Quantity Surveying By Building Information Modelling

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Abstract- Building Information Modelling (BIM) is mainly used in our country for creating 3D drawings. But it has vast potential in scheduling, estimation and life cycle costing. Quantity surveyors are still unsure of the capability of BIM in their practice and the advantages of its use in Quantity Surveying. Lack of awareness of the potential of BIM application is the main reason for low adoption of BIM. BIM permits to analyze the building, the structure, materials and performance in real time as it is being designed. This research is conducted with broader aim of exploring, the real potential of BIM in QS. It also checks expansions of QS roles, challenges of Quantity Surveying by BIM. This paper contains the preliminary findings of a literature review conducted on the current role and expend of BIM in QS and the probability of a case study for quantifying BIM performance.

Keywords: Building Information Modelling (BIM), Capability, Quantity Surveying, Construction Industry, Cost

INTRODUCTION

1. GENERAL

BIM is a new technological advancement, integrating all trades associated with Civil Engineering and Architecture into a single fold. But its implementation has been confined to 3D drawings in India and elsewhere. Its potential is known, but has not utilized in Quantity Surveying, due to fear it will alienate jobs and also lack of its authenticity in application in Quantity Surveying. This paper tries to alienate that fear and aims to compare the results by Quantity Surveying a project by conventional method and BIM.

1.1. BIM

Building information modeling is an innovative new approach to building design, construction, and management. In the construction phase of the building lifecycle, building information modeling makes available concurrent information on building quality, schedule, and cost. Completing a construction project within these three important parameters such as time, cost and quality are criteria of success for a project. BIMs defined in further dimensions such as 4D (time), 5D (cost) and even 6D (as-built operation).

1.2. QUANTITY SURVEYING PRACTICE

The main professional disciplines providing specialist project cost management services around the world are cost engineers, quantity surveyors, construction economists and project managers. Quantity Surveying is a profession with origins in the United Kingdom and is a professional title recognized mainly in Commonwealth countries. Cost Engineering is the term mainly used in North and South America, China and some parts of Europe. Construction Economist is used in some European countries and in other parts of the world as an alternated escraptor for the service. A Quantity Surveyor is an expert in the art of costing a building at all its stages who offer expert advices on construction costs. It is inevitable that, the advices are vital for life cycle costing, cost planning, procurement and tendering, contract administration and commercial management. The major tasks provided by quantity surveyors (QSs) include Quantification, bills of quantities preparation, estimation and pricing of construction projects. The use of traditional manual quantity surveying practice such as excel spreadsheet and 2D CAD have made quantity surveying a tedious and time consuming task, which are less efficient and are more susceptible to human errors. As a result, it has reduced the performance of QSs which subsequently affect the project cost outcomes. Besides, clients are becoming dissatisfied with the conventional ways of QSs performing their practice.

Following is the representation of the 9 most important traditional roles and responsibilities of a Quantity Surveyor identified by Fanous (2012) in his empirical study.

- Providing Approximate Cost Estimates
- Advice on Procurement
- Cost Planning
• Measuring Items on Site
• Preparing Bills of Quantities
• Preparing Schedules of Works
• Preparing Financial Statements
• Controlling Costs throughout Project
• Assessing and Negotiating Tenders

The following factors undermine the accuracy of the manual Quantity Takeoff.

• Errors associated with moving data between files
• Risk of double counting
• Risk of missing elements
• Multiple 2D drawings themselves are likely to contain many errors compounding the problem further

1.3. APPLICATION OF BIM IN QUANTITY SURVEYING

With the help of BIM we can accelerate the quantification of the building for estimating purposes and for the production of updated estimates and construction planning. BIM offers the capability to automatically generate quantity take-offs and measurement directly from a digital model of a building, a process that traditionally is very time consuming for quantity surveyors. Automating the process through implementing building information modeling (BIM) helps to resolve these problems. BIM removes many tedious tasks of traditional quantity surveying, such as measurement, take offs and the production of bills of quantities (BQ), by automating these tasks. There is limited research on investigations into potential and capabilities of BIM in quantity surveying practice. There are fears that adoption of BIM could threaten and challenge the existence of Quantity Surveying profession. Therefore it’s necessary to understand its potential expansions of QS roles in BIM based project delivery.

Under this context, the work presented in this paper is a part of an on-going research which is conducted with broader aim of exploring the changing key roles and responsibilities of future Quantity Surveyors in a BIM based project delivery. While the ultimate findings of such a study will be helpful in training Quantity Surveyors to face future challenges, this paper presents literature synthesis of the same identifying the appropriate next steps to further the knowledge.

The use of Building Information Modelling (BIM) in the construction industry is on the rise. It is widely acknowledged that adoption of BIM would cause a seismic shift in the business processes within the construction industry and related fields. The manual process requires a great deal of time for revising the BOQ to accommodate design changes. Hence, the BOQ is often out-of-date. Ashworth (2010) considers that the speed of response and the ability to reduce manual errors have led to the wide spread use of software applications for performing QTO and estimating. 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. The proponents of BIM are very useful for VM as the speed of response of BIM tools provides an excellent opportunity to perform VM throughout the design period. It is reported that Consolidated Contractors Company used BIM to generate bulky monthly payment applications, cost reports and estimated that by utilizing BIM in the DubaiMall project. That tasks which would possibly have required 25 full time QSs were carried out by employing 8 modellers and 2 BIM engineers. BIM suggest that a detailed building model would provide a greater certainty over the quantities of material, and therefore, BIM would produce amore reliable cost estimate compared to the traditional process (denote that large clients who have their in-house cost database can directly derive their estimates during the early stages of the project using BIM based estimating tools such as D-Profiler. Therefore, they can afford to do without the services of the QS.

1.4. OBJECTIVES OF THE STUDY
The objective of study is to

1. To know about BIM and its overall application in AEC Industry.
2. Understand the effect of BIM over the construction industry in whole and Quantity Surveyors in special.
3. To know the current extent and use of BIM in QS.
4. The advantages and limitations of use of BIM for QS.
5. To know the plus and minuses of QS by Conventional and BIM techniques.

LITERATURE STUDY

This chapter deals with the study and analysis of the degree of use of BIM for Quantity Surveying and the hurdles faced by construction firms for implementing it.

[1] Dr. Peter Smith “BIM & the 5D Project Cost Manager” 27th IPMA World Congress

Project cost management professionals need to be integrally involved across all project phases and need to embrace the 5th dimension to become key players in the BIM environment. BIM involves more than just 3D modelling and is also commonly defined in further dimensions such as 4D (time), 5D (cost) and even 6D (as-built operation). 4D links information and data
in the 3D object model with project programming and scheduling data and facilitates the simulation analysis of construction activities. 5D integrates all of this information with cost data such as quantities, schedules and prices. 6D represents the as-built model that can then be used during the operational stages of the facility.

BIM and automated quantities technologies provide the profession with enormous opportunities to raise the value of their services to a much higher and sophisticated level. The ability to simulate a range of design options with real-time cost advice and continue that real-time cost advice throughout the detailed design, construction and operational stages will arguably place the project cost manager at the top of the ‘value chain’ for project clients adopting BIM by also making it a prerequisite for all those involved in public sector projects to have BIM ready by 2016. BIM offers the capability to automatically generate quantity take-offs and measurement directly from a digital model of a building, a process that traditionally is very time consuming for quantity surveyors. The majority of the BIM based cost estimating or take-off tools developed outside UK and adopted the different practice and rules in quantification.

From the Quantity Surveyor point of view, BIM’s capability of automating measurement is its key benefit and it clearly speeds up the traditional estimating process. It is evident that BIM delivers a more efficient operational solution for the quantity surveyors for cost estimating with its ability to link the relevant quantities and cost information to the digital building model and update them simultaneous to design changes.

The substandard quality of BIM models, inconsistent level of design information included, data exchange issues in BIM tools, and inconsistent formats used for estimating, all need to be significantly improved to increase the confidence of QS professionals in BIM based estimating, and encourage a higher level of adoption of BIM within QS practices.


The building industry is broadly identified as unique and conservative. The technological variations may have potential to influence everyone’s professions in different ways. Although, the concept of Building Information Modelling (BIM) is not practiced in Sri Lankan construction industry yet, it is likely to become the project delivery standard in future. Introduce with the vision “sustainability by building smarter”, BIM will improve the performance of building professionals. It provides a study on comparative effectiveness offered by BIM for the traditional functions of a Quantity Surveyor.

Technology is developing rapidly by improving all its subsectors across the world and making all the real life functions easier than they were. Building Information Modelling (BIM) is one of the technologies that have been creating a buzz in the construction industry over the last few years which have potential to effect of Quantity Surveying profession. The review of current knowledge synthesized numerous benefits of BIM for QSs to offer effective service. Finding the validity of these conclusions empirically will be the next step.


The UK government has acknowledged technological advancements trend and is joining the radical movement of

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BIM is an integrated digital process providing coordinated, reliable information about a project throughout all phases, from design through construction and into operation.

**BIM benefits are**

- Better informed decisions
- Quicker decision making
- Improved quality
- Improved safety
- Reduced waste
- Greater cost certainty
- Increased profitability

**Where are we? – RICS Survey 2011**

- 10% of QSs are using BIM regularly.
- 4% of QSs invest regularly in BIM training.
- A further 10% of QSs are actively assessing BIM tools.
- Surveyors who work on BIM projects generally felt using it would be appropriate on 2.5 times as many projects.
- Respondents felt the RICS should provide BIM guidance and training.
- QS’s felt the barriers to BIM adoption were lack of client demand, lack of training, lack of application interfaces and lack of standards.

[6] O.A. Olatunji, W. Sher and N. Gu “BUILDING INFORMATION MODELING AND QUANTITY SURVEYING PRACTICE” School of Architecture and Built Environment, University of Newcastle, NSW, Australia 2308

Building Information Modeling (BIM) systems have the potential to revolutionize current practices and to automate the measurement of quantities from construction drawings. However, there are fears that such developments could threaten the viability of the quantity surveying profession. BIM challenges traditional roles of quantity surveyors and their relevance to the construction industry. The development of revised curricula for quantity surveyors and further research into standard systems of measurement is the way out.


Sustainability is the new mentioned goal of business. BIM can integrate into design and construction life cycle. BIM is a system aimed at integrating work systems, it aims to remove the routine drudgery. QS still depends upon QS as main line of business.


Quantity surveyors are slow in adoption compared to other professions due to lack of awareness of the BIM’s potential in their profession. It is still unclear on how BIM application can enhance quantity surveyors’ work performance and project performance. There are several BIM capabilities significantly correlated with project performance in time, cost and quality aspects.

**BIM CAPABILITIES IN QUANTITY SURVEYING PRACTICE ARE**

- Cost appraisal can be prepared quickly at the feasibility stage
- Preliminary cost plan can be prepared by extracting quantities directly from the model
- Easily update cost plans with more detail as design is developed
- Easily generate accurate cost estimates for various design alternatives
- Design changes reflected consistently in all drawing views
- Cost implication of design changes can be generated easily without manually re-measurement
- Clash detection reduces design errors and cost estimate revisions
- Cost checking performs quickly to ensure all items are captured.
- Improved visualization for better understanding of designs
- Automatically quantification for BQ preparation
- Intelligent information management system allows data to be stored in a central coordinated model.


BIM is not as advanced in some countries such as Malaysia that are moving rapidly towards developed status. Improved information with its dimensions of data visualization, reliable database and data coordination would potentially be achieved through BIM adoption. By implementing BIM in cost estimation, it would possibly improve input information and enhance estimator’s knowledge and understanding which ultimately leading them to produce more reliable cost estimates. The elements of BIM improved information to potentially improve the quantity surveying practice. From a practical
The Constraints Of BIM has been found to be change model to knowledge, awareness and cultures, the contractors may execute the cost consulting model, which works to put data, the contractors can quantify of clients are now realizing benefits that may obtain in each moment, for each building element, all model is upgraded with suitable in object is completed, the consultants and technical information for manufacturers and HVAC, energy and the 3D model with a wide variety of different properties of building elements. The setup of geometrical characteristics of building elements result in basic quantities such as side length, object surface area, and object volume. Thus, the 3D model of the building can be modified in a user-friendly manner during the design process because the basic quantities will be automatically updated. After the architectural design is completed, the engineers can upgrade the 3D model with a wide variety of different information related to structural analysis and design, HVAC, energy and environmental issues, visualization, facility management, product and technical information for manufacturers and distributors, etc. As soon as the 3D model of the construction object is completed, the contractors may execute the cost estimates and the project scheduling. When the building model is upgraded with suitable input data, the contractors may obtain in each moment, for each building element, all relevant information for the execution of works. Such model of the construction object can contain information about the type of building elements, the geometrical quantities, the number of items, the resources needed for implementation, the execution times of project activities.


Recently, Building Information Modelling (BIM) has been introduced and promoted as a process which enables quantity surveyors to carry out their roles more effectively, increasing productivity and accuracy especially in Quantity take-off or Measurement. Nevertheless, Quantity Surveyors’ roles in BIM which have been introducing in previous years are unable to comply with BIM practices. Review of the Quantity Surveying practices in managing the constraints of BIM implementation in Kotter’s change model indicates that culture constraints and process constraints have to be resolved in the initial stage of implementing BIM for consultant Quantity Surveying firms, followed by technological constraints and policy constraints. This reviewed result serves as a guidance for Quantity Surveying firms in planning their changes in BIM implementation in future. Motivation and positive culture are undeniably needed in order to implement any new strategy in a company. New roles and protocols are the following steps for the QS firms change model to standardize all processes and workflow of BIM implementation. Technological constraints and policy constraints are subsequent processes of removing barriers of BIM implementation in order to fasten the process of change from traditional QS practices to QS BIM practices.


The design work should not be executed through classical 2D drawings, but the 3D model of the construction object must be created on the basis of geometrical and material properties of building elements. The setup of geometrical characteristics of building elements result in basic quantities such as side length, object surface area, and object volume. Thus, the 3D model of the building can be modified in a user-friendly manner during the design process because the basic quantities will be automatically updated. After the architectural design is completed, the engineers can upgrade the 3D model with a wide variety of different information related to structural analysis and design, HVAC, energy and environmental issues, visualization, facility management, product and technical information for manufacturers and distributors, etc. As soon as the 3D model of the construction object is completed, the contractors may execute the cost estimates and the project scheduling. When the building model is upgraded with suitable input data, the contractors may obtain in each moment, for each building element, all relevant information for the execution of works. Such model of the construction object can contain information about the type of building elements, the geometrical quantities, the number of items, the resources needed for implementation, the execution times of project activities.

[12] Edyta Plebankiewicz1, Krzysztof Zima1, Mirosław Skibniewski2 “Construction cost and time planning using BIM-based applications” Creative Construction Conference 2015

The ability to automate the process of preparing a bill of quantities is one of the key advantages for the estimator. Such possibility is provided by the BIM model. Implementation of a BIM-based measurement and cost estimating practices in Poland is still at its early stages. The key approaches of BIM-based cost estimating, such as exporting quantities, using specialized BIM measurement tool and a cost estimate system and also identifies difficulties in taking full advantage of BIM, especially in data exchange issues in BIM.


BIM is beginning to change the way buildings look, the way they function, and the ways in which they are designed and built. Building Information Modeling is the innovative production of a single building model, which works to integrate information supplied from all disciplines involved, for use by the whole project team. For cost consultants, it is BIM’s capability of combining graphical and non-graphical data models, which will allow for the provision of more accurate cost information. It is important for cost consultants to fully understand how they can work effectively with BIM, as the UK ‘Government Construction Strategy 2011’ outlines that it will be mandatory for all public projects of £5 million and over, to be working collaboratively with level 2 BIM by 2016 (BIS, 2011). 80% of quantity surveying firms are using elemental cost estimates in their working practices, the Royal Institution of Chartered Surveyors (RICS) reports a lack of BIM knowledge amongst its members. BIM is “being rapidly embraced by the construction industry to reduce cost, time and enhance quality. Clients are now realizing benefits that BIM can offer them as owners. It has become essential that cost consultants expand their knowledge, awareness and usage of BIM, to ensure that they do not fall behind other construction professionals.


Building Information Modelling (BIM) represents the formation of digital models for use during the planning,
design, construction and operation stages of a facility’s life. Whilst BIM is currently receiving high volumes of attention within the UK, it appears that general understanding of it is relatively low. BIM has the capacity to influence the way that the construction industry operates, with the focus of this study being to identify the usability of BIM for cost consultants, and it’s likely impact during cost estimating. The widespread BIM implementation is anticipated to bring about a new way of working and thinking within the construction industry, in comparison to traditional practices. As supported by the RICS (2011a), it has been found that the usage of BIM is increasing within the UK and seemingly has the capacity of impacting every aspect of the surveying profession, therefore making it essential for cost consultants to adapt and embrace BIM, as to not risk losing ground to others.

[15] Hexu Liu, Ming Lu and Mohamed Al-Husseina “BIM-based Integrated Framework for Detailed Cost Estimation and Schedule Planning of Construction Projects” The 31st International Symposium on Automation and Robotics in Construction and Mining (ISARC 2014) BIM-based integrated framework product model developed in Autodesk Revit, is integrated with a construction process model retrieved from RS Means, with the objective of generating detailed cost estimation and a workforce construction schedule simultaneously. As the core of the proposed framework, the integrated WBS achieves cost and schedule integration as well as the integration between the product model and the construction process model. However, it is developed manually based on construction knowledge of a building project. Future research efforts are needed with respect to the automatic generation of WBS. Some other challenges regarding full automation of BIM-based detailed cost estimation and schedule planning are summarized as follows:

1. Temporary facilities such as formwork and scaffolding are missing from the 3D model. Consequently, quantities for formwork and scaffolding cannot be directly extracted from the BIM model without manual involvements.
2. Modeling of the temporary facilities in a BIM environment is difficult to achieve without the required construction knowledge. For instance, in the case study, CMU walls can be constructed concurrently by establishing multiple sets of scaffolds around the building; or they can be built sequentially by installing and moving only one set of scaffolds. In this case, the BIM program needs to have —intelligence embedded in order to automatically build a 3D model of the temporary scaffoldings.

[16] Curtis Harrison, Derek Thurnell “BIM IMPLEMENTATION IN A NEW ZEALAND CONSULTING QUANTITY SURVEYING PRACTICE” INTERNATIONAL JOURNAL OF CONSTRUCTION SUPPLY CHAIN MANAGEMENT Volume 5 Number 1 2015

5D BIM - generating cost data via the building information modelling (BIM) process - has the potential to be used by quantity surveyors (QSs) to streamline their workflows and increase their provision of a quality service. 5D BIM has numerous benefits over traditional methods, chiefly through the increased efficiency and visualization that BIM provides, along with the rapid identification of design changes. However, realization of these perceived benefits is limited to date, due to several barriers hindering 5D BIM implementation: incomplete design and insufficient model object data in the BIM model; a lack of standards to facilitate electronic measurement; legal issues, and a lack of government support.

Increasing 5D BIM implementation, in tandem with increasing use of collaborative project working through integrated project delivery, will, however, facilitate these benefits being achieved to a far greater extent in the future. The main perceived benefits of 5D BIM were found to be that it:

- enables increased visualization of the building;
- provides a bulk checking device for manual measurement;
- enables efficient data extraction for estimating at developed design stages, as well as for producing schedules of quantities;
- allows for rapid identification and costing of design changes, and provision of a commercial advantage over competitors.

Barriers hindering 5D BIM’s implementation are:

- frequent (and often numerous) design errors, and completeness in the BIM model;
- incompatibility with QS standard methods of measurement (e.g. NZS 4202:1995);
- a lack of industry standards and protocols to facilitate design embedment within BIM models;
- a lack of context for construction methodologies;
- the need for extensive manual bulk checking to ensure the accuracy of extracted quantities;
- a lack of government intervention to support BIM, additional costs to the client.

Participants asserted that the greatest benefits to date have been achieved when undertaking BIM in a collaborative environment, in particular, when the QS is involved early on in the design process.

LITERATURE REVIEW

A systematic literature review method was adopted for this paper in order to draw findings and form conclusions. Secondary information consists of sources of data that has been collected and recorded by others, which was derived for this research through a detailed literature review, to explore information already known on the topic of BIM. This stage
consist sreview of literature based upon data and analyzing the data. It provides us with a general knowledge about the topic and its current relevance in AEC Industry.

3.2. SETTING OF OBJECTIVE OF STUDY
In this step, the aim or the objectives of the Project is finalized. The problem statement based on that selection of research area has been done.

3.3. DATA COLLECTION
The data required for conducting Quantity Surveying is collected.

3.4. CASE STUDY OF A BUILDING
A simple building project is used as a case study to facilitate understanding of and verify the applicability of QS by BIM software. The same project is Quantity Surveyed by conventional method from BOQ and drawing.

3.5. COMPARITIVEDISALYSIS OF CASE STUDY
Fromthis, tables were created to list the associated advantages and challenges for QS using BIM, which was utilized to assess the usability and impact of BIM on Quantity Surveyors.

CONCLUSION

BIM is revolutionary software that not only affects QS Practice, but every aspect including design, analysis, and scheduling and facilities management.

BIM software is now in an infant phase, when using its 4D, 5D and 6D capabilities. It has problem with integration with other systems, and also need more friendly user interface.

FUTURE SCOPE OF STUDY

The analysis of the Literature’s gives a necessity for a case study, comparing QS by BIM and the Conventional methods, as there are not much study about a practical advantages, which is quantified. The main problem of not having such a study is the absence of standard method of QS in India. Most QS uses their own techniques.

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[3] Dr. Peter Smith “BIM & the 5D Project Cost Manager” 27th IPMA World Congress


[10] O.A. Olatunji, W. Sher and N. Gu”BUILDING INFORMATION MODELING AND QUANTITY SURVEYING PRACTICE” School of Architecture and Built Environment, University of Newcastle, NSW, Australia 2308


[13]Zoran Pučko, NatašaŠuman, UrošKlanšek”Building Information Modeling Based Time And Cost Planning In Construction Projects “
