIM is not completely trustworthy as a QS tool as nonconformity

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of the output data from BIM with the standard methods of measurement. Proving the above fact, Buckley (as cited in Shangvi, 2012) contended that BIM tools are not advanced enough to be capable to substitute the experience and expertise of the QS. Thus, the question has been raised whether BIM actually provides effectiveness over QS when performing QSs' tasks.

2.1. AIM

The aim of this research is to evaluate below statement.

"Can BIM provide either an equally effective or more effective solution compared to the conventional practice of QS in performing quantity surveying tasks"?

2.2. OBJECTIVES

Hence, the set objectives of the research were;

- Identify the conventional quantity surveying tasks performed in the construction industry
- Recognize the BIM tools available to perform the quantity surveying tasks
- Evaluate the effectiveness of BIM tools in performing quantity surveying tasks
- Establish comparative effectiveness of BIM tools against conventional methods

The preliminary phase of the paper is a comprehensive literature review which identified the features of BIM and QSs' practice distinctly and discovered the competence of performing QSs' tasks that can be achieved through BIM. The subsequent sections discuss the research methodology applied, followed by explored outcomes of the study and lastly presents conclusions and recommendations.

3. Literature Synthesis

A comprehensive literature synthesis was carried out which equated traditional QSs' practices with the performance of QSs' tasks that can be achieved through BIM.

3.1. ROLE OF A QUANTITY SURVEYOR

Qs are well-known to be specialists in terms of cost and value hence, they are accountable for guide clients on the paths of cost and value, appropriate implication of design decisions and the govern construction costs (Ashworth, Higgs & Hogg, 2013). Supplementary, RICS (2012) defined the work of the QS as: “Ensuring that the resources of the construction industry are utilised to the best advantage of society by providing the financial management for projects and a cost consultancy service to the client and designer during the whole construction process (p.17).”

Additionally, Gu, Olatunji, and Sher (2009) discussed that the majority of the most imperative traditional functions carried out by Qs are based upon the measuring and pricing of construction works. Further, AIQS (2011) indicated that preparing BOQ is one of the oldest tasks performed by the QS. In fact, the Qs got their name from the BOQ. Thus, it is factual and undoubtedly reflected that there is a direct link between QS and cost parameter of a project.

3.2. WHAT IS BIM?

BIM is eminent for its ability of digital demonstration which represents the physical and functional characteristics of a facility (NBS, 2008). BIM is also acknowledged as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition. Further, Thomsen (2010) revealed that BIM is a logical step to envision, which considers an entire building as a smart object with endless possibilities for algorithms that govern its behaviour and associated information. Alternatively, Smith (2007) defined BIM as a process of generating and managing data about the building, during its life cycle which typically uses three-dimensional, real-time, dynamic building modelling software to increase productivity in the design and construction stages. Thus, according to the above descriptions, BIM is characterized to function throughout the lifecycle of the projects. In spite of that, BIM also acts as a foreseer due to its ability of simulating physical space and expressing design intent graphically, providing a clearer image of design conflicts or constructability issues so that they are resolved before the real site operations begin (Chelson, 2010).

3.3. BIM AND QUANTITY SURVEYING PRACTICE

Technology is emerging promptly by enlightening all its subsectors across the world and making all the real life functions easier than they were. The construction industry which recognizes technology as vital has been sensitive to these technological modifications. Proving the fact, Sattineni and Bradford (2012) stated that, there is a widely acknowledgement towards the adoption of BIM, which would cause a seismic shift in the business processes within the construction industry and related fields. With relate to the Qs role, it was

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proved that BIM can assist the QS in various tasks rather than quantification as mentioned in the preceding paragraph. The statement was justified by Azhar, Hein, and Sketo (2010) who claimed that BIM software(s) have built-in cost estimating features. Supportively, Ashworth (2010) discovered that the speed of response and the ability to reduce manual errors have led to the wide-spread use of software applications for performing Quantity Take-Off (QTO) and estimating. Furthermore, Baldwin and Jellings (2009a) specified that the 5D model created by BIM has the potential to perform an automatic analysis of all materials and components and to derive their quantities directly from the model. Additionally, Eastmen, Liston, Sacks, and Teicholz (2008) mentioned that proponents of BIM are very useful for Value Management (VM) as the speed of response of BIM tools provides an excellent opportunity to perform VM throughout the design period. Hence, all aforementioned statements collectively agree on the opinion where BIM provide enough substitutional effort over QSs tasks.

Contra wisely, Buckley (as cited in Shangvi, 2012) recommended against this practice of preparing a cost estimate without the involvement of an estimator and he stressed that estimator's knowledge and experience are absolutely essential to adjust the estimate in accordance with the specific conditions of a project. Furthermore, he pointed out that BIM tools are not programmed to perform such adjustments by themselves. Similarly, Ogunsemi et al. (2010) have doubts over the reliability of QTO performed by BIM applications as BIM tools simply provide theoretical quantities based on the attributes of the model without any allowances for wastage, lapping etc. Moreover, Ashcraft (2008) elaborated that lack of standard contract documents delays development of BIM since consensus business model for BIM has not emerged yet.

4. Research Methodology

Through an extensive literature synthesis, the distinct features of BIM and QSs' practice together with the competence of performing QSs' tasks that can be achieved through BIM were identified. A qualitative analysis was utilized by using a documentary survey and NVIVO software, which explored the compatibility of BIM with recognized traditional and evolved tasks of a QS. The documentary survey was accompanied by research publications, online publications by personal and company blogs, online forums, online discussions at professional networks and websites.

5. Research Findings

The research findings of the documentary survey (Table 1) assisted in exploring the sustenance of BIM tools over QSs' tasks and comparative effectiveness of BIM tools against conventional quantity surveying approaches.

Table 4: Comparative effectiveness of BIM over conventional QS approaches

QS Tasks	Comparative Effectiveness against conventional QS approaches
Providing Approximate Cost Estimates	This task reflected a more effective behaviour with the amendment of BIM tools due to the absence of human errors may occur in terms of quantification and alternation of cost, as well as the reduction of time taken to the process.
Advice on Procurement	BIM techniques are more effective when advising on procurement method since, the combination of BIM and QS allows the prediction of probable uncertainties may occur during the process of selection.
Cost Planning	Due to the accelerated procedure, BIM tools are more effective when performing the task of cost planning.
Measuring Items on Site	The applicability of BIM in real site operations are still emerging. Hence, the collaboration of BIM into this task showed less effectiveness.
Preparing Bill of Quantities	BIM techniques associate much more effectively when preparing BOQ in terms of automating, removing human error, increasing efficiency and promoting collaboration.
Preparing Schedules of Works	BIM based scheduling is more effective due to early coordination, constructability analysis, and prefabrication which led to improved design and field productivity, reduced field effort, and significant reductions in the overall construction schedule, which resulted in a confident forecast of on-time delivery.
Preparing Financial Statements	BIM tools upgraded the performance of this task due to its ability of data integrity.
Controlling Costs throughout the Project	The impact of BIM tools have positive influence on the process of cost planning throughout the project by means of increases profits, lowers costs, and less scheduling time.
Assessing and Negotiating Tender	The efficacy of the process of assessing and negotiating tender is mostly relying upon the experience and the practice of a QS. Thus, the amalgamation of BIM into this task reflects a less effectiveness.
Investment Appraisal	As preceding task, the investment appraisal also requires accurate judgment of a QS which is entirely based on his practises and experiences. Therefore, it was concluded that although BIM tools support investment appraisal in a way, besides if the task take as a whole, the model is less effective.

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Advice on Cost Limits And Budgets	BIM uniquely offers the concurrent and immediate availability of all of the important information about the building that results in higher quality work, greater speed and productivity, and decreased costs to advice on cost limits and budgets. Hence, BIM has proved much effectiveness over this task.
Whole Life Costing	In terms of creating, using, gathering and sharing building life cycle data, BIM provides a great efficiency in the mechanism of whole life costing.
Value Management	Acceleration of the process is the main advantage of BIM tools with regard to the value management procedure. This allows carrying out value management from the design phase throughout the entire project greatly benefit from the capability to automate. Consequently, with regard to value management, BIM tools are more effective.
Risk Analysis	If accurate and reliable information exists, BIM tools have positive influence on the results of the risk analysis, whereas incomplete, improper or unjustifiable data may cause to wrong interpretation of safety and risk analysis. Thus, it seems to be that BIM tools have equal effective influence on analysing risks of the construction procedure.
Insolvency Services	Throughout the research survey conducted, facts that suggest the efficiency of BIM tool with relevant to the task could not be found. Hence, further research should be processed to investigate the relevancy of BIM tools with the aforementioned task.
Cost Engineering Services	BIM tools have positive influence on the cost engineering services in terms of cost controlling, ensuring the right information is available at the right time, manage change and limit or even eliminate unforeseen costs, delays and claims.
Subcontract Administration	Subcontract administration reflects more effectiveness with BIM as it coordinates and accelerates the communication process between contractor and subcontractors.
Environmental Services Measurement and Costing	Neither positive nor negative facts could be found with regard to this task. Hence, further research is suggested to explore the collaboration of BIM tools with this task.
Technical Auditing	The applicability of BIM in real site operations are still emerging. Hence, the collaboration of BIM into this task showed less effectiveness.

Planning and Supervision	Numerous activities of this task should be conducted physically and it directly expressed that BIM shows less efficiency on planning and supervision. Contra wisely, the BIM's ability of planning and tracking construction activities upgraded the performance of the task. Hence, it was concluded that BIM tools are having equal effectiveness with relevant to the aforementioned task.
Valuation for Insurance Purposes	Due to the unavailability of sufficient facts, it was recommended to carry out further investigation to appraise the effectiveness of this task with the combination of BIM.
Project Management	BIM provides a significant sustenance to utilize the functions of project management in terms of identifying, managing and analysing important data as well it assist in managing concurrent activities as well. Thus, it was expressed that the impacts of BIM tools have positive influence on project management activities.
Facilities Management	Facilities management operations are strongly enlightened by the functions included in BIM tools. Hence, BIM provides a significant support to utilize the functions relate to the facilities management.
Administering Maintenance Programs	Data contained in the BIM model can be used for managing remodelling, additions, and maintenance. Therefore, BIM tools are highly reliable for the performance of this task.
Advice on Contractual Disputes	BIM greatly reduces conflict issues by integrating all the key systems into the model, hence it minimizes probability of legal disputes which ultimately assists in this particular task.
Programme Management	Programme management essentials the expertise of a QS, which could only gained through the experience and practice. Thus, it was concluded that amendment of BIM causes for less effectiveness when fulfilling this task.
Cost Modelling	Findings revealed that, BIM tools have equal effective influence on cost modelling process of the project.

Table 2, elaborates the degree of efficiency of BIM tools with regard to the quantity surveying tasks.

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Table 2: Summary of key findings

Quantity Surveying Tasks	Efficiency of BIM tools		
	More effective	Equal effective	Less effective
1. Providing approximate cost estimates	×		
2. Advice on procurement	×		
3. Cost planning	×		
4. Measuring items on site			×
5. Preparing bills of quantity	×		
6. Preparing schedules of works	×		
7. Preparing financial statements	×		
8. Controlling costs throughout project	×		
9. Assessing and negotiating tender			×
10. Investment appraisal			×
11. Advice on cost limits and budgets	×		
12. Whole life costing	×		
13. Value management	×		
14. Risk analysis		×	
15. Cost engineering services	×		
16. Subcontract administration	×		
17. Technical auditing			×
18. Planning and supervision		×	
19. Project management	×		
20. Facilities management	×		
21. Administering maintenance programs	×		
22. Advising on contractual disputes	×		
23. Programme management			×
24. Cost modelling		×	

6. Conclusions and Recommendations

The findings demonstrated that when performing traditional QSs' tasks, BIM has proven a great efficiency besides evolved QSs' tasks interpreted a less efficiency. Particularly, tasks which have direct relationship with measuring and interpreting quantities, reached more benefits through BIM models. Furthermore, it was concluded that performing tasks which are required the skills of assessing, negotiating, supervising, auditing and planning are less effective with the assistance of BIM tools. Moreover, certain tasks seem to be having an equal impact of the effectiveness relevant to BIM. Throughout the research study, it was discovered that for several tasks namely insolvency services, planning supervisor, employer's agent and sustainability advisor not containing any information to interpret the relevancy of BIM tools and its efficiency.

This study recommends the application of BIM tools for performing the task of providing approximate cost estimation means of reducing time, cost and updating quantities without any errors. Furthermore, it suggested confidently the application of BIM tools when advising on procurement method with regard to the influence of uncertainties may occur during the process of selection. Further, considering the conflicts between positive and negative influences of BIM tools over preparing bills of quantity, the empirical evidence discussed that the key benefits of the model are strengthening the effectiveness over its negative circumstances. Hence, it can be recommended through proper improvements of BIM tools associate much more effective when preparing bills of quantity.

Further, this study praises the applicability of BIM tools over controlling cost throughout the project. It highlighted that practice of BIM tools for advice on cost limits and budgets effective as it let QS to focus on more significant and important activities. Furthermore, findings mentioned that BIM provides a great efficiency in the mechanism of whole life costing as a mean of creating, using, gathering and sharing building life cycle data and acknowledged that application of BIM tools in value management process as BIM tools allow carrying out value management from the design phase throughout the entire project.

Additionally study illustrated that application of BIM tools for administration of sub-contractors as it to increase the efficiency and rapid the speed of process. Also study recommended that application of BIM tools for administrating maintaining program and for advising on contractual disputes through the BIM tools. However, findings of this study specifically not recommended the application of BIM tools over measuring item on site, which requires further study. Moreover it cannot be suggested that practice of BIM

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tools for assessing and negotiation of tender as BIM tools are not capable with negotiation and evaluation process. Although BIM tools support on investment appraisal in a way, it cannot be recommended that application of BIM tools for investment appraisal when task taken as a whole. The study revealed that a necessity of a further research for ascertains the effectiveness of BIM tools over preparing financial statements, risk analysis, cost modelling and planning and supervision as those tasks have both strengthen and weakness when perform through BIM tools.

According to the findings, it would be beneficial to application of BIM tools in construction in both pre-contract and post-contract phases by meaning of reducing time, cost and improving buildability of project. Finally study disclosed that practice of BIM tools may increase the efficiency over most of traditional quantity surveying tasks performed by a QS.

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