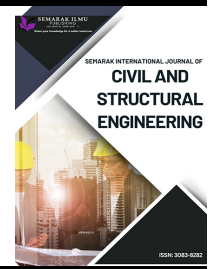




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Exploring the Problems of Bills of Quantities

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ABSTRACT

A bill of Quantities (BQ) is a well-known document in terms of its function and importance in the construction industry. For example, the success of the construction projects will be impacted by the quality of the information supplied in the BQ, including the avoidance of conflicts, overestimation, cost escalation, and profit loss. However, recent research demonstrates that BQ has been criticised for its declining utilisation and effectiveness in building projects, yet only a few studies have addressed the problems. Therefore, using inductive content analysis from thorough literature of 20 papers, this work investigated the problems with BQ. There are five problems with the BQ that have been identified, namely, problems with the accuracy of information, problems with its applicability with procurement methods, problems with the cost of its preparation, problems with the time-consuming nature of its preparation, and its not being fully utilised by the construction team, its inability to relate to everyday projects with the development process, its being misunderstood, its only being utilised during the tendering process, it's not encouraging input from builders and it's not representing any information on the reasonable risk. Furthermore, the quantitative content analysis results reveal that problems with the accuracy of information presented in the BQ are the most prevalent fault noted by nearly all of the researchers, and they should be underlined. The purpose of investigating BQ problems is not to replace the use of BQ, but rather to develop and give solutions for BQ from a variety of aspects.

1. Introduction

The success of a construction project depends on the quality of management throughout the construction processes and procurement routes. A construction project requires large sums of money to finance the purchase of numerous materials, labour salaries, and equipment provision. It also involves numerous parties, numerous processes, different phases and stages of work, and many inputs from both the public and private sectors. Hence, systematic management throughout the construction process and procurement routes is very important. Bill of Quantities (BQ) is one

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systematic way applied in the construction activities that records important information and acts as a fair agreement between parties. Inaccurate information provided in the BQ will lead to cost escalation, variations, claims for additional costs and disputations. Inaccurate information provided in the BQ will lead to cost escalation, variations, claims for additional costs and disputations. The quality of BQ has recently been criticised in literature, especially with regard to its efficacy in construction projects and its ongoing reduction in utilisation. On the other hand, the main issues raised by the criticism have received relatively little attention. BQ is not a novel aspect to the construction team because many construction teams have previously understood and are familiar with its application since 300 years ago due to its significance. As a result, the best course of action is to continue using it, but you must purposefully investigate its shortcomings in order to enhance it by proposing solutions and strategies for overcoming them.

By preparing BQ, construction management becomes more systematic and efficient, and it is the key to success in the construction business by encouraging excellent practice across the construction processes and procurement routes. It serves as a well-known document among the construction team, outlining the qualitative and quantitative aspects of each component of a proposed construction project [1], such as "fully describe and accurately represent the items of work" [2], with a "complete description of material and workmanship, including quality [3] and quantities [4]". Furthermore, it is a document that is used to make a tender document for contractors to price a building project [1], resulting in a fair agreement between parties. Based on its definition, it is clear that the BQ is a document that offers complete and crucial information on building projects. This demonstrates how crucial the BQ is in building projects.

However, the literatures proven that the BQ has been criticized [4,16,10] due to cost of its preparation [7], preparation of BQ is time consuming [7-10], BQ only suitable for certain type of procurement method only (The Aqua Group, 2003), the information in the BQ is not accurate and doubtful [4, 11-15] and others such as it is not fully utilised by project teams and many were not able to relate BQ for everyday project with the development process [4,10,16]. Although prior researchers suggested that BQ had drawbacks, relatively few studies have gone into detail regarding these problems. Because BQ is a document containing vital information, problems with BQ should be addressed properly and effectively to minimise any potential risks to building projects. As a result, the purpose of this article is to delve further into the problems concerning BQ in the construction business.

2. Methodology

The method used is a comprehensive literature review of 20 articles consists of conference papers and journal articles. The articles selected range from year 1978 until 2011 focusing on the keywords "bills of quantities" AND "problems". The sources was found by using search engine such as Google Scholar, Scopus, Science Direct and Databases provided by the higher education library. Table 1 shows the list of articles for this paper, the themes and frequencies. The themes discovered as follows:

- 1 – Inaccuracy,
- 2 – Cost of preparation,
- 3 – Time consuming
- 4- Suitability with procurement methods used
- 5 - Others

Table 1 List of Articles and the Fig. 1 shows the phases of content analysis process for this study.

Table 1
List of articles

No	Researchers	Year	BQ Problems				
			1	2	3	4	5
1	Scott and Rahman	1978	1				
2	Holt, Olomolaiye, and Harris	1996		1	1		
3	Akintoye	2000	1				
4	Perera and Imriyas	2003	1		1		
5	Davis and Baccarini	2004	1	1	1	1	1
6	Rosli, Muzani, and Siti Nurhuda	2006	1	1	1	1	1
7	Seng and Aminah	2006				1	
8	Oladapo	2006	1				
9	Maizon, Melissa, Chu Yin, Sock Hooi, Mong Heng, and Lee Yong	2006				1	
10	Hussein	2009	1				
11	Panthi, Syed, and Ogunlana	2009	1				1
12	Gaith, Khalim and Amiruddin	2009			1		
13	Kaliba, Muya, and Mumba	2009	1				
14	Olatunji, Sher and Gu	2010	1		1		
15	Khairuddin	2011	1			1	1
16	Laryea	2011	1				
17	Laryea and Hughes	2011	1				
18	Hafez, Nurshuhada, Mustafa and Nor Azlinda	2011	1	1	1		
19	Aftab, Ismail, and Ade	2011	1				
20	Hamimah, Abdul Hadi, Siti Maimunah, Azizan and Yih Chong	2011	1				1
Frequency			16	4	7	5	5

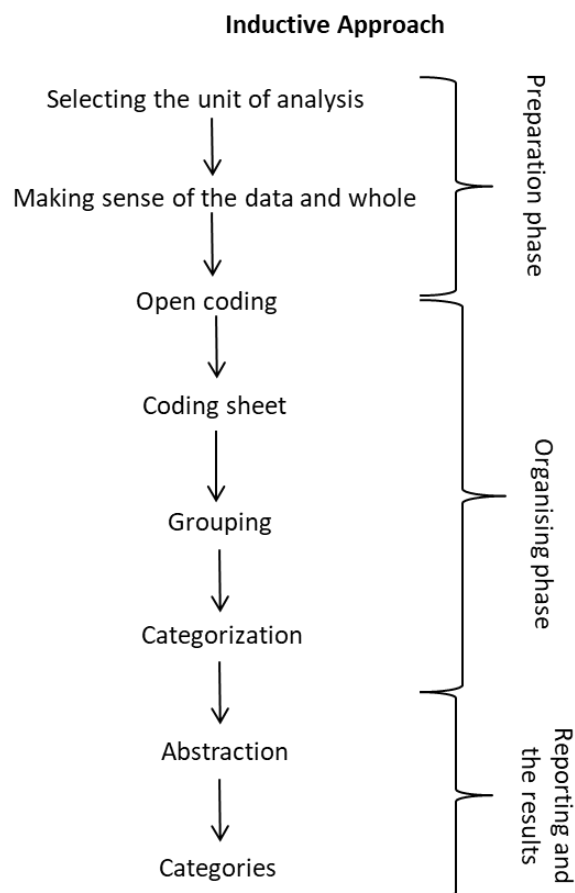


Fig. 1. Preparation, organizing and resulting phases in the content analysis process

Another method used is quantitative content analysis to determine the major problems among the five categories of BQ problems identified. The quantitative analysis done by using frequencies and percentage of the five categories of BQ problems identified. As mentioned by Neuendorf [17], content analysis can produce data in the form of descriptive. The procedure of content analysis of this research followed the procedure that is suggested by Gillham [18] which is producing analysis grid in the form of tabulation to highlight key point statements that really address about the research objectives. The highlighted points are then coded into categories. The qualitative data then is transformed into quantitative data by calculating the frequencies of the categories mentioned by the researchers and calculating the percentage which enable to rank the problems.

Eq. 1 Relative Frequency

$$\text{"Relative Frequency"} = \frac{f}{n} \quad (1)$$

f is the number of times the data occurred in an observation
 n is total frequency

Eq. 2 Percentage

$$\text{Percentage (\%)} = \frac{f}{n} \times 100 \quad (2)$$

The percentage calculated based on frequencies divided by numbers of articles/authors times hundred. This is due to some of the authors mentioned more than one categories of BQ problems. For example,

Eq. 2 Percentage

$$\text{Percentage (\%)} = \frac{16}{20} \times 100 = 80\% \quad (2)$$

3. Results

Table 2 was generated based on Table 1. Referring to Table 2, there were five categories of BQ problems found, namely, inaccuracy, time consuming, procurement methods, costly, and others. Among the five categories of BQ problems identified, the problem that is mentioned by majority of researchers is the inaccuracy of information in the BQ (80%). The highest frequency demonstrates that the problem has been mentioned repetitively and this shows that the occurrence of the problem is common. Inaccuracy is the common BQ problem that requires a higher concern in order to provide solution to reduce its occurrences. The second problem is time consuming (35%), followed by procurement methods (25%), others (25%) and costly (20%).

Table 2

Percentage of BQ problems

Code	Problems of BQ	Frequency	Percentage (%)	Priority/Rank
1	Inaccuracy	16 out of 20	80	1
2	Time Consuming	7 out of 20	35	2
3	Procurement Methods	5 out of 20	25	3
4	Costly	4 out of 20	20	5
5	Others	5 out of 20	25	4

The BQ has been criticised from various aspects. Based on the criticisms, it is found that there are a lot of problems that have been raised on the BQ. Based on content analysis, the problems are categorised into five;

3.1 Problems on the Accuracy of Information in the BQ

The problems of accuracy of the BQ has been criticised and doubted by Scott and Rahman [19]. The accuracy of the BQ is measured by assessing “errors” [4,11-14] and “mistakes” [12,15] in the BQ. There are three main contents that give impact on the accuracy of a BQ. They are quantities [10,13,15,19-23], unit rates [13,19,20,22,24-26] and descriptions [10,21,27]. The errors and mistakes are due to human errors [14] such as duplication of input [8], overlooking important things, QS lack of knowledge, insufficient skilled, lack of training and experience [15]. Hussein Ibrahim [15] mentioned that there are various steps and processes involved in preparing a BQ. Every step and process is a potential area of making errors and mistakes.

The accuracy of BQ is doubtful in terms of the information provided in the document. The information of the BQ that is mostly mentioned is the accuracy of the descriptions, quantities and unit rates, in which, many researchers claim that these information contain errors and mistakes. The main causes of the accuracy of the BQ are errors and mistakes made by human such as overlook of information, misprint, duplication of information, missing information, lack of knowledge, skills, and experience.

3.2 Problems on the Time for BQ Preparation

The documentation of BQ is very time consuming [7-10]. Time consuming is a problem of the BQ because it has increased the duration/period of BQ documentation [4] which caused delay in calling tender [11]. Gaith *et al.*, [28] and Perera and Imriyas [14] stated that a manually prepared BQ requires more time and does not promote speed [11]. The longer period of time required in manually preparing the BQ is due to the many steps and processes involved, such as studying the drawings, measurement (take-off, build up rates, call for quotations, queries, any addendum for changes), and transferring data to the final documentation [29-31].

Manual preparation of the BQ or the traditional way of preparing the BQ required more time which drags the tender period. The time consumed is due to multiple steps and procedures in processes involved particularly in measurement works and final documentation works such as studying the drawings, measurement (take-off, build up rates, call for quotations, queries, any addendum for changes), and transferring data to final documentation.

3.3 Problems on Applicability of the BQ with Procurement Methods

According to the Aqua Group [32], the production of BQ depends on the types of procurement used. Based on Table 2, another BQ problem is that it has been claimed as not suitable for all types of procurement methods [1,33-35]. BQ is only suitable for certain types of project [11]. Procurement method as defined by Ireland [36], is the practices and edifices management implemented on a project. It has been practiced since the establishment of the QS profession in 1834 [37]. There are three types of procurement methods; traditional system, design and build or turnkey and management contracting [10,11,37,38]. As mentioned by Davis *et al.*, [4], BQ is only suitable for the traditional procurement project.

In the UK, traditional method is a dominant procurement used until the introduction of design and build method in the 1980s. RICS [39] mentioned that there is a wane usage of BQ in the construction industry and it is predicted that BQ may totally disappear from the construction industry in the near future. This is due to the establishment of new procurement methods. According to RICS [39], in the UK, the use of BQ has declined from 65% in 1984 to 56% in 1989. Based on AIQS (Victorian chapter) survey in Table 3, there is a sharp downward trend in the production of BQ as cited in Davis *et al.*, [4].

Table 3
BQ production as percentage of office workload

1993	1994	1995	1996	1997	1998	1999
27%	30%	22%	16%	15%	17%	11%

Source: (AIQS Victoria, as cited in 4)

In Australia, the Legislative Council NSW has already identified from year 1991, the need for continuing research and has debated and advocated further research to establish whether BQ remains as an essential part of contract documentation prepared by the quantity surveyor (QS) as also regarding to the issue of applicability of BQ in the procurement system. In Malaysia, Traditional General Contracting method (with BQ) has been used worldwide by majority of clients in the construction projects at least for the past 150 years [38]. However, as reported by a research conducted by Rashid *et al.*, [1] pertaining to the BQ performance in today's construction procurement system and the introduction of design and build method, BQ is not necessarily useful for every type

of project or procurement system. This is the main issue contributing to the relevancy issue of BQ in the Malaysian construction industry [4,10,11,16,34,35].

It was mentioned by Rashid *et al.*, [10] that the processes involved in traditional procurement and non-traditional procurement systems (design and build and management contracting) are different and this is one of the factors that construction opts from traditional to alternatives methods. There are three factors of procurement selection; time, cost, quality [11,38] and design and build methods promote speed which can shorten the project duration/period [1]. According to Onosakponome *et al.*, [40], in traditional procurement system, the design and the construction are carried out by separate organisations in which, project delivery is a sequential process [11] as illustrated in Figure 2. The processes such as tendering preparation only starts when the detailed design is completed and the construction only commences after the tender is awarded. The BQ is prepared during tender and contract. This process, which is a sequential process, is claimed by researchers as tends to consume more time.

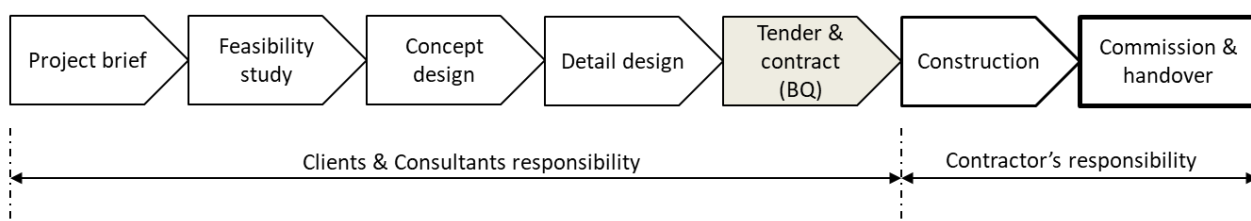


Fig. 2. Traditional procurement system
Source: [1]

However, in the non-traditional procurement system, the design and the construction are carried parallel, as well as the BQ production as illustrated in Figure 3 [1].

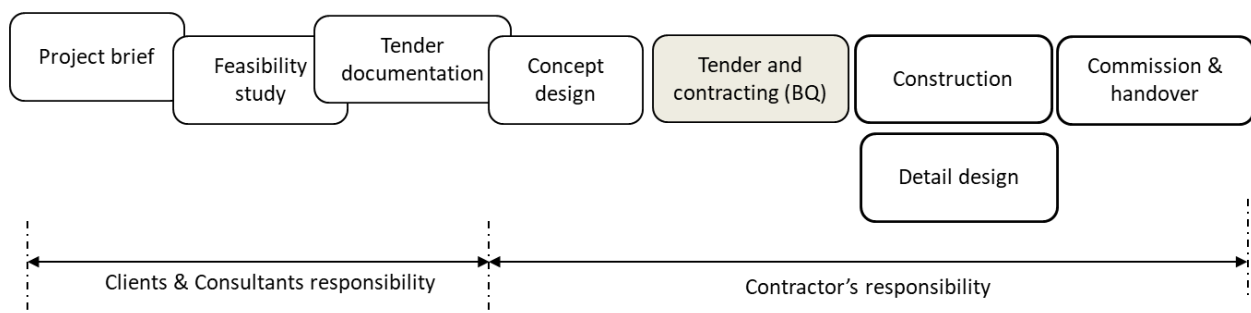


Fig. 3. Typical processes of non-traditional procurement system
Source: [1]

The applicability of BQ was claimed as not appropriate for all types of procurement; it is synonym with the traditional procurement method. In the UK, it was clear that the usage of BQ has declined and they have moved to a fast track procurement method. However, in Malaysia, traditional procurement method (with BQ) is still practiced by the construction industry. The main factor that causes the BQ as not suitable for all types of procurement methods is that it consumes longer construction period because of the sequential process compared to other non-traditional systems (design and build) which is a parallel process that can shorten the project duration/period.

3.4 Problems on the Cost of the BQ Preparation

The documentation of BQ is costly [7]. Holt *et al.*, [7] and Rashid *et al.*, [10] claimed that the preparation of BQ consumes cost as it upsurges the cost of documentation [4]. Holt *et al.*, [7] refers the cost of preparing BQ documents to various spending on the documentation such as paper usage which can be up to 500 pages (take-off and final document), staff salary on overtime basis, and bills [10]. The production of BQ increases the cost of documentation which is the use of papers, printings and certain tools to make bills into a documented form. It is also influenced by external factors that incur cost in preparing the BQ document such as bills (phone and fax bills in order to make calls for quotations, electrical bills), and overtime payment for staff. However, nowadays the technology is more advanced and provides options to prepare BQ using computers or also known as softcopy version which reduces expenses on papers, printings and tools to document the bills [14]. This is in contrast with the Aqua Group [32] which has mentioned that the issue on the production of bills of quantities is costly either using computers or without using computers.

3.5 Others BQ Problems

One of the others problems of BQ in the construction industry is that, it is not fully utilised by project teams and many were not able to relate BQ for everyday project with the development process [4,10,16]. Moreover, Australian Institute of Quantity Surveyor [41] claimed that BQ is perhaps the most misunderstood facet of building contracts today [4,16]. The worst is when BQ is only useful for tendering purposes since after tendering is completed, “it tends to be put away in a cabinet or store room to collect dust” [10] and this shows that “BQ does not fulfil what it is supposed to fulfil” [11]. Pertaining to this matter, Wood *et al.*, [42] has conducted a research on the effectiveness of BQ which is to enhance the utilisation of BQ among the project teams. As reported by them, the respondents (contractors, subcontractors and quantity surveyors) agreed that the information in the BQ is efficient but it is not effective. Therefore, improvements are required to prepare for the most appropriate composition of a SMM committee and development of a detailed BQ with input from all stakeholders [4,16]. Another problem in other aspects is the BQ does not encourage the input from builders. The use of detailed design that is associated with BQ discourages contractors from submitting alternative design solutions because the alternative design is subjected to amend the quantities of the items of work for construction projects [4,16]. Besides that, the BQ does not represent any information on the reasonable risk which can be allowed during project tendering [4].

There are three aspects in other problems of BQ which are the benefit of BQ is not fully utilised by project teams, the BQ does not encourage input from builders, and BQ does not represent reasonable risk. The information in the BQ should be easily understood by project teams. Therefore, the content of BQ should be in simple text explanation and fulfils the data required not only during tendering purposes but also during construction works such as purchasing materials and cost monitoring by contractors and QS. Another problem is the BQ does not encourage the input from builders. Contractor is knowledgeable and up to date on the construction technologies to be used for a construction project. Therefore, the input from them is advantage to the use and function of BQ. Besides that the BQ does not represent any information on the reasonable risks which can occur/be allowed during project tendering. The allowable of risk would be advantage to the effectiveness of the BQ as it will be priced by the contractors during tendering period. This provides security and minimises the risk to all parties, contractors and clients.

4. Conclusions

There are 5 problems with the BQ, which are the inaccurate information provided in the BQ, the time-consuming nature of BQ preparation, the costly BQ preparation, the fact that the BQ can only be applied to the traditional procurement method, and others (the benefit of the BQ is not fully utilised by project teams, the BQ does not include the information on reasonable risk, and the BQ does not encourage/is not encouraging input from builders). Based on the quantitative content analysis, inaccuracy of information is the most recurring problem that has been mentioned by most of the previous researchers and should be highlighted and concerned with improvement. There are three important cores discovered that contributed to the inaccuracy of the BQ, which are the unit rate, quantities and descriptions. The main causes of the accuracy of the BQ are errors and mistakes made by humans, such as overlooking information, misprints, duplication of information, missing information, and lack of knowledge, skills, and experience.

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