FACTORS AFFECTING THE PRE-CONTRACT USE OF THE BILL OF QUANTITIES

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Abstract
Debates over the preparation, use and relevance of the Bill Of Quantities (BOQ) in the construction industry have been long standing without commensurate research effort to address the problem. The objectives of this research are to determine the extent of use of the BOQ in the Nigerian construction industry, evaluate the criteria for the use/benefits of the use of the BOQ and to evaluate the factors mitigating the use of the BOQ. Data were collected through the administration of questionnaire on 53 randomly selected construction consultants. Majority of the respondents (47.2%) were quantity surveyors, 20.8% were builders, 17% were architects, 9.4% were civil engineers and 5.7% were mechanical and electrical engineers. The data collected were analysed with the Statistical Package for Social Sciences (SPSS) using descriptive statistics and analysis of variance. Key findings are that use of the BOQ constitutes 46.35% of construction professionals' overall workload, and the most important benefit of the use of BOQs in Nigeria is that they provide common bases for competitive bidding. The five most important factors mitigating the use of the BOQ at the pre-contract stage are: limitation in scope and spread of dedicated computer software for BOQ preparation, Absence/lack of implementation of legislations compelling the use of the BOQ, BOQs are not supported by emerging procurement systems, BOQs are expensive to prepare and lack of complete information on which to base the BOQ. This research provides useful information on the strength of the factors affecting the use of the BOQ at the pre-contract stage.

Key words: *Bill of quantities, Pre-contract, Quantity surveying and Construction Industry*

Introduction

Bill of quantities (BOQ) is reported to have existed in one form or another for over 300 years (Davis and Buccarini, 2004), and some years ago the quantity surveying profession was mainly involved in the production and use of the bill of quantities for various purposes (Birnie and Yates, 1996).

The BOQ is usually considered an important part of construction contract in many countries and it is recognised as a contract document by the World Bank and most forms of contract (Choudhury, 2007). Emerging trends however, show that some industry professionals are beginning to show dislike for the BOQ because of some of its weaknesses. Molloy (2007) asserts that the BOQ is the most maligned and misunderstood contractual tool and contract document. Likewise a discussion paper published by the Australian Institute of Quantity Surveyors (AIQS) in 2001 suggests that the BOQ is perhaps the most misunderstood facet of building contracts today. The movement away from traditional BOQ procurement system has been on going over the last twenty years (Birnie et al, 1996) and a survey by the AIQS (Victorian Chapter) indicates a sharp downward trend in the production of BOQs (Davis et al, 2004). In Nigeria, the picture appears to be different. Onwusonye (2009) maintains that the

formal sector (in Nigeria) is highly associated with overwhelming variables underpinned with relevant policies to the extent of legally binding the use of bill of quantities in the procurement of public goods and services. However, Idoro, Iyagaba and Odusami (2007) hold the view that reliance on the BOQ-based design-bid-build procurement method in the Nigerian construction industry inhibits introduction of new procurement systems that have gained wide acceptance in developed countries. The quantity surveying (QS) profession usually identified with BOQ preparation appears also to be emerging beyond the era of bill preparation (Oyeri, 1989, Potts, 2004, Davis et al, 2004). The profession is seen as having evolved beyond the era of preparation and use of the BOQ to the one of financial management of construction projects through the use of appropriate procurement systems (Birnie et al, 1996). Debate over the relative advantages and disadvantages of the BOQ has been long standing and generates strongly held and conflicting views (Davis et al 2004).

Bill of Quantities

BOQs are documents that describe the quality and give the quantities of the constituent parts of proposed building works (Hackett, Robinson and Statham, 2007). It is usually prepared by the quantity surveyor and (ideally) details out the terms and conditions under which a contract is to be let and itemises all works to enable a contractor to price the work for which he is bidding (Grieve, 2009). BOQ is a document containing descriptions of items of work to be executed by a chosen contractor as well as the quantities, units and rates of such work items, prepared in accordance with a standard method of measurement, with the main intentions of providing a uniform basis for tendering by bidders and valuing works carried out by the successful tender.

Previous Studies on the Uses of the BOQ

Criteria for the use/benefits of the use of the BOQ

Much in terms of empirical research into the uses of the BOQ does not exist (Davis et al, 2004). Various authors however, identify some uses of the BOQ both at the pre-contract and post-contract stages of construction procurement (Hore, Kehoe, McMillan and Penton, 1997, Jagboro, 1992, Seeley and Winfield, 1999, Choudhury, 2007).

Hore et al (1997) state that the overall purpose of the BOQ is to measure in systematic and standard manner, the work contained in the construction or alteration of a building, with the aim of obtaining competitive tenders. BOQ prepared by the project quantity surveyor (PQS) provides uniform basis for the pricing of tenders by contractors (Jagboro, 1992). The use of a BOQ for tendering reduces the tender period since tendering contractors do not have to produce their own bills. The time thus saved is more than the one spent by the PQS in preparing the tender documents (Choudhury, 2008). Davis et al's (2004) opinion survey of 86 Australian construction professionals shows that BOQs account for less than 25% of quantity surveyors' workload in the research area. The work went further to establish five characteristics or uses of the BOQ. Opinions of different professionals in the construction industry were not compared and the extent of workload of other professionals involving the use of the BOQ was not ascertained.

Factors Mitigating the Use of the BOQ

Potts (2004) posits that there is a shift in procurement system from the traditional BOQ to the use of lumpsum – plan and specification. Change in procurement system from the traditional procurement route to the design and build was identified as

possible explanation for the decline in the use of the BOQ by Birnie et al (1996). Hackett et al (2007) portrays that the BOQ is not a contract documents in some JCT forms of lump sum contract. Where a form in which the BOQ is not a contract document is operated in a given procurement system, the BOQ's relevance is insignificant (see Figure 1).

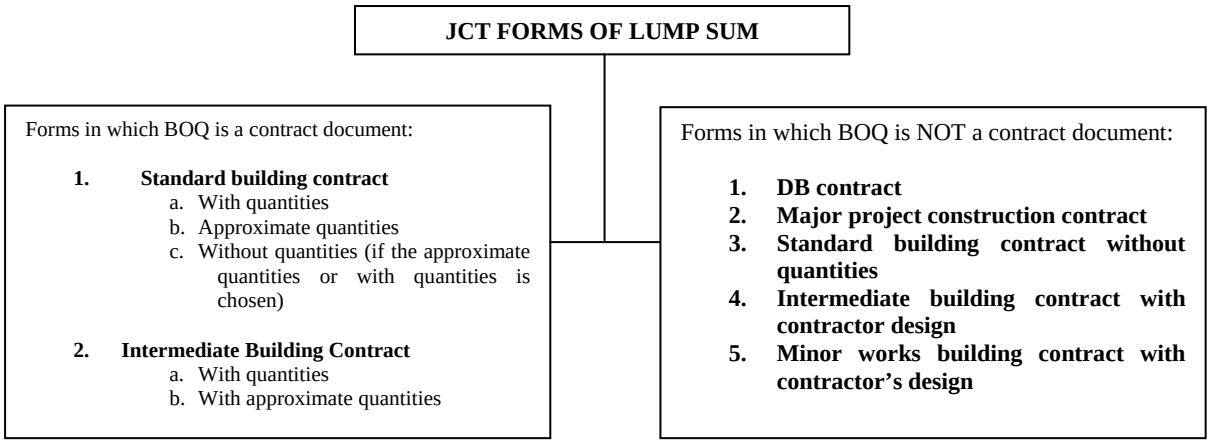

Figure 1: Division of JCT lump sum contracts into BOQ-contractual and BOQ-non-contractual forms

Davis et al (2004) found the disadvantages of the use of the BOQ at the pre-contract stage to include increase in cost of documentation and documentation period, tendency to make tenderers base their pricing on BOQ alone and ignore specification, and inhibition of submission of alternative design solutions by contractors.

Birnie et al (1996) further observed a growing recognition that the BOQ measurement may be less than adequate in the measurement of risk and uncertainty. Clients carry the risk of any errors in the stated quantities in BOQs, and the contractors transfer additional risk to the client through excessive loading on early trades in order to improve their cash flow (Potts, 2004).

Wilson and Kusomo (2004) see documentation at the pre-contract stage of procurement and bidder selection processes as costly and time-consuming activities for the client, which add to the resource consuming nature of the tendering process. It has also been argued that standard methods of measurement have become increasingly more complicated. They give rise to claims for additional payment based on interpretation of the method. The tendency has been for the methods to provide detailed sub-division of work and therefore scope for claims based on ambiguities of interpretation, failure to measure the tendered bills in accordance with the method and the application of exceptions to measure (Birnie et al, 1996). Empirical evidences are not found in literature comparing the variously speculated mitigating factors to the use of the BOQ, hence the need for this research.

Objectives of the Study

The objectives of this research are: (1) to assess the criteria for producing BOQs and uses of the BOQ at the pre-contract stage of construction procurement (2) to evaluate the extent of use of the BOQ in the construction industry in Nigeria (3) to evaluate the factors mitigating the use of the BOQ at the pre-contract stage of construction procurement.

There is dearth of empirical research in this area in Nigeria going by available literature.

The Research Survey

The study was based on a sample frame of 105 construction companies registered with the Nigeria Institute of Building (NIOB) whose registered addresses were in Lagos State.

In calculating the sample size, Yaro Yamane formula for finite population was applied. The formula is stated thus:

$$N = \frac{N}{1 + N(e)^2}$$

Where 1 = constant value

n = sample size

N = population size

e = co-efficient of confidence or margin of Error or allowable error or level of significance

For this study, 5% was used as the margin of error. Therefore, since N = 105 and e = 0.05, n can be calculated as:

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{105}{1 + 105(0.05)^2}$$

$$n = 83.17 \text{ approx. } 83$$

34 of the construction companies could not be found in their registered addresses; hence a sample size of 60 was used for the study.

The survey was carried out using questionnaire as instrument for data collection. A three page questionnaire accompanied by a covering letter was distributed to construction industry professionals. Amongst other things, the questionnaire contained the name of respondents' organisation, construction industry work experience of respondents, respondents' profession, volume of respondents' workload involving use of the BOQ, criteria for the use/benefits of the use of the BOQ at the pre-contract stage and factors mitigating the use of the BOQ at the pre-contract stage.

60 questionnaires were circulated. In all, 53 (88.33%) acceptably filled questionnaires were returned and used for the analysis.

Data Analysis and Results

The data obtained from the survey were analysed using the Statistical Package for Social Sciences (SPSS). Eight criteria for the use of the BOQ found in literature and eleven factors mitigating the use of the BOQ identified in literature and from the author's experience and survey were used for the study. The respondents were asked to rank each of these groups on a 4-point Likert scale using 1 for strongly disagree, 2 for disagree, 3 for agree and 4 for strongly agree. Importance index of each factor was computed using mean item score. The scores were then ranked in descending order. ANOVA statistic was used to test for significance in the mean observation of different construction professionals.

The reliability of the survey instrument was tested using Cronbach's alpha. The Cronbach reliability coefficient alpha is 0.954 with F – statistic of 40.975, p = 0.000, meaning that the instrument was reliable for testing the identified criteria for the use of the BOQ at 5% significance. For the post-contract mitigating factors, the Cronbach

reliability coefficient alpha of 0.982 was obtained with F-statistic of 26.542, p = 0.000 which means that the instrument was reliable at 5% significance.

About 15.09% of the respondents have less than five years experience working in the construction industry. Majority of the respondents (28.42%) however, have had cumulative construction industry work experience in the range 16 – 20years. Those whose experience spans more than 20years account for 20.79% of the respondents showing good representation of the older professionals in the research (see figure 2). Majority (47.2%) of the respondents were quantity surveyors. The historic growth of the QS profession is inextricably linked to the traditional procurement system which has as its heart BOQ (Birnie et al, 1996). BOQ preparation is a role many professionals would readily concede to the QS. 20. 75% of the respondents were builders, 16. 98% were architects, 9.43% of the respondents were civil engineers, while the rest (5.66%) were mechanical and electrical engineers (see figure 3).

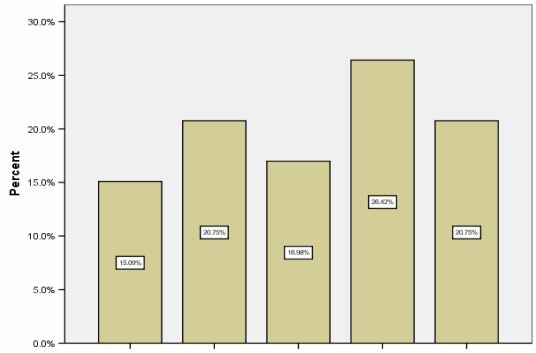

Figure 2: Respondents' Construction Industry Work Experience (CIWE)

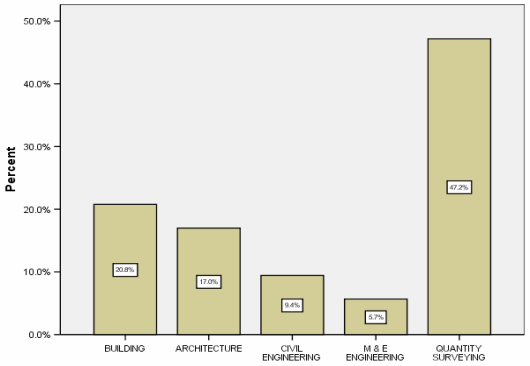

Figure 3: Respondents' Professions

Respondents' BOQ workload

Table 1: Respondents' BOQ workload

Respondents' Professions	Mean	N	Std. Deviation
BUILDING	17.77	11	16.18
ARCHITECTURE	43.83	9	24.50
CIVIL ENGINEERING	22.50	5	17.89
M & E ENGINEERING	17.17	3	.00
QUANTITY SURVEYING	68.10	25	26.66
Total	**46.35**	**53**	**31.94**

The questionnaire sought to know the extent of involvement of construction professionals in the use of BOQs. The result is shown on Table 1. The result shows that builders' workload involving the use of the BOQ is 17.77% just a bit higher than that of mechanical and electrical engineers' which is 17.17%. Quantity surveyors have the highest workload involving the use of the BOQ (68.10%) followed by the architects (43.83%) and civil engineers (22.50%). The result shows the overall industry usage of the BOQ to be 46.35%.

Table 2 shows that significant difference exists in the workload of construction professionals involving the use of the BOQ with F-statistic of 12.133 and p = 0.00.

Table 2: Test for difference in the BOQ workload of Construction Professionals

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	26265.944	4	6566.486	12.113	**.000***
Within Groups	26020.848	48	542.101		
Total	52286.792	52			

Significant at p < 0.05

Davis et al (2004) shows that the BOQ production as percentage of office workload of Australian quantity surveyors declined from 27% in 1993 to 11% in 1999. This finding shows that in Nigeria, quantity surveyors' BOQ workloads are still as high as 68.10%.

Potts (2004) shows a decline in the number of contracts procured based on lump-sum (firm BOQ) from 39.2% in 1995 to 19.6% in 2001. Birnie et al (1996) present a similar decline of firm-BOQ procurement from 59% in 1984 to 42% in 1993.

The finding of this research (46.35% overall industry BOQ workload) however shows that use of the BOQ procurement system may not have dipped so low in Nigeria. This supports an earlier research by Idoro et al (2007).

Criteria for the use/benefits of the use of the BOQ at the Pre-Contract Stage

Table 3 shows the results of the analyses. From the table the main criteria for the use/benefits of the use of the BOQ are: ***it provides a common basis competitive bidding, BOQ provides a yardstick for tender assessment, it makes the client aware of his financial commitment before project commencement, it eliminates wasteful cost of BOQ preparation by individual tenderers*** and ***as a tool for quality management, BOQ helps to investigate the drawings better.***

With the exception of the factor: ***it eliminates wasteful cost of BOQ preparation by individual tenderers*** and ***as a tool for quality management, BOQ helps to investigate the drawings better,*** there are statistically significant differences in the opinion of the respondents on the other factors listed above at 5% significance level. This means that on these factors, the opinions of respondents seem to differ.

BOQ ensures that all cost matters in a project are addressed, it is a requirement for accessing development loans by the client and ***it helps to reduce tendering period since tenderers do not have to produce separate BOQs*** were ranked low by the respondents.

Table 3: *Criteria for the use/benefits of the use of the BOQ at the Pre-Contract Stage*

S/N	Benefits	Total Index	R	QS	R	Builders	R	Arch	R	CVE	R	M&E	R	sig
1.	It provides a common basis for competitive bidding	3.81	1	3.80	1	4.00	1	4.00	1	2.40	8	3.67	1	0.005*
2.	BOQ provides a yardstick for tender assessment	3.72	2	3.80	2	3.82	2	4.00	2	2.80	7	3.33	2	0.00*
3..	It makes the client aware of his financial commitment in the project before it begins	3.62	3	3.64	3	3.82	3	3.78	3	3.80	1	3.00	4	0.00*
4.	Use of BOQs eliminates wasteful cost of BOQ preparation by individual tenderers	3.43	4	3.64	4	3.27	5	3.44	5	3.00	4	3.00	5	0.318
5	As a tool for quality management, BOQ helps to investigate the drawings better.	3.19	5	3.28	5	3.27	6	2.78	8	3.20	3	3.33	3	0.311
6.	BOQ ensures that all cost matters in a project are addressed	3.17	6	3.16	6	3.64	4	3.00	6	3.00	5	2.33	8	0.101
7.	It is a requirement accessing construction loans by the client	3.09	7	2.80	8	3.00	8	3.78	4	3.60	2	3.00	6	0.00*
8	It helps to reduce tendering period since tenderers do not have to produce separate BOQs	3.08	8	3.16	7	3.09	7	3.00	7	3.00	6	2.67	7	0.891

Significant at p < 0.05, R = Rank, QS = Quantity surveyors, Arch = Architects, CVE = Civil Engineers, M&E = Mechanical & Electrical Engineers

It provides a common basis for competitive bidding ranking first suggests BOQ's importance as a tool for ensuring transparency in the bidding process. ***BOQ provides a yardstick for tender assessment*** ranked 2nd which further buttresses the point that BOQs are used in the Nigerian construction industry to enshrine transparency, fairness and equity in the tendering process. The two factors were ranked 4th and 5th respectively by the Australian construction industry professionals (Davis et al, 2004).

The 3rd ranking factor, ***it makes the client aware of his financial commitment in the project before it begins*** suggests curiosity among clients as to what the tender prices to expect. This may not be unrelated to the reported cases of cost overrun in the industry. The 4th ranking factor ***use of BOQs eliminates wasteful cost of BOQ preparation by individual tenderers*** shows a positive inclination towards efficiency in the industry. Submission of different BOQs by tenderers is an expensive and time-consuming exercise, whose cost eventually gets incorporated in successful tenders (Wilson et al, 2004).

BOQ preparation helps to investigate drawings better ranked 5th. The implication is that professionals in the industry are beginning to view the BOQ, not just as a cost control document, but also as a quality control instrument.

Factors Mitigating the use of the BOQ at the Pre-Contract Stage

The five most important factors mitigating the use of the BOQ in the construction industry are:

1. Limitation in the scope and spread of dedicated computer software for BOQ preparation.
2. Absence/lack of implementation of legislations compelling the use of the BOQ.
3. BOQs are not supported by emerging procurement systems.
4. BOQs are expensive to prepare.
5. Lack of complete information on which to base the BOQ

There is agreement in the opinion of respondents on the factors, except in ***absence/lack of implementation of legislations compelling the use of the BOQ*** in which their opinions significantly differ at 5% level of confidence (see Table 4).

Limitation in the scope and spread of dedicated computer software for BOQ preparation means that available dedicated computer softwares for BOQ preparation are not versatile in their operations and/or there are not many professionals using them. Whereas some BOQ preparation softwares such as WinQS, Catopro, MasterBill, QS Elite, Snape Vector and In-house softwares were found in use in practice at various levels by Oladapo (2006). This finding suggests that industry wide spread of such softwares have not been achieved. A possible reason could be scarcity of personnel who are knowledgeable in their use.

Absence/lack of implementation of legislations compelling the use of the BOQ

In the public sector in Nigeria, certain policies and legislations make the use of the BOQ binding on public procurement officers (Onwusonye, 2009). This is hardly the case in the private and informal sectors. The ranking of this factor as the 2nd mitigating factor to the use of the BOQ questions the popularity of the Public Procurement Act and the National Building Code among industry professionals.

Table 4: Factors Mitigating the use of the BOQ at the Pre-Contract Stage

S/N	Benefits	Total Index	R	QS	R	Builders	R	Arch	R	CVE	R	M&E	R	sig
1	There is limitation in the scope and spread of dedicated computer softwares for BOQ preparation	2.72	1	2.76	2	1.91	10	3.22	2	3.00	1	3.33	1	0.031
2.	Absence/lack of implementation of legislations compelling the use of the BOQ	2.68	2	3.08	1	2.73	2	2.22	7	1.80	6	2.00	9	0.002*
3.	BOQs are not supported by emerging procurement systems (e.g. design and build, and concessionary project procurement systems)	2.57	3	2.76	3	2.55	3	2.22	8	2.00	4	3.00	6	0.132
4.	BOQs are expensive to prepare	2.55	4	2.68	5	2.18	5	2.56	3	2.20	3	3.33	2	0.362
5.	Lack of complete information on which to base the BOQ	2.53	5	2.76	4	2.18	6	2.56	4	2.40	2	2.00	10	0.200
6.	Current construction technology/materials can hardly be described and quantified accurately before commencement of construction	2.42	6	2.16	10	2.81	1	3.44	1	1.20	11	2.00	11	0.00*
7.	Preparation of the BOQ delays project commencement	2.36	7	2.44	6	2.18	7	2.33	6	1.80	7	3.33	3	0.328
8.	BOQs are hardly needed in private sector projects	2.21	8	2.36	8	2.00	9	1.78	9	2.00	5	3.33	4	0.007*
9	There is scarcity of qualified personnel to prepare useful BOQs	2.17	9	2.28	9	2.27	4	1.78	10	1.60	9	3.00	7	0.052
10.	SMM are difficult to use, understand and always changing	2.11	10	2.44	7	1.64	11	1.67	11	1.60	10	3.33	5	0.000*
11.	The size of projects rarely justify the use of the BOQ	2.02	11	1.80	11	2.18	8	2.44	5	1.80	8	2.33	8	0.129

Significant at $p < 0.05$, R = Rank, QS = Quantity surveyors, Arch = Architects, CVE = Civil Engineers, M&E = Mechanical&Electrical Engineers

BOQs are not supported by emerging procurement systems

The drive to try the use of non-traditional procurement routes poses a threat to the continued relevance of the consultant-prepared BOQ in the industry. While the BOQ-based design-bid-build procurement system remains the most prominent procurement option in Nigeria (Idoro et al, 2007), this result portends an anticipation of an end to that prominence.

BOQs are expensive to prepare

This factor refers to the cost to be incurred by the client for the preparation of the BOQ. It may be that respondents consider the professional fees of the consultant QS to be expensive. Further research can be carried out to determine clients' willingness to pay QS professional fees based on the professional scale of fees.

Lack of Complete information on which to base the BOQ

This factor was ranked 5th generally. The finding is consistent with that of Odusami and Onukwube (2008) to the effect that extent of completion of pre-contract design affects accuracy of the estimate at that stage of procurement. This result suggests growing awareness in the industry that the BOQ is as good as the design information on which it is based.

Conclusion

This work has examined the use of the BOQ at the pre-contract stage in the Nigerian construction industry. The preparation and use of the BOQ contributes 46.35% of the entire workload of construction professionals in Nigeria. The most important use of the BOQ in Nigeria is that ***it provides a common basis for competitive bidding*** while the most important factor mitigating its use is the ***limitation in the scope and spread of dedicated computer software for BOQ preparation.***

It is recommended that professional bodies in the construction industry should conduct further researches into the use of modern procurement systems in Nigeria in order to restrict the use of the BOQ to cases where its use is inevitable. Computer software manufacturers should widen distribution channels of BOQ-preparation software and endeavour to improve on their versatilities and capabilities.

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