

Significance and Roles of Bills of Quantities in the Construction Sector: A Content Analysis.

NWOKONTA CHIGOZIE, INNOCENT (BSC HONS, MSC)¹, EGEDEUZU UCHECHUKWU EUGENE²

¹Lecturer, Department of Architecture, Faculty of Environmental Studies, Abia State University Uturu, Nigeria.

²Assistant Lecturer, Department of Architecture, Faculty of Environmental Studies, Abia State University Uturu, Nigeria

Abstract- Bills of Quantities (BQ) is a systematic method used in the construction sector, primarily aimed at documenting work items for tendering and establishing a fair contract among the involved parties. However, there are several challenges related to the functions of BQ, such as it being a commonly misunderstood aspect of the construction industry, its perceived utility being limited to tendering purposes, the construction team not fully leveraging its advantages, and many professionals struggling to connect BQ with daily construction tasks and processes. Consequently, this paper aims to explore the significance of BQ and its roles within the construction industry.

Keywords: Bills Of Quantities, Importance, Functions, Construction Industry.

I. INTRODUCTION

The bill of quantities (BQ) has been in existence and has evolved for over 300 years (Miliken, 1996). According to Hussein (2009), Thomas Skaife introduced the BQ in 1774, with the intention of establishing pricing for tenders based on design drawings, enabling an estimate of the total project cost before construction commenced. Odeyinka et al. (2009) noted that the BQ has records dating back to the time the Egyptian pyramids were being built.

In the construction sector, a Bill of Quantities (BQ) is a document utilized in projects that provides detailed descriptions of materials, workmanship standards, and quantities required (Davis and Baccarini, 2004; Davis et al., 2009; RISM, 2000; Rosli et al., 2006; The Aqua Group, 2003). Its primary purpose is to facilitate the tendering process, allowing contractors to estimate costs for construction projects (Davis and

Baccarini, 2004; Davis et al., 2009; Rosli et al., 2006) and to establish a fair agreement among all parties involved (Lee et al., 2011) for contractual arrangements (Davis and Baccarini, 2004; Davis et al., 2009; Rosli et al., 2006) in construction initiatives.

II. PROBLEM STATEMENT

Despite being a versatile document that contains a wealth of crucial information, there are still challenges associated with the BQ. It is often misunderstood within the construction industry (Davis and Baccarini, 2004; Davis et al., 2009), and it is seen as being solely useful for the tendering process (Rosli et al., 2006). The construction team does not fully leverage the benefits of the BQ, and many members struggle to connect it with daily construction activities and processes (Davis and Baccarini, 2004; Davis et al., 2009; Rosli et al., 2006). This highlights a deficiency in the explanation and understanding of the BQ's significance and roles within the construction team.

III. OBJECTIVES OF THE STUDY

According to the problem statement, the goals of this study are

- i. To explore the significance of BQ in the construction sector
- ii. To examine the roles of BQ within the construction industry.

IV. RESEARCH METHODOLOGY

The approach taken for this study involves a content analysis of literature reviews from books and articles. This content analysis is performed manually by coding the recurring functions, which allows the researcher to classify these functions into sixteen distinct categories.

V. FINDINGS

The Significance of the Construction Sector Highlights the Roles of BQ In Malaysia, the construction sector is among the key industries contributing to the nation's economy (Abu Hassan, 2009; Abdul Rashid, 2008; Fadhlin, 2004; Fadhlin et al., 2004). Abdul Rashid (2008) noted that the construction sector is vital for the country's economic advancement (Fadhlin, 2004; Fadhlin et al., 2004) through exports, the creation of job opportunities, generating foreign currency, and improving Malaysia's reputation (Abdul Razak et al., 2010). Omar (2008) stated that the robustness of an industry is reliant on its governance. The Malaysian construction sector is structured under governance established by the Malaysian government, with various plans and policies being implemented.

"New methods and strategies aimed at replacing bills of quantities are frequently tested. Nevertheless, bills of quantities have persisted up to this point, undoubtedly due to the fact that, apart from their two main roles, they hold extensive information that can be beneficial in various ways." b. The significance of BQ in the Construction Sector As mentioned earlier by Rosli et al. (2006), BQ is a versatile document that can be utilized in numerous ways (Brook, 1998; 2004; 2008). As demonstrated by The Aqua Group (2003), the crucial nature of the information within the BQ is acknowledged by professionals in the construction industry, as the document continues to be utilized despite the introduction of many alternatives meant to replace it

The Bill of Quantities (BQ) is a crucial document that offers numerous benefits for construction projects because it "serves as the optimal foundation for estimation, comparison of tenders, and contract

management" (Ashworth and Hogg, 2002). As stated by the Aqua Group (1999), contracts that include bills of quantities have several advantages, including: i. The estimating risks for contractors are significantly reduced. ii. Competition becomes much fairer as all contractors submit bids on the same basis. iii. The overhead costs of contractors during the bidding process are lowered, leading to a more efficient building industry as a whole. iv. The process of measuring quantities allows for a detailed analysis of the total price, providing valuable cost feedback throughout the project.

The information can subsequently be utilized statistically for cost planning and other tasks. Bills of quantities serve as the most effective means for managing the costs associated with changes in the contract. While neither the Standard Form of Contract nor the Standard Method of Measurement explicitly states that quantities will be employed for management purposes, they do offer documents that significantly assist on-site, especially for ordering and managing subcontract work. It is probable that advancements in measurement techniques, along with computer technology, will result in their broader application for management purposes in the future. Measuring quantities prior to tendering is a valuable way to determine whether the drawings and specifications can actually be constructed.

Functions of Bills of Quantities In general, Bills of Quantities (BQ) serve two main purposes (Brook, 1998, 2004, 2008; Davis and Baccarini, 2004; Davis et al., 2009). In the phase of pre-contract management, the BQ aids contractors in developing their tenders by providing a systematic, detailed, and organized breakdown of the contractual tasks for tendering. Conversely, during post-contract management, the BQ assists both contractors and quantity surveyors in evaluating progress payments and changes, offering a financial framework for contract management. The BQ acts as a versatile document (Rosli et al., 2006), and its functions are numerous, as outlined in Table 1. According to Table 1, there are sixteen distinct functions of the BQ.

The functions of the Bill of Quantities (BQ) are explored in detail below:

Tendering Document Originally,

The Bill of Quantities serves as a document for tendering (Willis and Trench, 1998; Seeley, 1997; Ashworth and Hogg, 2007). Typically, the BQ is utilized as a tender document for construction projects that follow a traditional procurement method (Rosli et al., 2006). The BQ tender is employed in the open tendering approach (Mudd, 1984). These BQ documents allow contractors to estimate the costs of the work based on identical information while minimizing effort (Ashworth and Hogg, 2007)

Assessing Progress Payments

BQ is commonly utilized to evaluate the construction work completed for the purpose of issuing interim certificates and progress payments (The Aqua Group, 2003; Ashworth and Hogg, 2007). This is further corroborated by Davis et al. (2009), who noted that BQ serves as a foundation for determining progress payments. According to clause 28.0 of PWD Form 203A, the valuation of progress payments for the issuance of interim certificates includes the work completed by the contractor, as well as unfixed materials or goods that have been delivered to the project site.

Valuing Variations

According to The Aqua Group (2003), one of the key roles of bills of quantities is to offer a rate schedule that can serve as a foundation for assessing variations (Davis et al., 2009; Ashworth and Hogg, 2007). As stated in clause 24.2 of PWD Form 203A, a variation refers to “a change in the contract document that requires the alteration or modification of the design, quality, or quantity of the works” impacting the overall contract sum. Clause 25.0 specifies that the valuation of variations will adhere to the rates listed in the BQ.

Ordering of Materials Brook (1998, 2004 & 2008) noted that the Bill of Quantities (BQ) is valuable for contractors when it comes to ordering and acquiring materials (Ashworth and Hogg, 2007). This is due to the fact that the BQ contains comprehensive details regarding the quantities and descriptions of construction materials required for procurement (RISM, 2000) from local or overseas suppliers. According to Wang (1987), the consumption of

materials in construction projects exceeds 50%, including substances like cement, steel, and timber. Consequently, the details about materials and their quantities presented in the BQ simplify the process for contractors to request quotations from sub-contractors (Ashworth and Hogg, 2007)

VI. ELEMENTAL COST PLANNING

Elemental BQ aids consultants in estimating construction project costs (Brook, 1998, 2004 & 2008; Ashworth and Hogg, 2007). Elemental cost planning breaks down project costs by specific work elements designed for effective budgeting and cost management (Wang, 1987). As noted by Cartlidge (2013a), cost planning is a financial assessment process that occurs during the pre-contract phase, which gained significance in the 1970s, and the cost plan is created using a standard list of elements established by The Building Cost Information Service (BCIS)

VII. PLANNING FOR SITE PROGRAMME

Brook (1998, 2004, & 2008) indicated that the Bill of Quantities (BQ) serves as a useful document for site program planning. According to Ashworth and Hogg (2007), it aids in developing resource schedules and constructing work breakdown structures. Rosli et al. (2006) noted that it also facilitates critical path network analysis involving various tasks, making it simpler to track the progress of work on site (Wang, 1987).

Final Account

As noted by Ashworth and Hogg (2007) and Cartlidge (2013a), Bill of Quantities (BQ) is useful for final accounting before a construction project is completed. The final account represents the concluding segment of the audit trail for all financial activities associated with the contract, utilizing the BQ, and the process at the final account stage can be time-consuming. The components of the final account encompass all of the following (Cartlidge, 2013a):

[1] Final Account Statement

[2] Summary of Final Account

- [3] Adjustment of Prime Cost Sums
- [4] Adjustment of Provisional Sums
- [5] Adjustment of Provisional Items
- [6] Adjustment of Variation Account
- [7] Adjustment for Fluctuations
- [8] Adjustment for Claims by the Contractor

The Standard Form of Contract PWD 203 A includes a clause concerning the final account process, clause 31.0, which states that the final certificate will be issued and the last payment will be made to the contractor, if applicable, before the preparation of the final account.

Project Costing

As stated by Rosli et al. (2006), in a traditional procurement framework, the Bill of Quantities (BQ) is primarily utilized for assessing project costs, aimed at obtaining accurate estimates or pricing for the work. Per Ashworth and Hogg (2002 & 2007), project costing encompasses all expenses related to construction activities, starting from the initial phase and continuing until the agreement of the final account, with the goal of aligning cost estimates with the client's budget. The estimation involved in project costing is valuable for cost advice provided by the Quantity Surveyor (QS) to the client (Ashworth and Hogg, 2002 & 2007) and also for predicting the costs and value of the project (Cartlidge, 2013a). The activities involved in project costing include cost advice, cost planning, cost control, cost analysis, risk analysis, whole life cost, and value management analysis (Ashworth and Hogg, 2002 & 2007; Cartlidge, 2013a).

Database

According to Davis et al. (2009), one function of the BQ is to serve as a database for estimating future projects that are of a similar nature. Additionally, Cruywagen (2010) noted that the pricing within the BQ can be utilized as a reference for establishing weights for a new Tender Price Index (TPI). Gorse et al. (2012) define a database as “a collection of computer data that can be sorted or manipulated in various ways.” The BQ offers a database that includes detailed information on materials, workmanship, pricing, quantities, and units for materials, as outlined in the definition subheading.

Fee Calculation

Davis et al. (2009) pointed out that the BQ serves as a definitive basis for calculating consultants' fees. These consultant fees encompass various specialists such as architects, engineers, planners, quantity surveyors, and others (Forster, 1986; Wang, 1987). There are several methods to determine consultancy fees, one of which involves multiplying a specified percentage by the project's contract sum estimated from the BQ (Manual Perolehan Perkhidmatan Perunding, 2011). Ashworth and Hogg (2002 & 2007) describe fees as the charges for services rendered by consultants to clients, which depend on factors such as project complexity, volume, and duration.

Asset Management

Davis et al. (2009) indicated that the Bill of Quantities (BQ) offers easily accessible information for managing assets of completed buildings, conducting life cycle cost studies, scheduling maintenance, and assessing general and replacement insurance costs.

i. Quality Analysis

According to Ashworth and Hogg (2007), the BQ is utilized for quality assessment through reference to the clauses that preface trades. The word "analysis" refers to an in-depth examination, "quality" denotes a level of service or product, and "preamble" encompasses the information contained within the BQ regarding measurement rules and trade descriptions (Gorse et al., 2012).

Quotations

Additionally, the BQ serves to solicit quotations from subcontractors (Ashworth and Hogg, 2007). These quotations represent the prices proposed for undertaking specific work (Gorse et al., 2012). In the construction sector, suppliers provide quotations for resources required for projects, such as materials, equipment, and machinery (Cartlidge, 2013b). Typically, suppliers are the subcontractors selected based on predefined criteria. A range of steps is involved in requesting quotations from these suppliers (Cartlidge, 2013b).

Fairest Competition for Tenders

As noted by Ashworth and Hogg (2007), the BQ allows contractors to price the work accurately based on identical information with minimal effort, thereby facilitating the fairest form of competition (Rosli et al., 2006b; The Aqua Group, 2003; Brook, 1998, 2004 & 2008). Cartlidge (2013a) pointed out that the BQ is part of the traditional procurement system commonly used for single-stage competitive tendering, which helps secure lower tender prices (Ashworth and Hogg, 2002; 2007). The BQ fosters fair competition because all bidders price their work using the same project information (Ashworth and Hogg, 2002 & 2007), and the rivalry between bidders (Cartlidge, 2013b) may result in lower project price proposals.

Cost Control

Brook (1998, 2004 & 2008) concurred that the BQ is beneficial for cost management during the contract to ensure that expenses remain within budget. Cartlidge (2013a) stated that the BQ provides the construction project's costs during the pre-contract phase, as well as planned expenses and cost targets which must be kept under control.

VIII. CONCLUSION

To summarize, the significance of a Bill of Quantities (BQ) includes the following: i. The estimating risks for contractors are significantly diminished. ii. Competition becomes more equitable as all contractors are submitting bids on the same criteria. iii. The overhead costs for contractors in the bidding process are lowered, leading to a more efficient operation within the entire construction industry. iv. By quantifying the measurements, a detailed analysis of the total price can be conducted, providing valuable cost feedback that can be statistically applied to future projects. v. Bills of Quantities serve as a primary tool for managing costs associated with contract variations. vi. Although the Standard Form of Contract and the Standard Method of Measurement do not require quantities for management purposes, the documents they offer are incredibly useful on site, especially for ordering and overseeing subcontracted work. It is anticipated that advancements in measurement methods paired with

technology will increase their use for management in the future. vii. Measuring quantities prior to tendering is an effective evaluation of whether the proposed designs and specifications are feasible for construction. Having professionals from different fields review the drawings and analyze the construction details is undoubtedly beneficial in spotting potential issues that may not be immediately obvious. viii. There is a high degree of price certainty for construction projects, as costs are clear before the work begins. ix. It allows for competitive bids to be made at lower prices. x. It accommodates design modifications and enhances the cost management process. xi. The quality of tender documents is elevated. xii. It mitigates the risk of contractors manipulating the information within the BQ to their advantage. xiii. It can prevent selective work when comparing bids due to the consistency in the scope of work among tenderers. xiv. It may reduce both time and cost risks since the projects are estimated based on total floor area. xv. Valuing progress payments becomes simpler with the detailed information provided in the BQ. xvi. It helps to prevent contractors from forming collusive groups to inflate bids for projects. The roles of a BQ are categorized into three phases: i. During the pre-contract phase, the roles include: a. Tendering documents b. Project costing c. Cost planning d. Ensuring fair competition among tenders e. Consultant fee calculation ii. Ongoing functions include: a. BQ serving as a database for upcoming projects b. Providing cost information c. Utilizing the BQ for quotations d. Being useful for asset management iii. In the post-contract phase, the roles include: a. Valuing progress payments b. Assessing variations c. Ordering materials d. Conducting quality analysis e. Planning and tracking site schedules f. Using the BQ as a reference for the final account g. Cost control VII. Acknowledgements I would like to extend heartfelt appreciation to the faculty members of the Kulliyah of Architecture and Environmental Design at the International Islamic University Malaysia for their valuable suggestions and recommendations.

REFERENCES

- [1] Ashworth, A. & Hogg, K. (2007). *Willis's Practice and Procedure for the Quantity Surveyor*. (12th ed.). United Kingdom: Blackwell Publishing.
- [2] Brook, M. (1998). *Estimating and Tendering for Construction Work*. (2nd ed.). Oxford: Elsevier Butterworth-Heinemann.
- [3] Brook, M. (2004). *Estimating and Tendering for Construction Work*. (3rd ed.). Oxford: Elsevier Butterworth-Heinemann.
- [4] Brook, M. (2008). *Estimating and Tendering for Construction Work*. (4th ed.). Oxford: Elsevier Butterworth-Heinemann.
- [5] Caplehorn, P. (2012). *Whole Life Costing: A New Approach*. Oxon: Routledge Taylor & Francis Group.
- [6] Cartlidge, D. (2013a). *Quantity Surveyor's Pocket Book*. (2nd ed.). Oxon: Routledge Taylor & Francis Group.
- [7] Cartlidge, D. (2013b). *Estimator's Pocket Book*. (2nd ed.). Oxon: Routledge Taylor & Francis Group.
- [8] Chritamara, S., Ogunlana, S. O. & Bach, N. L.(2002). System dynamics modelling of design and build construction projects. *Construction Innovation*. 2, 269 – 295.
- [9] Cruywagen, H. (2010). The Use of Bills of Quantities for A New Tender Price Index. Proceedings of W 055 – Special Track held at 18th CIB World Building Congress 2010, 10 – 13 May 2010, The Lowry, Salford Quays, United Kingdom.
- [10] Davis, P. R., Love, P. E. D, & Baccarini, D.(2009). Bills of Quantities: nemesis or nirvana? *Journal of Structural Survey*. 27(2),99-108.
- [11] [11] Dmaidi, N. (2003). The State of the Art in Integration of Cost and Time Models. *An-najah University Journal of Research (N.Sc)*. 17(1), 99-122.
- [12] Gorse, C., Johnston, D., & Pritchard, M.(2012). *A dictionary of construction, surveying and civil engineering*. Canada: Oxford University Press.
- [13] Lee, S., Trench, W. & Willis, A.(2011). *Willis's Elements of Quantity Surveying* (11th ed.). UK: Wiley-Blackwell.
- [14] Maizon Hashim. (1999). The effects of procurement methods on performance of construction projects in Malaysia. Unpublished doctoral dissertation, University of Technology Malaysia, Skudai, Johor.
- [15] Miliken, J. (1996). "Bills of Quantities and the Tendering Process". *Building Economist*, 14-17.
- [16] Muhammad, N., Che Ani, A., I., Rakmat, R. A. O.K, & Yusof, M. A. (2010). Investigation on the Causes of Variation Orders in the Construction of Building Project – A Study in the State of Selangor, Malaysia. *Journal of Building Performance*. 1(1), 73-82.
- [17] Mudd, D. R. (1984). *Estimating and Tendering for Construction Work*. United Kingdom: Butterworths.
- [18] Ogunsami, O. E., Salako, O. A., & Ajayi, O. M. (2011). Risk Classification Model for Design and Build Projects. *Journal of Engineering, Project, and Production Management*. Vol 1 (1). Pp. 46 - 60.
- [19] Omar, O. (2008). *Emerging Governance and Economic Issues in Construction Industry in Malaysia*. Pulau Pinang: Universiti Sains Malaysia.