

## Bills of Quantities: Perspectives of Contractor in Malaysia

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**Abstract:** Bill of Quantities (BQ) have been used in Malaysia since their introduction to the industry by the British Colonial Government circa 1930. Many previous studies have carried out for the effectiveness of BQ, but very few discuss about the relationship between the usefulness of information in BQ at tendering stage and post - tendering stage from the view of the contractor. Therefore, this research would address the gap and analyse the usefulness of BQ to the contractor at the tendering and post - tender stage. Questionnaires were distributed to the contractors to obtain opinions regarding the BQ. It was found that although the BQ is useful to the Contractors at tendering and post-tender stage, the full potential is still not being achieved. Information in the BQ should be arranged in a directly useable way. It was found that, 'temporary work', 'work description' and 'prime cost-sum' are the key elements of the BQ information that need urgent improvement and presented in more meaningful format.

**Key words:** Bill of Quantities, Relationship, Tender, Post-Tender, Contractors.

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### INTRODUCTION

The BQ is a document that itemises the quantities of materials and labours in a construction project. It is usually prepared by professional QS on behalf of the principal, based on detailed drawings and specification (David & Baccarini, 2002). According to Rashid *et al.*, (2006) the BQ are mainly used for cost estimating and more importantly, as part of tender document for use in soliciting competitive tenders from contractors. It also helps in making decision in bidding (El-Mashaleh, 2010). Subsequent to this, it is widely used for post-tender work such as; cost planning, projected cash flow and budget, valuation of interim payments and variation orders and for settlement of final account (Kodikara *et al.*, (1993). Kodikara, (1990) found that 50% of the BQ required some form of reworking to suit the production needs.

The function of BQ has not changed very much ever since it was about hundred (100) years ago (Rashid *et al.*, 2006). Kodikara *et al.*, (1993) stated that the prime purpose of the BQ is to enable all the contractors tendering for a contract to price on exactly the same information and it agreed by Rashid *et al.*, (2006) which stated that the BQ is a uniform document for Contractors to estimate or price the work on precisely the same basis, thus allowing for the fairest bidding.

The aim of the research was to identify the contractor's use of the BQ at tendering and post-tendering stage. Hence, the study will investigate the relationship between the usefulness of information in BQ at tendering stage and post-tender works.

The research would address a different approach from the previous studies by looking at the contractor's perspective for the relationship between the usefulness of information in BQ at tendering stage and post-tendering stage, where the recent previous studies focused on tendering stage (Morledge and Kings, 2006) or general perspective from the construction stakeholders (Davis *et al.*, 2009). It would identify crucial areas in the BQ which need urgent attention in order to achieve a better use of measured data in contractor organisations.

#### ***The Use of BQ:***

The discussion of the use of BQ should consider the tendering stage and post-tender stage in order to have a comprehensive view. At tendering stage, the purpose of BQ is to assist the contractor in his tendering by providing useful information (Brook, 1998). It enables the contractor to insert suitable rates to the list of descriptive quantitative items. Based on Davis & Baccarini (2004) at pre-tender stage, the BQ assists contractors in the formulation of their tenders. The BQ breaks down the contract works in a formal, detailed, structured manner for tendering. Indeed, the risks could be observed and analysed in this stage for proper monitoring and controlling of construction process subsequently (Bu-Qammar *et al.*, 2009).

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At post-tendering stage, the BQ acts as construction management information with regards to planning, programming, procurement of plant, materials, labour and sub-contractor, payments, budgetary control, etc. and also to act as a legal document when implemented (Kodikara *et al.*, 1993). It could lead to compensation claims as to the errors in the BQ under lump sum contracts (Ho and Tsui, 2010).

In addition Davis and Baccarini (2004) stated that, at post-tender stage the BQ also assists contractors and quantity surveyor (QS) in the valuing of progress payments and variations. The BQ provides a financial structure for contract administration. Furthermore, Jaggar, *et al.*, (2002) stated that the BQ became essential document as it allowed the contractor to use the information in the BQ to assist in the on-site checking and management of the construction process. Chan, (2003) had listed down some various purposes of the BQ i.e.: to avoid unnecessary effort from multiple Contractors to prepare the bill, to provide the quality control, cost analysis, cost planning and to provide basis for financial reporting/cash flow.

At the same time, Pasquire (1991, in Baccarini and Davis, 2002) found that builder's quantities, based on measuring the resource requirements rather than fixed-in-place measurements, was the most beneficial in supporting other management functions, resulting in an estimated saving of 63% of staff time across the management functions in post-tender management.

Wood and Kenley, (2004) carried out research aimed to explore if the information in the BQ was presented in a manner that could be utilised effectively by the end user. From the populations surveyed; contractor, sub-contractor and quantity surveyor agreed that the BQ is a document that should be retained and would be used if produced.

Morledge and Kings, (2006) conduct a study to reviews the effectiveness of BQ; used to identify the extent of the work to do during competitive construction tendering. The study considered from the perspective of the contractor's estimator as primary user of these documents. It is found that the current BQ is not effective. The current format of documentation increases the overall cost of the tendering process, the overall level of risk endured by the contractor and the potential for post-tender dispute. The accuracy of the tendered priced is also potentially impaired. The study suggested that; (1) quantity surveyor and consultant should seek to ensure that the documents which they present meet the needs of the tendering parties and (2) any standard method adopted should prescribe the approach to be adopted but also enable flexibility.

Skinner (1979), in Baccarini & Davis, 2002, Kodikara *et al.*, 1993) carried out detailed research work on the contractor's use of the BQ and the utility derived from information contained in the bill for the whole contracting process. According to the research, to continue to justify the bill simply as a vehicle for contractor selection, fails to recognise the potential of its detail and more particularly, ignores its extensive contribution to production, which may as far as the successful contractor is concerned, greatly exceed its contribution to tendering.

Wood (2000, in Baccarini & Davis, 2002) found that the BQ had inadequacies for utilisation by contractors. Location information was not adequate. Also, the computerisation of BQ has not led to any increased transference of data from the quantity surveyor to the contractor, so that while the efficiency of BQ production has increases, then overall effectiveness of the BQ has not.

Prompted by the result of all the above survey, a decision was made to conduct a similar survey on Malaysian contractor. This survey will not match the depth of investigation or breadth of analysis achieved by the United Kingdom and Australia team, but it did produce some meaningful results for Malaysian construction industry.

#### **Research Methodology:**

The questionnaires survey has been grouped into two (2) sets target of respondent; the construction companies registered with Malaysian Construction Industry Development Board (MCIDB) under Grade 7 and 6. All the section reflects the specific objectives that need to be achieved. The survey data is analysed using the Statistical Package for Social Science (SPSS) to perform the data analysis for the questionnaire survey. Five (5) points Likert-type scale are also applied in this part.

For the purpose of examining the usefulness of the BQ at post-tender works, twenty-one (21) most critical management tasks under five (5) management function (headings), namely; estimating, purchasing, planning, site management and financial control identified by Kodikara *et al.* (1993) were used to represent contractor's post-tender work in the most and simplest manner.

Analysis of mean was chosen to draw inferential differences from the values measured. Mean was considered most appropriate for the analysis on the justifications it takes the 'skews' within the values. Hence, it would provide more accurate values for the analysis.

#### **Analysis of Correlation:**

There are two (2) types of correlation used in these studies: (1) Kendall's Tau Correlation and (2) Pearson Correlation.

***Kendall's Tau Correlation:***

Kendall's Tau Correlation analysis, which is non-parametric, was used to investigate the relationship of: (1) correlation between the usefulness of information in BQ at tendering stage based on individual information and overall information and (2) correlation between the usefulness of BQ for post-tender works based on individual management tasks and overall management tasks.

The correlation coefficient can range between  $\pm 1.0$  (plus or minus one) the sample estimate for the correlation coefficient is denoted by samples coefficient of correlation ( $r$ ). The 'r' identifies the degree and nature of the relationship between the two variables.

The coefficient of correlation can be interpreted as the following:

- i) A value close to zero – no correlation.
- ii)  $<0.5$  or  $>-0.5$  – weak or low correlation.
- iii) Between  $\pm 0.5$  and  $\pm 0.7$  – moderate correlation.
- iv) Higher than  $0.7$  or lower than  $-0.7$  – high/strong correlation.
- v) Positive correlation means the two variables are moving in the same direction and vice-versa for negative correlation.

***Pearson Correlation:***

Pearson Correlation analysis, which is parametric, was used to investigate the relationship between the usefulness of information in BQ at tendering stage and BQ used for Contractor's management tasks at post-tender stage.

Prior to use correlation analysis, a normality test has been carried out to determine whether the individual respondents' perception score for the usefulness of information in BQ and usefulness of BQ at post-tender works are normally distributed using the One Sample Smirnov-Kolmogorov (K-S) Test.

The Kolmogorov-Smirnov Z test, also called the Kolmogorov-Smirnov D test, is a goodness-of-fit test which tests whether a given distribution is not significantly different from one hypothesized (ex., on the basis of the assumption of a normal distribution). (Massey, 1951). After the normality is established, the study is in the position to use the parametric Pearson Correlation.

The Pearson's Correlation is used to find a correlation between at least two (2) continuous variables. The value for a Pearson's can fall between 0.00 (no correlation) and 1.00 (perfect correlation). Other factors such as group size will determined if the correlation is significant. The Pearson product-moment correlation coefficient is a measure of the strength of the linear relationship between two (2) variables. It is referred to as Pearson's correlation or simply as the correlation coefficient. If the relationship between the variables is not linear, then the correlation coefficient does not adequately represent of the relationship between the variables. The detail result was discussed in Chapter 5.

For the interview, eight (8) contractors were selected by using sampling techniques to give a representative sample of the industry. During the discussions, they were questioned about their use of the BQ for their tasks. First, the ten (10) information packages were explained to the interviewee. Then the twenty-one (21) management tasks were explained and they were questioned about their use of information packages for the tasks at post-tender stage. The question addressed 'why' and 'how' to explore and discover the problems of current use of the BQ. The purposes of the interview are to develop more understanding on the use of BQ by their opinions and suggestions and to support the information gathered from the questionnaire

There were two (2) statistical tests selected for the analysis: (1) analysis of mean and (2) analysis of correlation. In addition, there are two (2) types of correlation used in these studies: (1) Kendall's Tau Correlation and (2) Pearson Correlation.

***Usefulness of Information in BQ at Tendering Stage:***

Forty contractors participated in the questionnaire study. Most of them were quantity surveyors and project manager who had more than 10 years working experience, which made up 87.5% of the respondents. They were questioned about their use of the BQ for the ten (10) information packages. The information packages were discussed after the statistic results.

The average mean score of the ten (10) items is 3.59. Following the interpretation of a 5-point scoring system, this implies that on the average, the contractors surveyed consider the information packages taken as whole to be useful to them when preparing a tender for submission. The results for the individual items were shown separately in decreasing order of usefulness (decreasing level of satisfaction).

***Quantity Units:***

The contractors are very satisfied with the information under this item which received a mean score of 4.75. They found that it is highly useful and consider it the most useful vis-à-vis other information package is well based. In BQ, quantity units are prepared according to the Standard Method Measurement (SMM) published by Institution of Surveyors Malaysia (ISM) which the quantity surveyors in Malaysia have to follow when

preparing tender document. It can be concluded that, the contractors are happy because the standardised information makes it easier for them to compete with other contractors in bidding for the proposed project. That is, they exactly know what the quantity units are.

***Quantities:***

It received the mean score of 3.90, which imply that there are individual contractors who are not satisfied with this item of the BQ. Feedback from among these respondents obtained from interviews suggests that their dissatisfaction has to do with the fact that quantities used in the BQ are nett quantities. For example, construction cost for suspended floor does vary from floor to floor. Since the quantities in the BQ are nett quantities, contractors bidding for project with such quantity specifications have to fill in the average cost of the upper floors. The cost of constructing upper floors is normally higher than that for lower floors due to the extra cost of hoisting materials, among others.

Another deficiency is that the quantities provided in the BQ are not always accurate. contractors bidding for a project sometime need to check the accuracy of these quantities with the consultant first, but time is always a constraint in tendering process. In this situation, if the quantities specified in the BQ are more than the actual, the contractor (s) winning the bid will stand to gain from the extra quantities, and will lose if the quantities are less than the actual. To minimise this uncertainty, especially from losing, most contractors put up higher price estimates on other items, especially those under preliminaries. In doing so, they may price themselves out against their competitors. Daly (1981) also commented that not enough emphasis is placed on accuracy of quantities is made. This could be one important reason why there are individual contractors who do not rate this item highly.

***Time/Duration:***

The mean score of 3.78 implies that on the average, the respondents are satisfied with the item. However, the relatively low numerical score together with the fact that the minimum is 1 (very unsatisfied) indicate that there are individual contractors who are not satisfied. Feedback from the interviews suggested that this has to do with that fact that the time/duration item does not detail the phases of a multiple-phase project tendered out and that the completion date and inter-dependencies between the phases are not stated in the BQ (for project involved or divided into phases).

Take the case of a project involving the construction of two (2) sections (say, Section A and Section B), where its scope of works implies that the two (2) phases have different completion dates. However, because of an oversight on the part of the QS preparing the tender document, only the completion date of the whole project is mentioned in the BQ. This incomplete information causes difficulty to contractors in coming up with the actual cost. In practice, most contractors do not bring this problem immediately to the QS for rectification, preferring to ignore it and hoping it will sort itself as the project progresses.

***Preliminaries:***

The mean score of 3.65 indicates that on the average, the respondents are satisfied with the information contained in this item. There are individual contractors who do not consider it useful as implied by the minimum score of 1. The preliminaries section of the BQ describes the scope of work being tendered, including size, type of construction, number of buildings, etc. It may also provide information on the location, distance, services available (in the location) and whether the site is busy or isolated. These information guides the contractors in anticipate the complexity of the works and therefore produced a competitive tender.

Feedback from some interviews reveals that the preliminaries section often contains too many items which are irrelevant and unnecessary to the project. This usually happens when preliminaries items for other projects with different requirement or size are used without any adjustment (direct copy) to suit the project. Sometime the consultant employed to prepare the tender document use preliminaries from work that is of different scope altogether. An example is the use of preliminaries from a civil project for a building project.

The approach by contractors bidding for the project is to put a cost on these relevant items only. Pricing those irrelevant items will cause the tender amount high. This may be alright if they are not competing against other bidders. Perhaps, it is this uncertainty that dilutes the usefulness of the information package.

***Material Specification:***

Material specification of the BQ provides information on types of materials required and standard (quality) to be followed for each element of the work tendered. Its mean score of 3.60 implies that on the average, the respondents are satisfied with it or that they find the information useful. The level of satisfaction by contractors is relatively low because these specifications are not always helpful. First, this document often contains too many unnecessary items. Second, instead of incorporating the actual requirements, some consultants preparing tender documents use standard specifications from any projects. This in itself would not lead to serious problem.

However, due to oversight on the part of these consultants, the original clauses of the adopted standard specifications were not deleted or rectified, thereby causing the tender document to contain more than the project requires and has been agreed by Daly (1981) that the BQ contain too much irrelevant information and detail.

***Working Methods:***

This item in the tender BQ provides information relating to method of construction, workmanship and performance standards (e.g. curing, drying and protection). The mean score of 3.58 implies that the average respondents are satisfied with it, while its descriptive statistics point to the presence of individuals who do not find the information useful. This could be attributed to the fact that the work description, as alleged by some respondents from the interviews, often contains too many irrelevant items.

***Provisional Sums:***

The mean score of 3.35 implies that the average respondents are satisfied with the information package, but only marginally. Feedback from the interviews suggests that any dissatisfaction with it has to do with the lack of detailed description of the work and that the information does not state the extent of the work itself.

***Prime Cost Sums:***

The mean score of 3.23 implies that the average contractors find the information package somewhat useful. As the descriptive statistics indicate, there are individual contractors who are indeed not satisfied with the information contained. According to them, the prime cost sums does not give detailed descriptions and extent of work, rendering it inadequate for tender planning. The real dilemma is that the contractors are not involved with the works although they are contractually responsible for the works until the architect had made a specific nomination.

***Work Description:***

The mean score of 3.10 implies that the average respondents are somewhat satisfied with this information item of the BQ. This information package is supposed to provide detailed description of each item in the work and how it is to be constructed. According to the respondents, the information is not sufficient as it does not mention the location of the works (i.e., ground floors or upper floors). The cost of construction varies between ground floors and upper floors due to extra vertical and horizontal movement. If this location is not stated, it would be difficult to estimate their price. This problem, as we have seen, also plagues the quantities section of the BQ.

Another deficiency in the work description section is that it does not provide information on the types of operation the contractors have to use. For example, excavation work for pad footing could be done either manually or by machine. If not stated, the contractors will have to make their own decision as they have to come up with the correct pricing. Moreover, the work description in term of “finished work” and the complexities influence the cost of the construction involved are generally ignore. It is in this context that work description in the BQ is considered barely useful by the average respondents.

***Temporary Works:***

Items under temporary works such as scaffoldings, safety nets, etc., are not directly part of the final product of the contracted work, hence the lack of specifications such as types and methods associated with them in the BQ. However, contractors find this deficiency disturbing enough to the extent of considering it relatively the least useful. In fact, the mean score of 3.05 indicates that the average respondents are closer to being not sure whether the information package is useful or otherwise. As a project gets more complex, the magnitude and myriad of requirements under temporary works expand and these will increase the actual project cost. A contractor bidding for the project has to estimate the cost of these temporary works. Putting the cost low places him at an advantage against competitors, but this will reduce profit. The tender BQ is invariably silent about the actual items of temporary works; it gets away by specifying that Contractors bidding for the project shall supply all necessary plants, tools, etc. for the proper execution of work.

***Improvement Required for Information Packages in Tender BQ:***

Based on the mean scores, there are four (4) information packages in tender BQ that are perceived by the respondents to be somewhat wanting. In descending order of level of satisfaction (declining usefulness), these are: provisional sums (mean = 3.35); prime cost sums (mean = 3.23); work description (mean = 3.10); and, temporary works (mean = 3.05). On a scale of 1 (very unsatisfied) to 5 (very satisfied), where 3 denotes neutral or not sure, the mean scores indicate that the majority of the contractors are closer to being not sure whether the information contained in the four (4) items are useful or not. According to Kodikara *et al.* (1993) information packages with mean scores of less than two-thirds (2/3) of the maximum score (i.e.  $2/3 \times 5.0 = 3.33$ ) need

improvement. In this context, the information packages that need improvement, in descending order of priority, are temporary works, work description, and prime cost sums. The findings contrast from study by Kodikara et al. (1993) which found that information packages of quantities, quantity units and unit rates need urgent improvements.

In the case of temporary works, the tender document must specify the actual items of the temporary works, complete with its specification with respect to types and methods. This will put prospective contractors on equal footing and come up with a more realistic and reasonable estimate of the cost. With respect to work description, the BQ must specify the location of the works (i.e., ground floors or upper floors), types of operation (manual or mechanical), and the actual complexities of the work rather than merely referring to it as “finished work”. For prime cost sums, the BQ must detail the descriptions and extent of work associated with the project. At least, these are some aspects of the information packages in questions that need to be improved to enhance its usefulness.

***Usefulness of BQ for Contractor’s Management Tasks at Post-Tender Stage:***

There are twenty-one (21) contractor’s management tasks identified at post-tender stage under five (5) management functions (headings); estimating, purchasing, planning, site management and financial control.

The results for the individual items are presented at below subtopics:

***Incorporating Preliminaries in the Programme (Planning):***

It was mentioned earlier that the average respondents are very satisfied with it (mean = 4.70). The minimum score being 4 means that everyone considers this information package in the post-tender BQ at least useful. The preliminaries section of the BQ provides information on the numbers and requirements of the site accommodations such as the temporary buildings, temporary offices for engineers, clerk of work, meeting room, stores, sanitary appliances etc. This enables contractors to anticipate what the construction site should contain and where to put all the accommodations in the site.

***Compilation of Time-based Programme (Planning):***

On the average, the respondents are satisfied with the use of BQ for *Compilation of Time-based Programme* (mean = 3.90) which can be considered as high. These results contrast with the study by Kwek et al. (2006) that identified BQ are only ‘sometime’ use by contractor in produced work programme. Feedback from the interview agreed the BQ provide information relates to the nature of the project and also the time allowed for the construction of the works (date of possession and completion) which helps Contractors design their own work programme for the project. However, not all of the information can be used directly as the sequence of work is not provided in the BQ, perhaps, leading to some Contractors finding it less useful.

***Identification of Task and Construction Method (Planning):***

The use BQ for this task has a mean score of 3.90 (similar to that for *compilation of time-based programme*), implying that the average respondents are satisfied with it. It is listed third in the table (after *Compilation of Time-based Programme*) because its mean score has a relatively larger standard deviation. For this task, the BQ provides information relating to the size and types of projects as well as time of completion. It helps contractors to determine the tasks and construction methods suitable for the project. An experienced contractor would normally be able to identify the suitable method to use by looking at the description and quantities provided in the BQ.

**Table 1:** Mean Scores of Information Packages in BQ.

No	Information Packages	Min	Max	Mean	Std Deviation
1	Quantity Units	4	5	4.75	0.439
2	Quantities	2	5	3.80	0.687
3	Time/Duration	1	5	3.78	0.862
4	Preliminaries	1	5	3.65	0.921
5	Material Specification	1	4	3.60	0.928
6	Working Methods	1	5	3.58	0.958
7	Provisional Sums	1	5	3.35	1.099
8	Prime Cost Sums	1	5	3.23	1.165
9	Work Descriptions	1	5	3.10	1.172
10	Temporary Works	1	4	3.05	1.218
	All information (average)	2.2	4.7	3.59	0.519

***Taking Quotations from Sub-contractors or Pricing Prime Cost (Estimating):***

The selection of sub-contractors is an important factor to consider at this stage. Reference has to be made to the pre-contract planning with respect to earlier quotations utilised in the estimate prior to offering the tender. The BQ would be used to review the tender rates to assess profitability to the contractors. Wherever possible,

quotations from the selected sub-contractors should relate to the BQ. The mean score of 3.85 implies that the average respondents are satisfied with the information provided in BQ for this task.

The relatively lower level of satisfaction of the contractors may plausibly be due to the difficulty in obtaining quotations from sub-contractors. It is known that main contractors often sub-let certain trades. They have to provide copies of the specifications for these trades to the sub-contractors, but the information for a particular trade is spread throughout the section. For instance, the relevant specifications for sub-contracted plumbing work usually appear under plumber, metal worker, roofer, drain layer etc. If the main contractors who intend to sub-let their works have to prepare an abstract of the items and obtain quotations on them. The respondents claim that this represents extra work to them and that they invariably make errors in estimating.

***Assessment and Allocation of Plan for Works (Site Management):***

The information relates to the nature of the project which can be obtained from the BQ influence the requirements of plant for the works involved. However, the Contractor has to decide when and what plant should be delivered to the site depending on the progress of work. The mean score (3.80) implies that the average respondents are satisfied with the use of BQ in *Assessment and Allocation of Plan for Works*.

***Preparation of Final Account (Financial Control):***

The information in the BQ serves as a reference for contractors when preparing the final account. With this information, arguments on rates and other discrepancies can be reduced to a minimum, and the final account can be settled earlier. On the average, the respondents are satisfied with the use of BQ (mean = 3.78). However, the BQ cannot be used directly since the contractors need to prepare further calculation to get the actual amounts.

***Incorporating Procurement of (hired-in) Plant in Programme (Planning):***

The amount of works to be done which can be ascertained from the BQ will help contractors to work on the plant required. If the works are large and require a lot of materials and labour, the Contractors may decide to hire or buy bigger machines or those with larger capacities. However, because the BQ does not state directly mentioned what plant is needed for the work, some respondents are not satisfied with the use of BQ in this task. These results are similar to the study of the use of BQ by Singaporean contractor by Kwek et al, (2006) that only 34% of Contractors use for requisition of plant and equipment which consider low. Furthermore, research by Queensland Chapter, Daly (1981) identified that BQ is generally not used for procurement of plant. Nevertheless, the average respondents are satisfied with the information package (mean = 3.77).

***Reviewing the Material Quotations and Potential Supplier (Purchasing):***

The BQ is supposed to provide sufficient information on the types and quality of materials required for the work. Based on the information provided, contractors develop a schedule of material and quantities together with the terms and conditions and forward it to potential suppliers for quotations. In many cases, some contractors just make copies of the material requirement in the BQ and send these to potential suppliers for quotations. Normally, the suppliers will provide extra suggestion on alternative items such as details for roof, window, tiles etc., as they are the experts in this matter.

Some of the respondents are not satisfied because they find the information is inadequate such as types and quality of materials not being clearly stated. This does not help them with their review of quotation from potential suppliers. However, the mean score of 3.75 implies that the majority of the respondents are satisfied with the use of BQ in this management task.

***Accommodating Variations to the Works (Financial Control):***

The effect on cost of variations to the original design can be accurately and equitably assessed if BQ is provided. If not, any variations in the work that arise later will have to be negotiated, and quite often these negotiations are not to the satisfaction of both contractors and clients.

The BQ provides for claims against any variations made and helps identify as well as value variations. However, the contractors almost always have to refer back to the original dimension sheets in order to identify exactly what were included in the bills for the work for which the variations are made. The unit rates set out in the BQ, form the basis for value the variations. However, there are discrepancies between the original contractual rates and the actual variation rates, which lead to argument on what rate should be used. Perhaps, this confusion leads to some contractors to be dissatisfied with the BQ. Nevertheless, the average Contractors are satisfied with the use of BQ in *accommodating variations to the works* (mean = 3.75).

***Taking Quotations from Suppliers (Estimating):***

As is the case with *reviewing quotations for materials and potential Suppliers*, which is under purchasing, the information provided by the BQ in *taking Quotations from Suppliers* (under estimating) enables contractors

to develop a schedule of materials and quantities which would be sent to Suppliers. The type of materials can be easily obtained directly from the BQ or it can be calculated from the finished work stated in the BQ.

In many cases, the contractors involved would just copy this section of the BQ and send it to Suppliers. Just as in the case of *reviewing quotations for materials and potential Suppliers*, suppliers normally will provide extra suggestion on alternative items such as details for roof, window, tiles etc., as they are the experts in this matter.

The mean score of 3.75 implies that the average respondents are satisfied with the use of BQ in this management task. However, the size of this mean value and the minimum score suggest that there are individual contractors who are not satisfied. If so, this has to do with inadequate information (sometime not clearly stated) in BQ on types and quality of materials stated in the BQ.

***Preparing Resource Schedules for Ordering Purpose (Purchasing):***

BQ provides some basic information on quantities and units that serves as a guide for contractors in purchasing materials for the work. However, the BQ itself cannot be used directly for materials purchasing because there are no separation between materials. The quantities stated are all nett quantities and do not represent the actual amount needed for the complete works. For example, in order to produce concrete which contains cement, sand and aggregate and water but these materials are not specifically separated. The contractors have to determine these quantities by coming up with their own built-up rate. In fact, regarding to this issue, the preliminaries clearly states that the BQ should not to be used directly for ordering materials

The average contractors accept their responsibility on this issue and are satisfied with the use of BQ (mean = 3.75). However, the size of this mean value and the minimum score suggest that there are individual contractors who are still not satisfied.

***Identifying Material Requirements to Purchase or Order from Head Office (Purchasing):***

For this purpose, the BQ serves as a reference in helping contractors identify the materials to purchase or order as it provides information on materials required for the works. As is the case with *preparing resource schedules for ordering purpose*, there are no separations between some of the materials required. For example, the works requires concrete which contains specific amount of cement, sand and aggregate and water, but these materials are not specifically separated, leaving Contractors to identify the actual material needed. Perhaps, it is this aspect of the BQ that cause dissatisfaction to some contractors although the average contractors find the BQ is useful (mean = 3.70).

***Placing Orders for Resources (Purchasing):***

As is the case with the preceding contractor's task, this section of the BQ serves as a reference for contractors to identify the materials to purchase or order. However, because there are no separations between some of the materials required in the BQ, it is left to the contractors to identify the actual materials to purchase. This is the aspect of BQ that may have led some contractors to find the BQ is not useful although the average contractors are satisfied with it (mean = 3.70).

***Purchasing or Hiring/Leasing Plant and Equipment (Purchasing):***

The quantities extracted from the BQ will assist Contractors to determine the plant and equipment required for the works. Also, the information that relates to the nature of the project will help contractors decide on the types and number of suitable plant and equipments to purchase. However, several respondents claimed that the information provided were inadequate for the purpose of selecting the right plant. An example is the construction of a temporary bridge. In the preliminaries section, the clause only mentions that the contractors have to provide such elements and is silent on the type of plant to use or chose. This deficiency in the BQ is not perceived favourably by a number of contractors although the average Contractors find the information useful (mean = 3.70).

***Preparing Interim Valuations for Completed Work (Financial Control):***

The rates and quantities provided in the BQ should be able to assist contractors to carry out interim valuations. For example, where there is a BQ, the evaluation of the preliminaries will usually be easier, and the results more satisfactory. Also, it enables comparison to be made between the completed and the tendered works. However, if the works involve large changes which require different methods and materials, the existing rates and quantities may not be suitable as a basis for evaluation. In such cases, the contractors and consultants need to revise the quantity and cost of the whole works. Nevertheless, the average respondents find the BQ useful when preparing interim valuations for completed work (mean = 3.68).

***Monitoring and Recording Actual Use of Resources and Sub-Contractor Work (Site Management):***

The BQ is normally used as a guideline by Contractors in monitoring and recording actual use of resources and Sub-Contractor work. The average respondents are satisfied with this aspect of the BQ (mean = 3.57). Individual respondents who depend on their own experience and do not use the BQ as reference when making the above exercise are the most likely to feel dissatisfied with the BQ.

***Assessing and Allocating Labour for Works (Site Management):***

With the completion date for work being stated in the BQ, contractors have a target date to work upon. If the contract period is long, the contractors may bring fewer workers to the work site and still be able to complete the project on time. If the contract period is short, the contractors either increase the number of workers or alternatively resort to overtime to meet the completion date. In whichever case, the contractors are aware that they are not granted extension of time (EOT) by the client and that they are subject to Liquidated Ascertained Damages (LAD) for delays. As such, contractors need to calculate the total number of workers required for the project, and most importantly determine the number available on-site per work programme. The average contractors are satisfied with this aspect of the BQ (mean = 3.50).

***Assessing and Allocating Materials for Works (Site Management):***

The material specification in the BQ provides information to prospective contractors on the quantity and quality of materials required for the project. However, the BQ does not provide the time and quantity schedule for the on-site delivery of materials required for the works. This is left to the discretion of contractors who usually arrange for it according to the progress of works. The mean score of 3.40 implies that the average respondents are only somewhat satisfied with this element of the BQ. The mean and the minimum score suggest that there are individual respondents who are not satisfied with it.

***Preparing and Monitoring Cash Flow (Financial Control):***

Bill of Quantities cannot be used directly to prepare cash flow. The contractors have to determine the best design of cash flow to achieve their targeted profit. This usually depends on their experience in handling project. The average respondents are somewhat satisfied with the use of BQ with respect to guiding them in preparing and monitoring cash flow (mean = 3.33).

***Making Arrangement with Sub-Contractors on Works (Purchase):***

The information on materials, quantities, works description, etc. provided in the BQ tells the contractors what jobs need to be done before they liaise with sub-contractors. In so far as its usefulness for the purpose of liaising with sub-contractors is concerned, the majority of the contractors do not consider the information to be that much useful. The average respondents are only somewhat satisfied with it (mean score = 3.32). Perhaps, this owes to the fact that in practice some respondents do not refer to the BQ, but use their own knowledge from experience.

***Incorporating Off-site Manufacture Items, Special Resources, etc. (Planning):***

The BQ is silent on certain things, for example, whether contractors should use concrete mix produced on-site or ready mix concrete. The same goes with other special resources. The decision on this is left to the contractor. The average respondents are only marginally satisfied with this aspect of the BQ (mean = 3.15), and many individual respondents would have perceived the BQ as not being useful.

***Overall Satisfaction on the Usefulness of BQ For Contractor's Management Tasks at Post-Tender Stage:***

Earlier, the level of satisfaction (perceived degree of usefulness) of respondents afforded by the usefulness of BQ for each of the twenty-one (21) contractor's management tasks was manifest in the overall mean score of 3.70. That is, taking into consideration of all the twenty-one (21) management tasks, the average respondents are satisfied with the BQ for which it is prepared. The respondents were also asked to rate the usefulness of the BQ for contractor's management tasks based on the overall use of BQ. .

***Correlation between Satisfactions Based on Individual Items and that Based on Overall Information:***

Considering that there are ten (10) items involved in perception based on individual information packages and only one (10) item in perception based on overall information, the *Kendall's Tau* Correlation Coefficient, which is a non-parametric tool of correlation analysis, was used (Aripin, 2007). Table 2 summarises the result of the correlation analysis. It can be seen that the two (2) entities are positively correlated with one another. The correlation coefficient of 0.368 is statistically significant at 0.01 level ( $p = 0.006 < 0.010$ ). The interpretation of this result is that on the average, a respondent who is satisfied with the information in BQ based on individual information packages is likely to be satisfied as well with the document based on overall information. It is concluded, therefore, that the respondents are consistent in their perceptions of the usefulness of the BQ.

**Table 2:** Correlation Between the Usefulness of Individual Information Packages and the Usefulness of Overall Information: Tender BQ.

	Satisfaction of individual information packages	Satisfactin of overall information
Satisfaction of individual Information packages	1.000 (0.000)	0.368** (0.006)
Satisfactin of overall Information	0.368** (0.006)	1.000 (0.000)

Figures in parentheses are p-values  
 \*\* Significant at 0.01 level

**Correlation Between Usefulness of BQ for Post-Tender Work Based on Individual Management Tasks and That Based on Overall Management Tasks:**

Considering that there are twenty-one (21) Contractor’s management tasks involved in perceiving usefulness of BQ based on individual management tasks and only one item in that based on overall management task, the *Kendall’s Tau* Correlation Coefficient, which is non-parametric, was used in the analysis. Table 3 summaries the result of the correlation analysis. It can be seen that the two (2) entities are positively correlated with one another. The correlation coefficient of 0.305 is statistically significant at 0.05 level ( $p = 0.021 < 0.05$ ). The interpretation of this result is that on the average, a respondent who is satisfied with the use of BQ for post-tender work based on individual management tasks is likely to be satisfied as well with the use of BQ based on overall management task. It is concluded, therefore, that the respondents are consistent in their perception of the usefulness of the BQ for contractor’s post-tender work.

**Table 3:** Correlation between Satisfaction Based on Individual management tasks and Satisfaction Based on Overall management tasks.

	Satisfaction of individual information items	Satisfaction of overall information
Satisfaction of individual information items	1.000 (0.000)	0.305 (0.021)
Satisfaction of overall information	0.305 9(0.021)	1.000 9(0.000)

Figures in parentheses are p-values  
 \*Significant at 0.05 level

**Conclusion:**

From the analysis, it was found that respondents who are satisfied with the information packages in BQ at tendering stage is likely to be satisfied with the use of BQ at post tender works as well. Most contractors considered the use of BQ for the Contractor’s management tasks in post-tender are useful for their post-tender works. By individual management task, they consider incorporating preliminaries in programme as being highly useful and incorporating off-site manufacturer items, special resources, etc least useful. It is concluded that, although the contractors widely use the BQ for post-tender works, the full potential was not being achieved throughout the contract.

**Recommendation:**

These recommendations are designed in order that the BQ can provide useful information to the Contractors both in pre-tender and post-tender stage:

- a) General descriptions and descriptions of items should briefly describe the work to be carried out. Also, any irrelevant causes or sections not applicable to the pricing should be excluded. Every effort shall be made to include all information of materials, workmanship and methods of operation of the project irrespective of whether those items were considered should have been there or they were too trifling to be included as long as they were relevant.
- b) Information provided should be presented in a clear logical sequence, that is, consistent. The quantities provided in the BQ must be accurate. In order to get accurate quantities, all high learning education such as, University, College etc, need to teach proper guideline to their students in doing the measurement, so when they becomes one of the Consultants, they know how to prepare and make proper BQ without mistakes. Furthermore, the Consultants need to make sure the quantities are correct; they should check or countercheck all the quantities done by their assistants or staffs.
- c) The measurement and the presentation should be strictly in accordance with a set of codified rules familiar to and both Contractors and QS, that is, following the Standard Method of Measurement. In practice, there were some measurement did not follows the SMM for example, formwork for kickers. Usually, the QS do not measure kickers even there was a provision for kickers in the SMM. With this, the QS need to apply to the rules.

Beside that, these are some recommendations on how to improve the BQ. Extra section for Method-Related Charges (MRC) as in Civil engineering Standard Method of Measurement (CESMM) should be provided. This will enable the Contractors to determine their requirements and made suitable claims for works or plants which are not mentioned in the bills.

A MRC is a provision whereby Contractors were allowed to insert in the BQ such items as he may decide to cover items of work relating to his intended method of executing the works, the cost of which is not to be considered as proportional to the quantities of the other items and for which he has not allowed in the rates and prices for the other items.

Each item for MRC inserted in the BQ shall fully described so as to define precisely the extent of the work covered and to identify the resources to be used and the particular items of Permanent Works or Temporary Works, if any, to which the items relates.

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