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THE ROLE OF BUILDING INFORMATION MODELLING (BIM) IN THE QUANTITY SURVEYING METHOD

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Abstract

Building information modelling (BIM) is crucial for enhancing the effectiveness of quantity surveying profession. Quantity surveyors oversee cost management from project inception to completion, including feasibility, design, and construction phases. Quantity surveyors are currently not as proficient in using BIM technology as other professions. The primary factor contributing to the poor adoption of BIM is a lack of understanding about its possible applications. Quantity surveyors are uncertain about the efficacy of Building Information Modelling (BIM) in their professional work. The position of Quantity Surveyors would undergo a significant revolution if their building procurement process were based on Building Information Modelling (BIM). BIM allows for real-time analysis of the building, including its structure, materials, and performance, throughout the design phase. Therefore, a study is being carried out with the overarching objective of investigating the possible extensions of Quantity Surveyor (QS) functions, as well as the transformation of key tasks and responsibilities of future Quantity Surveyors in a sustainable Building Information Modelling (BIM) project delivery. This research aims to provide Quantity Surveyors with the necessary skills to confront future difficulties. This article presents the first results of a literature analysis that examined the existing primary duties and obligations of Quantity Surveyors in local construction procurement, as well as the anticipated future requirements in a project delivery system based on construction Information Modelling (BIM).

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

1. Introduction

Building information modelling (BIM) is a cutting-edge methodology for designing, constructing, and managing buildings. During the construction phase of the building lifecycle, building information modelling provides simultaneous information on building quality, time, and cost. Successfully completing a construction project requires meeting three crucial parameters: time, money, and quality. Quantity surveying is a crucial field that offers cost control services in the building sector. Quantity surveyors (QSs) are responsible for many key duties, such as quantification, creation of bills of quantities, estimating, and pricing of building projects. The use of conventional manual quantity surveying methods, such as excel spreadsheets and 2D CAD, has resulted in a laborious and time-consuming process,

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which is less effective and more prone to human mistakes. Consequently, this has diminished the efficiency of QSs, thus impacting the project's cost results. In addition, customers are increasingly unsatisfied with the traditional methods used by quantity surveyors in carrying out their work. BIM enables us to expedite the process of quantifying the building for estimation purposes and for generating up-to-date estimates and construction plans.

Implementing building information modelling (BIM) automates the process and effectively resolves these challenges. BIM streamlines certain laborious aspects of conventional quantity surveying, including as measurement, take offs, and the creation of bills of quantities (BQ), via the automation of these processes. There is a scarcity of study on the exploration of the potential and capabilities of Building Information Modelling (BIM) in the field of quantity surveying. There are concerns that the use of Building Information Modelling (BIM) might potentially jeopardise and undermine the viability of the Quantity Surveying profession. Therefore, it is essential to comprehend the prospective expansions of Quantity Surveyor (QS) jobs in Building Information Modelling (BIM) based project delivery. The study described in this article is part of an ongoing research effort that aims to explore the evolving roles and responsibilities of future Quantity Surveyors in a BIM-based project delivery. This research provides a literature synthesis that identifies the proper next steps to further knowledge in educating Quantity Surveyors to effectively tackle future difficulties. The eventual conclusions of this study will be beneficial in this regard.

2. Building Information Modelling

BIM is a digital representation of a building and its associated project/lifecycle data. It serves as a centralised information source for building owners/operators to use and manage during the facility's lifespan. BIM, as a digital representation, offers a virtual perspective of the items inside a structure, including its physical geometry (2D or 3D) and other functional characteristics like materials and spatial relationships. Designers assemble these BIM components to create a building model, which includes both physical and functional information recorded inside the BIM elements. After the building model is finished, users may create all the necessary information for fabricating, analysing, constructing scheduling (4D BIM), estimating costs (5D BIM), and managing the facility throughout the building's operational phase. Building Information Modelling (BIM) entails creating a visual representation of the building while simultaneously handling relevant data at various stages, including design, construction, and operational phases. BIM often employs live, interactive building modelling software that operates in three dimensions, as well as including workflow management in four dimensions and quantity surveying in five dimensions. This approach aims to enhance productivity and efficiency, minimise expenses throughout the design and construction phases, and lower ongoing expenditures post-construction.

3. Quantity Surveying using BIM

Quantity surveyors play a crucial role in the building sector. According to a 1971 report published by RICS, the role of a quantity surveyor is to optimise the utilisation of resources in the construction industry by offering financial management for projects and a cost consultancy service to the client and designer throughout the entire construction process. Their responsibility include cost management from project inception, including feasibility

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and design, till the project is fully constructed. A Quantity Surveyor's primary responsibilities include overseeing the financial aspects, cost management, and contractual administration of a project throughout its many stages. Their services may be categorised into two distinct phases: the pre-construction stage and the post-construction stage of the projects. During the pre-construction phase, quantity surveying services include several tasks such as creating initial cost estimates and feasibility studies, developing cost plans and schedules, preparing bills of quantities, managing procurement and bidding processes, and evaluating tender submissions. During the post-construction phase, quantity surveying services include several tasks such as offering overall contractual guidance, appraising partial payments, reviewing changes in scope, creating financial statements, finalising accounts, and facilitating alternative dispute resolution (ADR).

The primary services offered by QSs are measuring and the creation of bills of quantities. The cost estimation procedure entails doing a quantity takeoff (QTO) and incorporating cost data into the QTO list. Quantity taking off (QTO) is the established procedure of measuring the amounts of different construction parts. The conventional quantity take-off (QTO) method using CAD designs is manually picking certain parts within the CAD drawings, utilising the software to automatically ascertain the measurements for the take-off, and entering the amounts into the QTO list. Estimators must dedicate a significant amount of time to generate the quantity takeoff (QTO) for the complete design. Due to the reliance on human procedures for both the selection and measurement processes, mistakes and omissions often occur throughout the QTO process. Nevertheless, BIM technology offers a promising approach to address the aforementioned issues by automating these laborious activities.

BIM, or Building Information Modelling, is a technique that involves creating and managing a centralised model to enhance many aspects of the design, building, operation, and maintenance processes. BIM operates on a unified platform that encompasses information representing the complete building, including designs and data from many design professions. It functions as a simulation model that aids in modelling real-life scenarios and detecting possible issues in a virtual setting prior to actual implementation. Early detection of clashes and difficulties allows for prompt rectification measures to be performed, hence minimising the potential effects.

Building Information Models are being used by many stakeholders throughout the project lifecycle, including owners, designers, contractors, and engineers. Designers have extensively used Building Information Modelling (BIM) for the purpose of visualising designs, hence enhancing the overall quality of design results. Contractors use Building Information Modelling (BIM) to facilitate the planning and scheduling of building projects, enabling them to closely monitor the progress and performance of the work. Nevertheless, QSs have only just started to be affected. The construction sector is characterised by the necessity for contractors to provide owners with a price guarantee, even before they have determined the final cost of completion. Prior to the commencement of the project, it is essential to do the necessary calculations, which necessitates a heightened degree of precision during the estimation phase for contractors. Due to the object-based nature of BIM models and their inclusion of parametric information, it is more convenient to measure the quantities of items in BIM. Consequently, the process of quantification takeoff (QTO) using BIM drawings will provide more precise results with fewer mistakes and omissions. Furthermore, as construction

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projects get increasingly intricate, customers are becoming discontented with the traditional methods used by quantity surveyors in carrying out their task. Therefore, it is imperative for Quantity Surveyors to transition away from ineffective techniques. It is feasible to rapidly get precise measurements straight from a Building Information Model (BIM). BIM applications include functionalities for extracting component counts, space area and volume, material amounts, and generating reports in different schedules. These values are appropriate for cost estimate. The use of an automated technique for quantity takeoff may significantly alleviate the labor-intensive process of manually extracting these numbers from 2D drawings. It is feasible to automatically connect this measurement assessment to estimation software.

Quantity surveying technique is inherently linked to the fifth dimension (5D) of Building Information Modelling (BIM). The 5D BIM combines the 3D BIM model with the construction schedule (4D) and contract price (cost) for quantity surveying applications. BIM facilitates the automated generation of quantities and take-offs, so streamlining the process of estimating and reducing both time and costs. It obviates the need for laborious manual measurement, human fallibility in estimating, and it offers a swifter method for analysing data and creating cost estimates. The primary advantage of Building Information Modelling (BIM) for cost estimate is in the domain of quantity takeoff. Estimators may use software programmes to extract quantities from the BIM for the purpose of cost estimating. A Building Information Model (BIM) may assist estimators across all stages of the design process. During the first phases of a project, Building Information Modelling (BIM) may provide measurements such as volume and total area. These figures may potentially provide precise estimates by establishing a connection between the overall volume of the construction and a cost per cubic metre. As the model becomes increasingly intricate, it becomes feasible to get precise measurements of each individual building component (such as beams, columns, and floors) from the model. These figures may serve as the foundation for more precise estimations, which are essential in subsequent project phases.

BIM provides substantial advantages compared to the conventional manual procedure of taking-off based on drawings. When modifications occur, it necessitates the manual modification and updating of all drawing views, which is both laborious and susceptible to mistakes. The manual procedure requires a significant amount of time and effort to adjust the amounts in order to meet the design changes. The QSs would need to consistently verify any modifications, additions, or omissions. This procedure is laborious and results in significant repercussions if the alterations go unnoticed. BIM offers a distinct advantage over CAD in effectively managing design changes via the use of parametric change technology, which coordinates and maintains consistency as changes occur. Any modification made in one drawing view will be automatically synchronised and reflected in all other drawing views. The feature enables Quantity Surveyors to quickly recognise modifications in the drawings and automatically adjust the amounts when there are changes in the design.

Utilising Building Information Modelling (BIM) offers a dual advantage. Firstly, it has the capability to automatically generate precise measurements, which are then used for the purpose of estimating costs. Additionally, it is feasible to establish a dynamic connection between the design and associated expenses, so that any modifications made to the design would automatically update the estimated costs. Utilising Building Information Modelling (BIM) in cost assessment has a direct impact on the estimating process. As a result, BIM has

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revolutionised the way Quantity Surveyors carry out their responsibilities, which in turn has a significant influence on the pace and effectiveness of their professional services. By adopting Building Information Modelling (BIM), Quantity Surveyors (QSs) may enhance their efficiency and effectiveness, since BIM enables the automation of laborious operations.

4. Capabilities of BIM

In this research, BIM competence is defined as the capacity of BIM to carry out activities in quantity surveying procedures, with the aim of improving work performance via the use of BIM.

STAGE 1: Preparation stage
During this phase, Quantity Surveyors conduct feasibility studies by creating a cost assessment to ascertain the starting cost of constructing the project. QSs provide clients with expert cost advice to evaluate the practicality and potential success of performing the project.

STAGE 2: Concept design
Once the cost range has been determined at the feasibility stage, the design team proceeds to further develop the design at this step. The primary responsibility of Quantity Surveyors (QSs) is to provide a more thorough cost estimation by using a more refined design and scope of work. Quantity surveyors begin the preparation of the first structured cost plan, also known as the preliminary cost plan, with the objective of validating the budget established during the feasibility stage.

STAGE 3: Developed designs
During this stage, the design evolved gradually as more specific information became accessible. Quantity surveyors do further cost analyses and assessments to revise the cost plans that were first given in an elemental cost style. These plans include detailed information on building materials, finishes, specifications, as well as the corresponding unit rates and quantities for each element. The drawings, details, and specifications provided by designers are crucial at this stage for quantity surveyors to conduct meticulous cost assessment. Significant fluctuations in design and scope throughout the design phase can lead to cost overruns, since the cost of a project is directly linked to the building's design. Undetected design modifications and revisions may have a significant influence on the project cost.

STAGE 4: Technical designs
At this time, the creation of bills of quantities (BQ) continues to be a significant function supplied by quantity surveyors (QSs). It is important to note that quantity takeoff is a laborious and time-consuming job during the creation of a bill of quantities. The process of counting and measuring each component in the picture requires a significant amount of time, effort, and attention from the QSs. Automated quantity takeoff is a Building Information Modelling (BIM) feature that streamlines and eliminates the repetitive and tedious aspects of this activity.

5. Important of Implementing BIM in Quantity Surveying Practices

The field of quantity surveying has seen significant growth in recent decades. Due to the

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increasing complexity of construction projects and employers' dissatisfaction with current methods of cost management and settlement, there is a pressing need for an independent quantity surveyor. Quantity surveying is an essential component of the building process, including all stages from project initiation to project close-out. A quantity surveyor is a professional consultant who mainly enhances the financial and contractual management of construction projects throughout the pre-construction, construction, and post-construction phases. Quantity surveying is a profession that requires extensive knowledge and the accurate and skillful use and understanding of this information. Additionally, it requires accurate interpretation and comprehension of designs and their numerical representation (BIM Journal, 2009). The quantity surveyor utilises several operations such as cost estimate, feasibility studies, tendering, cost planning, value management, and conflict resolution. The cost management tasks of Quantity Surveyors are succinctly elucidated as follows.

Bills of Quantities: Bills of quantities are essential instruments used in the cost administration of building projects. Developers of BIM technology take pleasure in the ability of their software to automatically generate bills of quantities, which is considered the fifth dimension of BIM. The integration of BIM technology has greatly improved the collaborative and integrative capabilities of automating bills of quantities. The use of automated processes in generating bills of quantities removes laborious old take off techniques and concurrently minimises human fallibility.

Cost Estimates: BIM technology enables the precise extraction of quantities and spaces, which may be used for cost estimation at any stage of a project's design. Additionally, it enables estimators to discern and convey connections between quantities, expenses, and locations, as well as differentiate the contributions of different sections and components of the building to the overall project cost. Comprehending and recognising the factors that determine costs enhances the expertise of cost estimators. When combined with the precise quantity take-off generated by the BIM, it allows the estimator to provide dependable and precise cost estimates within the initial phases of the design process.

Rapid Updating of Costs: Integrating cost estimate with a BIM design tool enables designers, estimators, and clients to do value management throughout the design process. Modifications to the BIM may automatically update the cost estimate by extracting values from the new model, eliminating the requirement for the estimator to manually calculate quantities.

Bidding Process: Utilising competitive tendering and bidding processes with BIM models helps mitigate the inherent risks associated with project collaboration by enhancing transparency and accessibility to project information and documentation. The Building Information Modelling (BIM) system offers much superior construction information compared to traditional working drawings, resulting in a more precise bill-of-quantities. Furthermore, aspiring builders have the opportunity to undergo instruction in the extraction of quantities and measuring techniques using the BIM. During the tender process, potential bidders have the opportunity to detect and rectify any mistakes in the model, which in turn allows for more precise and accurate offers.

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5.1 Challenges of BIM

- Expanding the use of BIM to include subcontractors, the owner, and facility management is crucial in order to fully realise its worth. Facilitating access to the model and enabling users to contribute and connect more information are crucial.
- Accessing the model (even on-site) – How can a subcontractor be provided with a visual representation of a specific section of the model to address a problem without the need to download and install any software? What are the most efficient and expedient methods for individuals to cooperate on that perspective? How can they access it on the tablet while physically present at the location?
- Integrating models with external data - Various project-related material, such as drawings, RFIs, and spec sheets, is stored separately from the model. What methods may be used to establish connections between these papers in order to create a more comprehensive model? Owners may want a 3D model, but it is important to connect it with all the other data generated and collected throughout the project to have a complete understanding.
- Tracking approvals and audit trails may be challenging due to the use of many authoring tools and the frequent changes in created models, which makes it difficult to get and document approvals. Keeping track of the multitude of choices made over the lifespan of a model may make it very difficult to establish an audit trail documenting the individuals responsible for each action and the corresponding timestamps.
- Handling substantial file sizes - When BIM models might exceed 50MB, transferring data securely and effectively can become challenging, if not unattainable. Email is not capable of handling large file files, and FTP services do not provide the necessary access control or audit trail.

5.2 The Influence of BIM on Quantity Surveying Profession

The field of quantity surveying, like to other professions, is always developing and must adapt to the dynamic circumstances of the construction sector. Quantity surveyors play a crucial role in building development by carrying out operations such as cost estimate, feasibility studies, tendering, cost planning, value management, and dispute settlement. BIM offers not just construction project management and scheduling capabilities, but also includes a range of cost management features that are useful for quantity surveyors. According to Eastman et al. (2008), building information models are accurate and computable, making them a dependable source for owners to execute quantity take-off and estimating. Additionally, they give quicker cost feedback on design modifications. The model autonomously evaluates all materials and components and immediately derives quantities from them. It aims to streamline some conventional responsibilities carried out by quantity surveyors and eliminate the monotonous and tedious aspects associated with these jobs. BIM can be utilised to automatically generate bills of quantities, which in turn allows for the production of cost estimates at different stages of the project. It also enables the swift updating of costs in response to design modifications, as well as the calculation of maintenance expenses. Additionally, BIM can be employed to assess space planning or renovation options during the post-construction phase of a project. By automating the generation of bills of quantities, quantity surveyors may generate deliverables with more efficiency, timeliness, and precision.

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Integrating BIM into a quantity surveying business will enhance the accuracy and efficiency of quantity surveyors' work, providing them with a competitive edge. The effective deployment of BIM will inevitably impact the quantity surveying profession in some manner. The implementation of BIM's cost management functions will revolutionise the cost management process in construction projects. This will result in a redistribution of responsibilities among professionals, particularly quantity surveyors, who will need to concentrate on different aspects of cost management. As a result, they will have new responsibilities and opportunities, and the structure of their work will be reorganised. Here are some of the obstacles and potential dangers that have been highlighted for the quantity surveying profession while implementing Building Information Modelling (BIM).

Software and Computer Systems: The computerised estimating tools and methods are now essential in the estimation process due to their efficacy, consistency, and accuracy in developing estimates for deliverables and sub-deliverables. With the increasing significance of BIM in the design phase of a building project, it is essential to include the cost management process into the collaborative model-based working environment. In an optimal BIM setting, the first stage involves creating a 3D model of the client's proposal. The subsequent step is automatically generating resource requirements, cost calculations or estimates, a compilation of product specifications, and bills of quantities. Conventional techniques for exchanging project information via file interchange, employing formats like .dxf, .dwf, .dwg, and .pdf, fail to communicate the necessary levels of object intelligence across different models. Bazjanac (2010) argues that the creation of a Building Information Model (BIM) is only meaningful if there is software available to input data into the BIM that can be utilised by other software, and if there is software that can extract and import data from the BIM. Despite the integration of project consultants in a shared system, quantity surveyors continue to encounter issues with data interoperability due to the prevalence of proprietary file formats in most applications. Conventional computerised estimating and costing tools used by quantity surveyors must be modified to provide compatibility with the most recent BIM software.

Adjusting Services and Responsibilities: The process of quantity takeoff and bill generation is very time-consuming and susceptible to errors. Despite being a modest component of cost control, it demands significant concentration and attention from the quantity surveyor. BIM incorporates 5D simulation, enabling it to automatically create values based on the model and the data included inside it. Put simply, it has the capability to automate a fundamental activity of quantity surveying. This necessitates the quantity surveyor to modify some jobs or responsibilities. Regrettably, the automation of bills of quantities also entails drawbacks. Producing bills is often one of the most routine responsibilities carried out by quantity surveyors. Automating this job will increase productivity by allowing them to do more work with a reduced production crew. This will result in a decrease in the required workforce, leading to a drop in the scale of quantity surveying procedures. To overcome these difficulties, quantity surveyors must always innovate and continuously enhance their professional services to provide added value.

Training and Expenses: The deficiency in knowledge and expertise pertaining to advanced software and procedures may often be effectively addressed by participation in training programmes, seminars, workshops, and software tutorials. product developers often provide

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training sessions to firms that are adopting their product. Staff will need training not only in the use of a new programme, but also in the modifications to their responsibilities, the alterations within the organisation itself, and the shift in the utilisation of the information derived from the BIM. Adopting the most recent technologies and maintaining a competitive edge usually entails expenses. Software is often a significant financial investment and is not changed without careful consideration and budget planning. Introducing and using new procedures and technologies often impose significant time limitations on firms.

6. Conclusion

Implementing BIM into the quantity surveying profession will have a significant impact on the conventional tasks and responsibilities of quantity surveyors and the structure of quantity surveying organisations. The automation of bill of quantities creation by BIM, a basic duty of quantity surveyors, will have both advantageous and disadvantageous impacts on the quantity surveying business. Automating the generation of bills of quantities will allow quantity surveyors to participate in the first design phases of a building project. This will help designers understand the financial consequences and effectively control costs from the beginning. This will allow designers to prioritise cost considerations in their designs, rather than having quantity surveyors determine the cost based on the design. This approach will meet the employer's need for cost-effective construction. BIM skills will enable quantity surveyors to save time, allowing them to dedicate their efforts to other things that may not be considered vital in conventional procedures, but will provide significant advantages to employers. Quantity surveyors may provide additional services, such as overseeing the extensive and ongoing data interchange among various consultants involved in a building project based on Building Information Modelling (BIM). Quantity surveyors have had to adapt to the constantly changing and technologically advancing construction sector in order to fulfil its expanding demands. The research in this report has validated this assertion and demonstrated that BIM, while providing significant benefits to the construction industry, will require quantity surveyors to continuously adapt and expand the range of their services in order to uphold their prominent position as managers of construction costs. To have a deeper understanding of the future function of Quantity Surveyors (QS), it is necessary to do a comprehensive analysis of the particular information that will be sent to them via Building Information Modelling (BIM) at various stages of a project. Additionally, it is important to determine the information that QS professionals need to give at each step. This is recognised as the optimal approach for the present investigation.

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