THE USE OF SCHEDULES OF QUANTITIES IN PROVIDING FINANCIAL MANAGEMENT IN CONSTRUCTION PROJECTS

Grant Bryan Jackson
Student Identification Number: 1325256

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ABSTRACT

The Schedule of Quantities (SOQ) emerged after the industrial revolution of the 19th century in Europe however due to the popularity of alternative procurement methods, their use over the past 20 years has dramatically decreased. The literature noted that a SOQ is considered the most misunderstood facet of construction contracts and there is a belief by some clients that a SOQ is an additional cost that produces no benefit to the project. The misunderstanding is further compounded by the perception that a SOQ can become a key source of variations due to potential measurement errors. However the literature also presented a conflicting view whereby the benefits of a SOQ are clearly demonstrated. These benefits include providing financial management in the form of cost certainty and control. Due to these conflicting views, the objective of the research was to obtain client representative feedback on the efficacy of a SOQ in providing financial management. The research method was in the form of semi-structured interviews which comprised a questionnaire collecting both quantitative and qualitative data from client representatives. The overall findings demonstrate the use of a SOQ to be effective for financial management because it provided a documented price containing the proposed scope, quantity and cost for a project. Furthermore the SOQ provided numerous financial management benefits which extend throughout the duration of the project. These benefits include a fair basis for the comparison of contractors’ tender submissions, an effective variation management tool, basis for progress payment evaluation, a useful cost database for future estimation purposes, together with other beneficial uses.
CONFIDENTIALITY STATEMENT

The author has agreed that all personal and company names of participants in this research will be kept confidential. The identity of participants is maintained through the use of labels, e.g. Participant No.1.
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<table>
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<th>Abbreviation</th>
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<td>SOQ</td>
<td>Schedule of Quantities</td>
</tr>
<tr>
<td>QS</td>
<td>Quantity Surveyor</td>
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<td>PQS</td>
<td>Professional Quantity Surveyor</td>
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1 INTRODUCTION

1.1 Introduction

This chapter introduces the research subject and outlines its significance. The chapter identifies the research question and its context in the construction industry.

1.1 Schedule of Quantities and Financial Management

A SOQ:

*is a document that contains descriptions and/or measurements of all items of work required to carry out a given construction project...is compiled from information provided in drawings, specifications, conditions of contract and like documents prepared by the designers. It should be presented in a form to suit trade/industry pricing and tendering practice (generally without need of further measurement) and to suit the monetary administration and financial control of construction projects. (Standards New Zealand, 1995, p. iii)*

SOQ emerged after the industrial revolution of the 19th century in Europe however their use over the past 20 years has dramatically decreased. This decline in use is considered to be due to SOQ being outdated and no longer required in the current procurement market due to the popularity of the design-build model. The literature presented conflicting findings on the use of a SOQ, being (1) an additional cost that produces no benefit to the project compared with (2) a key document during the pre-contract and post-contract phases of a project for financial management.

Financial management is the ability to monitor and control all money related issues. For effective financial management it is important to identify what, when and why costs will be incurred during the project life.
1.2 Research

There appears to be a lack of research in regards to the linkage between a SOQ and effective financial management. Furthermore, the literature presents conflicting arguments in regards to the benefits of a SOQ for financial management. The literature notes that there is a perception that clients believe a SOQ is an additional cost that produces no benefit to their project. This researcher sets out to explore this perception so that the efficacy of a SOQ for financial management can be determined. The study will address: What are client representative perceptions on the efficacy of a Schedule of Quantities in achieving financial management?

This research will expand on the body of knowledge in the area of SOQ from the viewpoint of a client representative and how such a document can be used in the financial management of a construction project. This research is of significance because current literature presents conflicting views on the benefits of a SOQ. The value of this research will help client representatives better understand the potential uses of a SOQ for financial management.

1.3 Report Structure

This research report is structured as follows:

Chapter 2 contains a review of the literature on the effectiveness of a SOQ specifically the documents characteristics and uses. The topic of financial management is also reviewed.

Chapter 3 contains information on the research methodology used to solve the research question. The chapter discusses the research design, data collection method and type of analysis. It also covers reliability, validity, data management and ethics.

Chapter 4 presents the data collected.

Chapter 5 discusses the quantitative and qualitative findings and links them to the existing literature.
Chapter 6 presents a summary of the research including the methodology used, the significant findings, the overall conclusion, the limitations and areas of future study are suggested.

Appendix A includes the questionnaire.

Appendix B contains the sanitised data.


2 LITERATURE REVIEW

2.1 Introduction

Although SOQ have existed for a long period of time and have been widely used in the construction industry, there is only a limited body of research available concerning the value and effectiveness of a SOQ. Chapter 2 presents a review of the available literature regarding the use of a SOQ. Initially, the SOQ and financial management are defined and a brief history provided on the development of a SOQ. The research goes on to outline perceived criticisms of a SOQ. Then the characteristics and uses of a SOQ are identified and expanded upon.

2.2 Schedule of Quantities

2.2.1 Definition

A SOQ is defined as:

- a document that contains descriptions and/or measurements of all items of work required to carry out a given construction project...is compiled from information provided in drawings, specifications, conditions of contract and like documents prepared by the designers. It should be presented in a form to suit trade/industry pricing and tendering practice (generally without need of further measurement) and to suit the monetary administration and financial control of construction projects. (Standards New Zealand, 1995, p. iii)

A SOQ is similarly defined by Rashid, Mustapa and Wahid (2006) as a document detailing qualitative and quantitative aspects of a proposed construction project. They also define it as a document containing information about the type, nature and quantities of the finished work in a proposed construction project.

Furthermore, Davis, Love and Baccarini (2009) define a SOQ as a document that itemises work in a construction project usually prepared by the client’s Quantity Surveyor and based on detailed drawings and specifications. They also state that a
Schedule of Quantities has two primary uses, being pre contract – assisting contractors in establishing their tender price and post contract – assisting Quantity Surveyors value progress payments and assess variations.

Davis et al (2009) go on to define the circumstances in which a SOQ shall be commissioned. They believe that a SOQ shall be used when the estimated saving on the tender price is believed to be higher than the Professional Quantity Surveyors (PQS) fee for preparing the schedule. They also recommend the use of a SOQ for alteration projects and/or those complex in nature. However they argue that a SOQ shall be utilised for projects with estimated construction costs in excess of $2 million that are less complex in nature. Blyth (2001) argues that SOQ shall be encouraged as good practice and be commissioned for projects estimated to cost greater than $1 million.

2.2.2 History

The Schedule of Quantities emerged after the industrial revolution of the 19th century in Europe. At this time the Quantity Surveyor measured the work after completion for use in making payments to workers. Processes were later established where the owner of the proposed building called for tenders from contractors who prepared a form of Schedule of Quantities to reach their proposed contract value. The contractors realised that they were duplicating a lot of effort by each measuring the same quantities from the documentation and recognized it was more economical for a group of contractors to employ and share the cost of a Quantity Surveyor to measure the proposed work and prepare a Schedule of Quantities. Each contractor then priced the Schedule and submitted their tenders based on the same scope and quantities. The owners of the proposed buildings realised that as they were ultimately paying for the Quantity Surveyor to prepare the Schedule they might as well directly employ the Quantity Surveyor. Since these early developments, the Schedule of Quantities hasn’t dramatically changed apart from updated methods of measurement and the advent of information communication technology (Rashid, Mustapa, & Wahid, 2006).
2.2.3 Criticisms

The greatest misunderstood facet of construction contracts according to Blyth (2001) is the use of a SOQ. Davis et al (2009) take the same viewpoint. Blyth (2001) argues that the misunderstanding comes from the fact that clients believe a SOQ is an additional cost that produces no benefit to their project. They go on to state that when a SOQ is utilised, errors in quantities are a key source of variations. Boon (2008) supports Blyth’s (2001) argument and states that commercial clients in the nineties believed a SOQ was an unnecessary expense and did not want to accept the risk on documentation (quantity) errors. He did however suggest that since the nineties a significant re-growth in their use had taken place. Taking the argument further on the use of SOQ, the results from Wilkinson’s (1995) research suggests that PQS practices were less interested in the production of SOQ and its future was non-existent. Cartlidge (2009) also supports this argument and believes that the number of contracts procured using a SOQ has declined sharply in the last 20 years. He goes on to state that the decline is due to SOQ being outdated and no longer required in the current procurement market. Boon (2008) and Burnside & Westcott (1999) take Cartlidges (2009) argument a step further stating the decline is due to the use of design-and-build procurement methods that do not require SOQ to be prepared in accordance with standard method of measurement (SMM). However Burnside and Westcott (1999) point out that schedule production not to SMM is requested by design-and-build contractors.

Back to the misunderstanding of SOQ, Rashid et al (2006) notes that the operational use of them ends when the contract has been let and often get stored away to collect dust. Rashid et al (2006) strengthen their argument and state that the full potential of a SOQ is not understood because it exceeds most people’s knowledge.

2.3 Financial Management

2.3.1 Definition

Financial management is the effective control of all monetary related issues associated with a project. The areas include “controlling expenditure, advising on cash flow and payments” (Ashworth, 2004, p. 514). Similarly Burtonshaw-Gunn
(2009) described financial management to be understanding what, when and why costs will be incurred before the project commences and then during the project knowing “what costs have been incurred... when this expenditure happened and what future costs are planned.” (Burtonshaw-Gunn, 2009, p. 157)

2.4 Pre-Contract Schedule of Quantity Characteristics/Uses

2.4.1 Facilitates Design Quality Management

Blyth (2001), Davis et al (2009) and Potts (2004) perceive design quality management as a pre-contract advantage to procuring a SOQ. Firstly Potts (2004) believes that procuring a project through a SOQ pushes the design team to complete the design before scheduling can commence, fore well knowing that if it is not complete questions will be raised within the consultant’s project team.

The design quality management aspect can be viewed as follows. “The process of producing a BOQ (SOQ) requires the QS to interrogate the design and specification. Enabling the QS to identify inaccuracies in drawings and specification prior to tender, and the subsequent reduction in post contract problems” (Davis et al, 2009, p. 102). Blyth (2001) goes one step further likening the QS preparing the SOQ to a funnel, whereby all project documentation and information is channelled and reviewed for inclusion into the SOQ from a detached perception, free of vested interested. Blyth (2001) describes the channelling and reviewing process as providing the client with a de-facto QA auditor on behalf of all design consultants, picking up discrepancies and errors between various design disciplines. He believes the process also includes ensuring individual design disciplines drawings and specifications do not contradict one another. Blyth (2001) also believes that the design quality management process is an extension of cost planning, allowing the review of design scope against confirmed budgets. Another extension of the cost planning process in preparing the SOQ is the ability to identify savings, if required in the future, to ensure budget is met. Blyth (2001) also suggests that through the measuring process, Quantity Surveyors have the ability to identify buildability issues. This process occurs at the time of SOQ preparation before the project is issued for tender potentially reducing variations to contract.
2.4.2 Tender Assessment

A large body of research indicates tender assessment to be a pre-contract advantage to procuring a SOQ. The study by Blyth (2001) argues that a SOQ provides tenderers a common basis of quality and quantity to compete for the proposed project, potentially resulting in more competitive pricing. Davis et al (2009) agree with this argument and believes the SOQ simplifies tender assessment due to the documents structured format. Rashid et al (2006) agrees with this argument, stating it facilitates competitive tender prices through fair bidding on precisely the same basis. Cartlidge (2009) also agrees, adding that the SOQ is unsurpassed as a procurement tool to gain competitive bids even though previously expressing criticisms against it. Finally, Kodikara, Thorpe & McCaffer (1993) reinforce the argument and state the SOQ primary use is during the tendering process.

This argument is reinforced further by the fact that “where a BOQ (SOQ) is not provided, each tenderer prepares its own quantities and the principal cannot be sure that tenders are compared on the same basis. The absence of a BOQ (SOQ) may lead to greater variability, increased risk in estimating and more disputes” (Davis et al, 2009, p. 102).

2.4.3 Increases overall project cost

Research carried out by Davis et al (2009) suggests the use of a SOQ increases the overall project cost. They believe that “tenderers may ignore the specification” (Davis et al, 2009, p. 103) and price the job as per the SOQ without reading it in amplification to the specification. Davis et al (2009) suggest that contractors may underprice the works and later run the risk of poor performance and quality in-order to limit their losses. There is also the argument that the PQS fees for preparing the SOQ contribute to an increase in overall project cost. Blyth (2001) takes the argument a step further and argues that the increase in overall project cost is heightened as some contractors are not experienced enough with SOQ and may not provide their subcontractors with the relevant pricing documentation.

Taking the argument in a new direction is Blyth (2001), Davis & Baccarini (2004) and Davis et al (2009) who argue that a project tendered on a SOQ provides more
competitive tenders. Blyth (2001) defends his argument stating that the competitiveness of a contractor’s bid is affected by tenderers perception of the potential risk involved. Consequently the prices become more competitive for projects with less potential less risk. If the project is procured where a SOQ is included as a contract document, the risk to tenderers is reduced and therefore it is perceived that the client saves money. Davis & Baccarini (2004) support this argument and estimate savings to tender prices of approx. $140k on medium complexity projects to the value of $10million with a SOQ prepared for approx. $60k. This suggests that the clients re-coup the SOQ preparation fee and that in order to have an effective SOQ produced a reasonable PQS fee needs to be provided. Davis et al (2009) also support Blyth’s argument and go one step further stating that tender prices can be lowered by approx. 2.5% on simple projects not exceeding A$5million. While approx. 4.2% can be saved on projects greater than A$5million. They extend the argument further by suggesting that reductions in tender prices are produced by the decrease in cost incurred by tenderers in not having to measure the works. Blyth (2001) also argues that contractors receive more subcontractor pricing and is consequently covered by a smaller price range. Once again Davis et al (2009) take this argument a step further and believe that with a greater number of subcontractor prices, due to the use of a SOQ, savings of approx. 12% are realised.

2.4.4 Increases overall project time

There is an argument that the duration of time required to prepare a SOQ increases the overall pre-tender documentation period, according to Blyth (2001), Davis et al (2009) and Rashid et al (2006). Drawing upon the above, Rashid (2006) takes the argument a step further and argues that the ‘taking off’ process has developed from the monotonous manual processes to computer based measuring packages including sophisticated on-screen measuring software packages, all contributing to a reduction in production time. They do however reinforce that the process still involves the time consuming process of toiling through drawings and specifications, raising queries and clarifications, editing and printing hundreds of pages.
Furthermore, the preparation is extended due to the tedious task of ‘taking-off’ with research showing that “80% of building costs... contained in 20% of the BOQ (SOQ) items” (Wood & Kenley, 2004, p. 293).

Blyth (2001) and Davis et al (2009) take the argument in a new direction by stating that the tendering time is in-fact reduced due to the use of a SOQ. Blyth (2001) defends his argument, stating that as the quantities have been measured by the PQS, the contractor can focus on pricing the works, particularly on large projects. Davis et al (2009) defend their argument, stating that contractors believe the use of a SOQ speeds up their tendering time with subcontractors which is ultimately passed onto the client.

2.4.5 Preparation Cost

As discussed in 2.4.3, there is an argument that the PQS fees for preparing a Schedule of Quantities contributes to increasing the overall project cost. According to Blyth (2001) PQS fees for preparing a SOQ is approx. 0.5% of the construction cost. Therefore on a project with a construction value of $10million, the SOQ preparation fee is approx. $50,000. The argument against the preparation cost, also as discussed in section 2.4.3, is there are potential savings in tender prices.

2.4.6 Design Documentation Quality

The production of a SOQ is heavily reliant on the completion of design documentation to provide the client with cost certainty prior to the commencement of construction (Odeyinka and Kelly, 2009). Potts (2004) supports this argument, adding that when a SOQ is part of the procurement method, the design team is forced to complete their documentation before preparation of the SOQ can commence.

Davis et al (2009) takes this argument a step further, believing that the preparation of a SOQ has become a problematic activity due to the poor quality of tender documentation produced, with some drawings un-interpretable. Blyth (2001) supports this argument and takes it one step further arguing that due to the quality of documentation, the ability of the SOQ to reflect tender documents has been affected. He also argues that the production of SOQ has become difficult with design
consultants supplying generic specifications to cover trades. Boon (2008) suggests that the reduction in use of SOQ is linked to the fact that stakeholders are not prepared to accept the risk of commissioning a SOQ from mediocre design documentation.

Furthermore, Davis et al (2009) adds that clients need to be aware and allow a realistic time period for the production of complete design documentation and subsequently an accurate SOQ that provides cost certainty. They believe that the extra time spent preparing a SOQ is compensated by a potential reduction in the tender period.

2.5 Post Contract Schedule of Quantity Characteristics/Uses

2.5.1 Variation Management

Variation management is perceived as post-contract advantage to procuring a SOQ. It is believed the SOQ is a key document in the valuation of variation orders (Blyth, 2001; Davis et al, 2009; Potts, 2004; Rashid, 2006). The argument is taken as the cost of variations is reduced due to the use of SOQ rates (Blyth, 2001; Davis et al, 2009). Furthermore, the SOQ reduces disputes over variations (Blyth, 2001) as the document clearly identifies the change from time of tender (Economic Development Committee (Victoria), 1994 as cited in Davis et al., 2009), in turn reducing the negotiation of variation orders (Ramus & Birchall, 1996 as cited in Davis et al., 2009).

2.5.2 Progress Payment Evaluation

A large body of research indicates that a priced SOQ is a useful document in the valuation of interim progress payments (Blyth, 2001; Davis et al, 2009; Potts, 2004; Rashid et al, 2006). Blyth (2001) extends his argument further stating that through the use of a SOQ, the financial structure of the contract is identified allowing progress payment to be evaluated accurately. Davis et al (2009) take this argument further calling the priced SOQ a post contract administrative tool that allows for the straightforward and reliable calculation of progress payments. They support their argument further, believing that the accurate calculation of interim progress payments on projects provides principal, contractor and stakeholders certainty that the
certification matches work complete on site (Australian Institute of Quantity Surveyors, 2001 cited in Davis et al., 2009).

### 2.5.3 Unit Rates

The priced SOQ comprises of rates for each item of work and are called unit rates. As discussed in sections 2.5.1 and 2.5.2 a priced SOQ is a useful post contract administration tool. However the unit rates forming a priced SOQ can be questionable according to Davis et al (2009) for several reasons. They argue that contractors can improve cash flows by increasing unit rates on early trades (e.g. excavation or concrete) while reducing unit rates on later trades (e.g. siteworks). Furthermore, they believe that some contractors adjust the rates of items included in client commissioned SOQ that they estimate had an error. Assuming they win the contract and there was a quantity error, the contractor would claim the variation at the inflated unit rate included within the priced SOQ and therefore making a win. Potts (2004) echoes this argument and takes it a step further believing extra risk is transferred to the client. Risk is increased if the adjusted unit rates are not picked up by the PQS, potentially exposing the client to inaccurate progress payment valuations and inflated SOQ error (discussed in section 2.6.4) variations.

### 2.5.4 SOQ Errors

A large body of research indicates that SOQ errors causing variations are a disadvantage of using a SOQ as they expose the client to increased risk (Blyth, 2001; Brewer, 1998; Davis et al., 2009; Potts, 2004). Potts (2004) extends the argument further stating that SOQ errors causing variations are the main disadvantage of using a SOQ. A SOQ comprise a lot of detail from various design discipline documentation, meaning “there is a significant chance of finding errors, omissions and discrepancies between drawings and the BOQ with consequent dispute” (Davis et al, 2009) “outweighing the advantages of BOQ’s (SOQ)” (NSW legislative Council, 1991 as cited in Davis et al., 2009, p. 104). Brewer (2009) echoes this argument and believes uncertainty in SOQ arises from unclear rules regarding the preparation of SOQ resulting in the inclusion of inaccurate items. Drawing upon Brewer, Blyth (2001) believes if the SOQ is not prepared according to SMM, variation claims may arise.
Blyth (2001) goes onto state that any errors/under measures in the SOQ are treated as variations.

Furthermore, Blyth (2001) takes the argument in a new direction to point out that clients perceive errors/under measures in the SOQ as a complete extra to the contract, when in fact they are not paying again for something they already have. Additionally, errors/under measures do not cause a large number of variations (Australian Institute of Quantity Surveyors, 2001 cited in Davis et al., 2009).

2.6 Other Schedule of Quantity Characteristics/Uses

2.6.1 Provides cost database

Upon the PQS completing the SOQ, the project goes out to tender, contractors price the job, submit their tender along with a priced schedule. The priced SOQ forms an important database of construction for not only the current projects for the valuation of progress payments and variation management as discussed in sections 2.5.1 and 2.5.2 above (Blyth, 2001). The document also becomes a cost database for future estimating purposes (Davis et al, 2009).

2.6.2 Basis for fee calculation

According to Davis et al (2009) consultant fees can be calculated through the use of a SOQ.

2.6.3 Provides data for insurance purposes

According to Blyth (2001) a priced SOQ forms an accurate source of information in assisting clients with arranging general insurance cover and insurance replacement costs.

2.6.4 Asset Management

Asset management involves the preparation of an asset register for depreciation purposes. According to Blyth (2001) and Davis et al (2009) a priced SOQ forms an
accurate source of information to prepare an asset register. Items within the schedule can be directly transferred between documents.

### 2.6.5 Maintenance Profiles

The use of a SOQ by the client and consultant team is not limited to the construction phase of the development. Its use has the potential to extend into the buildings occupation and management phase (Wordsworth, 1996). A case study was carried out by Wordsworth (1996) to investigate if a SOQ could be transferred from a document utilised during the construction phase to the occupation and management stage of a £6m university library in the Liverpool, United Kingdom. The initial findings of Wordsworth’s research was along with a post practical completion survey of the building, the SOQ could be adapted “into a detailed and costed 60 year maintenance profile, indicating probable life spans of the buildings components, their estimated replacement costs (at a present value), and which highlighted any expected difficult or costly areas of maintenance” (Wordsworth, 1996, p. 1). This demonstrates to clients that the life of a SOQ does not end once the building is occupied, therefore ultimately improving the clients’ value for money in commissioning a SOQ.

Wordsworth (1996) did however argue that the information contained within the SOQ was too detailed but at the same time not location specific to assist in preparing a maintenance profile.

### 2.6.6 Cost Reporting

The perceived advantages and disadvantages of using a (priced) SOQ have been outlined above in relevant sections. Another perceived advantage of using a priced schedule is the ability to provide accurate cost reporting to the client throughout the project (Blyth, 2001; Rashid et al, 2006).

Upon completion of the SOQ by the PQS, the project is issued for tender. During this time the PQS can prepare a pre-tender estimate to inform the client of the expected tender price. The PQS prices his pre-tender estimate from the company’s cost database, adjusting rates where necessary to match the present market conditions.
This process also allows the PQS to review the actual scope to what was allowed for during the cost planning stage and to identify to the client where changes have occurred (Blyth, 2001).

The main concern of development stakeholders according to Rashid et al (2006) is to ensure their projects are completed on time, to the specified quality and within budget. However stakeholders now wish to be kept informed regarding the financial status of their project. The cost information contained within the SOQ allows the PQS to prepare regular accurate cash flow updates, periodic project account information and variation cost data (Rashid et al, 2006).

### 2.6.7 Procurement

The use of a SOQ in the procurement of a project is only appropriate for the traditional design-bid-build system. The disadvantage of this system is that the procurement method is strict, not allowing contractors to readily submit alternatives that have the potential to provide the client with savings (Davis et al, 2009).

However it could be argued that the information contained within a SOQ provides an effective value management tool.

### 2.7 Summary

SOQ emerged after the industrial revolution of the 19th century in Europe however their use over the past 20 years has dramatically decreased. This decline in use is considered to be due to SOQ being outdated and no longer required in the current procurement market. The current market promotes the design-build model whereby the client’s risk is transferred to the contractor and there is no requirement to prepare a SOQ. The literature notes that SOQ are considered to be the greatest misunderstood facet of construction contracts. This misunderstanding comes from the fact that clients believe a SOQ is an additional cost that produces no benefit to their project. This misunderstanding is further compounded by the belief that when a SOQ is utilised, errors in quantities can become a key source of variations and are considered a complete extra to the contract. Conflicting views are presented in some literature.
whereby the benefits of a SOQ are clearly demonstrated. These benefits include providing financial management in the form of cost certainty and control. The SOQ provides financial management throughout the project’s duration. An example is variation management where the SOQ is a key document in the valuation of variation orders. This is directly in conflict with the view expressed above. Due to these conflicting views the researcher wished to obtain client representative feedback on the efficacy of a SOQ in providing financial management. This research will address the question of: What are client representative perceptions on the efficacy of a Schedule of Quantities in achieving financial management?
3 METHODOLOGY

3.1 Introduction

This chapter explores the research methodology used to determine the efficacy of a SOQ in achieving cost management in construction projects. The chapter comprises a summary of the study this current research has been adapted from; discusses the purposes of the current research, data collection methods, the questionnaire, reliability, validity, ethics and how the data was analysed.

3.2 Research Design

The research investigated the efficacy of Schedules of Quantities in achieving cost management.

The research objectives were to identify perceptions amongst client representative’s on the efficacy of Schedules of Quantities and to rank and compare its characteristics in achieving cost management in construction projects. Selected results were compared to a similar study carried out within Australia which is detailed in section 3.2.1. To allow sections of the results to be comparable, the design of this research is similar to that carried out by Davis et al (2009).

3.2.1 Davis, Love and Baccarini’s (2009) Research

The research undertaken by Davis, Love and Baccarini was carried out in Australia and the data was collected from members of the Australian Institute of Quantity Surveyors (AIQS). The data collection method was in the form of a Questionnaire which was hosted on the AIQS website, with members receiving a global email notifying them of the questionnaire. The website informed members of the questionnaire instructions and advised them on the method of return to the researcher. The questionnaire was made available for members to answer over a two week period.
The first part of the questionnaire collected demographic data to allow the results to be filtered and further analysed into groups. The second part of the questionnaire asked respondents which measurement method was most commonly used to procure projects. While the third part, asked respondents to rate the important uses of Schedule of Quantities by using a 5 point Likert scale. Based on the results and analysis, it can only be assumed that the scale meant the following, 1 = not at all important to 5 = very important. The findings were generally analysed in a qualitative manner apart from calculating the mean score for each use characteristic.

3.2.2 Current Research

To achieve the objective of the current research, the most suitable method of data collection was in the form of an interview survey based upon a questionnaire. The questionnaire was adapted from Davis et al (2009) to enable the comparison of results. The theory and justification for selecting this research method is detailed in the sections below.

The purpose of the research is confirmatory and exploratory. Confirmatory research asks what is really happening now. While exploratory research asks is what we knew in the recent past still relevant today. This research fits under both categories because similar research has been undertaken in another country and this study aims to compare results making it confirmatory research and exploratory because no research on the efficacy of Schedules of Quantities as a tool in achieving financial management from the client representatives’ perspective appears to exist.

This research is a cross-sectional clarification investigation, confirming the perceptions of client representatives’ of what is happening in the construction industry now.

The type of data required to carry out the proposed research is in the form of quantitative and qualitative data. Quantitative data is defined by Fellows and Liu (2003) as factual data collected to study relationships between facts and how those facts and relationships compare with the results of previous literature. Denscombe (2003) believes the advantages of quantitative data include:
The ability to carry out statistical analysis providing scientific reliability;
- Data can be checked by others for authenticity;
- Large quantities of data can be processed and interrogated quickly; and
- The findings can be communicated effectively through tables and charts.

On the other hand the disadvantages of Quantitative data according to Denscombe (2003) include:
- The quality of data can vary depending on the use of research methods;
- Data overload; and
- The researchers ability to influence analysis.

Qualitative data is defined by Fellows and Liu (2003) as data that investigates the opinions, beliefs and views of people to understand their perceptions of the world. Denscombe (2003) believes the advantages of Qualitative data include:
- In-depth study provides rich and detailed data;
- Allows for further explanation from participant;

On the other hand the disadvantages of Qualitative data according to Denscombe (2003) include:
- Findings can be difficult to generalize with previous literature;
- Researchers opinions can affect data collection and analysis;
- Establishing themes in the data can be difficult when several outlying results exist; and
- The analysis of data can be a time consuming process.

Through the use of an interview survey based around a Likert Scale questionnaire both quantitative and qualitative data was collected. A Likert scale is qualitative data and provides respondents perceptions on the subject, presented in a quantitative manner through a 5 point scaling system (refer section 3.3.2 for further detail).

The quantitative data collected is simply the respondents rating of various factors around the use of Schedule of Quantities in effectively achieving project requirements and does not allow an in-depth statistical analysis of the results. From this data method collection the main form of analysis is qualitative. Nevertheless limited
quantitative data analysis does take place in the form of tabulating the frequency of each response and allowing for further discussion in the qualitative analysis section.

Through the use of both quantitative and qualitative data a triangulated study is introduced. This approach “reduces(s) or elimante(s) disadvantages of each individual approach whilst gaining the advantages of each” (Fellows & Liu, 2008)

3.3 Methods

3.3.1 Data Collection

As briefly outlined above, the data collection method for this research was in the form of a survey with a questionnaire as the research instrument. Surveys are most appropriate when:

1. “Clear and narrow targets” of information are required to be collected;
2. Researcher knows what factors are important and what kind of information is required;
3. Data is required on “relatively straightforward, relatively uncomplicated facts, thoughts, feelings or behaviours”; and
4. Data is required on patterns of activity within groups or categories.

(Denscombe, 2003)

Each of the above items apply and are appropriate to the present research for the following reasons:

1. Clear and narrow target is the perceptions on the use of a Schedule of Quantities;
2. The important factors are the use factors of a Schedule of Quantities and the information required is respondents opinions through a Likert scale adapted from Davis et al (2009) of the use factors;
3. The data required is neither complicated nor sensitive;
4. A demographic section is required to analyse patterns of activity among different groups. (e.g: Greenfield Vs. Brownfield)

Three survey strategies exist and include: the telephone survey, the postal survey and the interview survey. The interview survey strategy has been chosen due to limitations
of data collection methods by the Unitec Research Committee. A face-to-face interview survey strategy provides high response rates and improved reliability according to Naoum (2007) and Neuman (1997). While Denscombe (2003) believes the dis-advantages of a face-to-face interview survey is they are costly with increased time and travel commitments compared to other survey strategies.

There are three different face-to-face interview structures which are listed and detailed below:

1. Structured Interview – tightly controlled interview with a pre-determined list of questions and answers (closed questions) for the interviewee to offer limited response, similar to a posted questionnaire except done face-to-face;
2. Semi-Structured Interview – medium controlled interview a pre-determined list of questions (closed and open questions) allowing the interviewee to expand on topics and provide further insight into the topic;
3. Unstructured Interview – little control allowing interviewer to introduce topics and themes to get the interview rolling and the interviewee to develop their thoughts and ideas. (Denscombe, 2003)

The most appropriate interview structure for my research data collection was semi-structured interview as the research instrument is basically a questionnaire with open ended questions.

The semi-structured interviews were recorded and transcribed.

3.3.2 The Questionnaire

The questionnaire was adapted from the Likert scale presented in Davis et al (2009). It comprised twenty SOQ characteristics/uses which have been slightly modified and added to following findings from the literature review.

The questionnaire is broken down into two sections and comprises a demographic section and the Likert scale and is covered in further detail below.
The length of the questionnaire has been developed with guidance from Denscombe, 2003, p. 161 and 162 summarised below:

- Only ask questions that are critical for the research;
- Develop the questions to ensure a straightforward and speedy response from participants;
- Undertake a pilot questionnaire;

The wording of the questionnaire has been developed with guidance from Denscombe, 2003, p. 163 and 164 summarised below:

- Ensure wording of questions is unambiguous;
- Ensure questions are specific and not vague;
- Use minimal amounts of technical jargon;
- Ensure wording of questions is suitable for the target group;
- Ensure questions are short and concise;
- Avoid leading questions (questions that prompt the participant to provide a particular answer); and
- Avoid the use of words that may cause offence to the participant.

3.3.2.1 Section A

The purpose of the questionnaire’s first section was to collect demographic information on the interviewee and their previous experience with a Schedule of Quantities. Questions included:

1. Occupation – to analyse perceptions based on occupation;
2. Experience – to analyse perceptions based on industry experience;
3. Schedule of Quantities use in last five years – to analyse perceptions based on the recent use of a Schedule of Quantities;
4. Sector Experience – to analyse perceptions based on the sector (i.e. Public and/or Private); and
5. Project value with Schedule of Quantities – to analyse perceptions based on project value.
3.3.2.2 Section B

The purpose of the questionnaire’s second section was to collect information on the perceptions held by client representatives on the use of a Schedule of Quantities and its effectiveness as pre and post contract tool to achieve project requirements.

A five point category Likert scale is used to measure the importance on the use of a Schedule of Quantities. The rating system is as follows:

1. not at all effective
2. of limited effectiveness;
3. moderately effective;
4. effective; and
5. very effective.

The characteristics included in the Likert scale were adapted from the scale used in the research by Davis et al (2009). A qualitative question was included to allow participants to add any further characteristics of Schedules of Quantities that they considered effective in achieving cost management. Qualitative questions were included to provide further insight on why participants ranked certain characteristics higher or lower than otherwise.

3.3.3 Sampling

Sampling is “the process of selecting a subgroup of population to represent the entire population”. (Glossary of Sampling Terms, n.d., p. 1)

The sampling approach used for the present research study is Non-probability convenience sampling. This approach is defined by Castillo (2009) as an arbitrary method that uses the most convenient and accessible people to the researcher.

According to Statistics Canada (n.d) the advantages of non-probability sampling include speed, and being inexpensive and convenient for the researcher. Castillo (2009) believes the biggest advantage is that the researcher can collect data and trends without having to use a randomized sample and that the approach is useful for
detecting relationships among different facts. The biggest disadvantage according to Castillo (2009) is the sample is not representative of the population.

The use of non-probability sampling is beneficial for the current research topic as it is not practical to ensure that every client representative has the chance of being interviewed. This comes down to the size and duration of the research topic.

The use of convenience sampling is beneficial for the current research topic as it allows the researcher to conveniently collect data that can be easily used to detect relationships amongst facts.

The sample size for the current research study is 7 No. client representatives.

3.3.4 Data Analysis

The demographic data contained in section A of the questionnaire was analysed and inserted into a table to understand survey participant’s industry experience and experience with Schedules of Quantities.

An in-depth analysis of the quantitative findings would provide distorted results due to the small sample size which had been restricted by the data collection method. However findings from the Likert scale in section 2 were tabulated to show the ratings for each factor, the mean calculated and the factors ranked in order of effectiveness.

The qualitative data analysis came from critiquing the results of the questionnaire and responses from questions 3 and 4 of section 2. The analysis was in the form of describing trends and conflicts found in the data and also comparing the results with findings in the literature review particularly Davis et al (2009) findings.

3.3.5 Data Management

The Likert scale in the questionnaire was split amongst the following three categories; pre-contract, post-contract and other activities as per the Likert scale adapted from Davis, et al (2009) (refer Appendix A for questionnaire and Davis, et al (2009) paper). Each characteristic in the Likert scale was numbered. The characteristics in the Likert
scale were re-coded following completion of the data collection to include abbreviations for the three categories; Pre = pre-contract, Pos = post-contract and Oth = other activities. For example characteristic No. 1 (pre-contract) was coded 1 – Pre. This coding was also used to thematically analyse the data from the interview transcripts, allowing participants perceptions to be clearly identified.

To ensure each interview was run consistently, an interview process checklist was developed and filled out as the interview progressed improving the reliability of data collected. The interview checklist comprised but was not limited to the following processes; arrange interview time with participant, participant reads information form, signs consent form and ask participant if they wish to receive a copy of transcript or report upon completion.

Denscombe (2010) suggested that supplementary notes were prepared prior to undertaking the interviews. Supplementary information was prepared for each characteristic contained within the Likert scale.

Denscombe (2010) also suggested that characteristics of the interview that could not be captured in the audio recording of the interview also be noted. Such characteristics included; the participants key points; between the lines information (i.e. participants body language, attitude, mood etc); in-consistent answers; ‘fob-off” answers; exaggerated answers and answers to simply please interviewee. Prior to undertaking the interviews, a recording sheet was prepared to note down these characteristics in addition to the audio recording.

All of the interviews were recorded on a digital audio recording device that enabled the files to be transferred to a secure private computer. The digital audio recording device ensured that the data was securely stored and accurately transcribed.

### 3.3.6 Reliability

Reliability is “whether a research study or methodology produces consistent results” *(Reliability and validity in research, n.d., p. 1)*. Reliability in research is concerned
with how the findings are being measured. The reliability of the current research findings are high due to the following:

1. To ensure consistent results, consistent questions were asked of participants in a semi-structured interview with the aid of a questionnaire. The questionnaire maintained a consistent approach for each interview ensuring high reliability.

2. To ensure that participant responses and behaviour were not influenced by their relationship with the researcher, relationships including employee/employer and relatives were avoided. This was achieved through the use of convenience sampling reducing the risk of this occurring and in turn increasing the reliability of the results.

3. To ensure participant responses and behaviour were not influenced by the location of the semi-structured interview, each interview took place in the respective participants office meeting room. This ensured a quiet location with no distraction for both parties and allowed clear audio recordings to be accurately transcribed.

The demographic questions in the questionnaire doubled as a data analysis tool as well as a reliability check. The questions determined the participant’s knowledge and experience working with SOQ and ensured the information they were providing was credible.

Questions 3 & 4 of the questionnaire ensured the use of triangulation to improve the credibility of the data by asking participants to justify why they gave certain factors a higher ranking than others and vice-versa.

3.3.7 Validity

Validity in research “is concerned with what is being measured, and how well that fits with the process of how it is measured” and is broken down into two types – internal and external (Reliability and validity in research, n.d., p. 2).
1. The internal validity of the current research question was relatively high as the data collection instrument was adapted from a previous study carried out by Davis et al (2009).

2. The external validity of the current research question was relatively low as the sample size was small and selected for convenience therefore the results cannot be generalized to the population.

3.3.8 Ethics

Throughout the research, design and implementation research ethics were considered. There are two parts to research ethics – harm minimisation and informed consent.

Harm minimisation is defined as “participants must not be subjected to unnecessary risk of harm as a result of their participation” (Research ethics – core principles, n.d, p. 1). The privacy of the participants was respected and given the choice to participate and interviews were arranged to suit them. Confidentiality was strictly adhered to with participants not being named. The data required is not commercially sensitive but purely participants’ opinions, however participants were assured that the data would be securely stored at Unitec for five years. The design of the research had high reliability as part of it was based on a previous study and the other part was been reviewed by the research supervisor. Obtaining consent from participants was addressed and the purpose of the research was explained. Questions contained in the questionnaire were carefully thought through and are justified in section 3.3.2 above. Data asked of participants was all relevant and referred to in the analysis.

3.4 Summary

The current research study has been adapted from a similar study carried out by Davis et al (2009). The chapter has detailed the objective of the research which was to compare client representative’s perceptions on the characteristics of Schedules of Quantities in achieving financial management. To meet this objective, the use of an interview survey with the aid of questionnaire was explained. The questionnaire collected both quantitative and qualitative data increasing the reliability of the data
through the benefits of triangulation. The validity of the questionnaire was relatively high as the characteristics listed in the Likert scale were adapted from the similar study. Issues surrounding ethics were detailed along with the analysis of the data collected. The next chapter will present data obtained from interview survey and questionnaire.
4 DATA

4.1 Introduction

The quantitative data gathered from the face-to-face semi-structured interviews is presented in chapter 4. These interviews were conducted with client representatives from different construction industry backgrounds.

4.2 Responses / Participant Information

As discussed in chapter 3, the questionnaire comprised two sections. The first section, questions 1 to 5 collected demographic data on the survey participants.

Referring to Figure 1, four out of the seven participants were Quantity Surveyors, three currently holding positions at Professional Quantity Surveying (PQS) firms. The fourth is a contractors QS but has previous experience as a PQS. Two of the participants were Project Managers, while Participant No. 5 noted himself as a Contracts Administrator. The participants’ occupations meant they currently or previously have represented clients and all have had experience in managing or being closely involved with the financial management of commercial construction projects, hence meeting participant requirements.

![Figure 1 Participants’ Occupations](image-url)
Referring to Figure 2, out of the seven participants, three had over 20 years experience in the construction industry, while another three had 11 to 20 years. The experience of the participants interviewed suggests that their perceptions are well grounded.

**Figure 2 Participants’ Experience**
Question three asked participants to provide an approximate percentage of projects in the last five years utilising a SOQ. Participants’ use of SOQ’s ranged from 3% to 80% with a mean of 36% as seen in Figure 3 below.

![Projects utilising SOQ’s in last 5 years](image)

**Figure 3** Percentage proportion of project in last five years utilising SOQ

Question 4 asked participants to provide a sector split (private and/or public) for projects in the last 5 years utilising SOQ’s. Referring to Figure 4, six of the seven participants had 100% private or 100% public projects utilising SOQ’s. While only one participant had a mix of both, with 73% private and 27% public sector.
The final question of section 1 asked participants to advise the construction cost for projects utilising a SOQ in the past twelve months. Furthermore it advised that a total of 26 projects fitted into this category. Referring to Figure 5, fourteen of the twenty six projects fitted into the $10m plus construction cost range, while only 1 fell into the $0 to $1million range.

Figure 4 Participants SOQ use in last 5 years by Sector

Figure 5 Construction cost of projects utilising SOQ’s in past 12 months
4.3 Overall Effectiveness Scores

4.3.1 Schedule of Quantities Characteristics

Question 6 collected ratings from client representatives on the effectiveness of a SOQ in achieving financial management on construction projects. The questionnaire asked participants to rate the effectiveness of different SOQ characteristics/uses by using a five-point Likert scale (1=not at all effective, 2=of limited effectiveness, 3=moderately effective, 4=effective, 5=very effective).

The mean ratings are shown in Table 1 below. The characteristic/use with the highest mean rating score was ‘variation management’ with 4.86. ‘Unit rates’ and ‘provides cost database’ received the equal third highest mean rating score with 4.71, followed by ‘progress payment evaluation’ and ‘cost reporting’ which received the equal fifth highest mean rating score with 4.43.

Table 1 Mean Ratings of Effectiveness of SOQ characteristics/Uses (n=7)

<table>
<thead>
<tr>
<th>Key</th>
<th>SOQ Characteristic/Use</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean Rating Score (1-5)</th>
<th>D, L &amp; B Mean Rating (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Facilitates design Quality Management</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>3.71</td>
<td>3.41</td>
</tr>
<tr>
<td>2</td>
<td>Facilitates Tender Assessment</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>4.14</td>
<td>4.11</td>
</tr>
<tr>
<td>3</td>
<td>Increases Overall Project Cost</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1.71</td>
<td>2.24</td>
</tr>
<tr>
<td>4</td>
<td>Increases Overall Project Time</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>3.29</td>
<td>2.33</td>
</tr>
<tr>
<td>5</td>
<td>Preparation Cost</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>4.14</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Design Documentation Quality</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4.00</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Variation Management</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>4.86</td>
<td>4.27</td>
</tr>
<tr>
<td>8</td>
<td>Progress Payment Evaluation</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4.43</td>
<td>4.19</td>
</tr>
<tr>
<td>9</td>
<td>Unit Rates</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>4.71</td>
<td>2.93</td>
</tr>
<tr>
<td>10</td>
<td>SOQ Errors</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2.00</td>
<td>3.20</td>
</tr>
<tr>
<td>11</td>
<td>Provides Cost Database</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>4.71</td>
<td>4.07</td>
</tr>
<tr>
<td>12</td>
<td>Basis for Fee Calculation</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.86</td>
<td>2.65</td>
</tr>
<tr>
<td>13</td>
<td>Provides Data for Insurance Purposes</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2.86</td>
<td>3.07</td>
</tr>
<tr>
<td>14</td>
<td>Asset Management</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3.86</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Cost Reporting</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4.43</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Procurement</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4.00</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Pre = pre-contract activities; Pos = post-contract activities; Oth = other activities

Note: D, L & B = Davis, Love and Baccarini (2009)
The SOQ characteristic/use with lowest mean rating score was ‘increases overall project’ with 1.71. ‘Basis for fee calculation’ received the second lowest mean rating score with 1.86, followed by ‘SOQ errors’ with the third lowest mean rating score with 2.00.

4.3.2 Schedule of Quantities Characteristic Activities

Davis et al (2009) research identified SOQ characteristics/uses by three activity categories, pre-contract activities; post-contract activities and other activities. Identical activity categories have been used in this study. The characteristics/uses that make up each activity category are shown in Table 2 below. The mean value for each activity category is calculated from the relative SOQ characteristic/uses that form the respective activity category.

Table 2 SOQ characteristic/use activity efficiency mean scores (n=7)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Ranking</th>
<th>Mean Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Post Contract</strong></td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>4.00</td>
</tr>
<tr>
<td>7 - Pos Variation Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 - Pos Progress Payment Evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 - Pos Unit Rates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 - Pos SOQ Errors</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>3.62</td>
</tr>
<tr>
<td>11 - Oth Provides Cost Database</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 - Oth Basis for Fee Calculation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 - Oth Provides Data for Insurance Purposes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 - Oth Asset Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 - Oth Cost Reporting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 - Oth Procurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pre-Contract</strong></td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>3.50</td>
</tr>
<tr>
<td>1 - Pre Facilitates design Quality Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 - Pre Facilitates Tender Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 - Pre Increases Overall Project Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 - Pre Increases Overall Project Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 - Pre Preparation Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 - Pre Design Documentation Quality</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The use of a SOQ ‘post-contract’ was rated the most effective in achieving financial management with a mean rating score of 4.00. Three out of four characteristics/uses were in the top five overall ratings (refer Table 1). The second most effective activity
was ‘other’ with a mean rating score of 3.62 followed closely by ‘pre-contract’ activities with a mean rating score of 3.50.

### 4.3.3 Comparison by Occupation

**Table 3** SOQ characteristic/use efficiency ratings by occupation (n=7)

<table>
<thead>
<tr>
<th>Code</th>
<th>SOQ Characteristic/Use</th>
<th>Quantity Surveyor</th>
<th>Project Manager</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ranking</td>
<td>Mean Value</td>
<td>Ranking</td>
</tr>
<tr>
<td>1 - Pre</td>
<td>Facilitates design Quality Management</td>
<td>11= 4.00</td>
<td>7= 4.00</td>
<td>15= 2.00</td>
</tr>
<tr>
<td>2 - Pre</td>
<td>Facilitates Tender Assessment</td>
<td>11= 4.00</td>
<td>12= 3.50</td>
<td>7= 4.00</td>
</tr>
<tr>
<td>3 - Pre</td>
<td>Increases Overall Project Cost</td>
<td>16= 1.60</td>
<td>14= 2.50</td>
<td>15= 2.00</td>
</tr>
<tr>
<td>4 - Pre</td>
<td>Increases Overall Project Time</td>
<td>13= 3.40</td>
<td>7= 4.00</td>
<td>15= 2.00</td>
</tr>
<tr>
<td>5 - Pre</td>
<td>Preparation Cost</td>
<td>7= 4.20</td>
<td>7= 4.00</td>
<td>7= 4.00</td>
</tr>
<tr>
<td>6 - Pre</td>
<td>Design Documentation Quality</td>
<td>11= 4.00</td>
<td>2= 4.50</td>
<td>11= 3.00</td>
</tr>
<tr>
<td>7 - Pos</td>
<td>Variation Management</td>
<td>3= 4.80</td>
<td>2= 4.50</td>
<td>5= 5.00</td>
</tr>
<tr>
<td>8 - Pos</td>
<td>Progress Payment Evaluation</td>
<td>4= 4.60</td>
<td>12= 3.50</td>
<td>5= 5.00</td>
</tr>
<tr>
<td>9 - Pos</td>
<td>Unit Rates</td>
<td>3= 4.80</td>
<td>7= 4.00</td>
<td>5= 5.00</td>
</tr>
<tr>
<td>10 - Pos</td>
<td>SOQ Errors</td>
<td>15= 2.00</td>
<td>15= 1.50</td>
<td>11= 3.00</td>
</tr>
<tr>
<td>11 - Oth</td>
<td>Provides Cost Database</td>
<td>3= 4.80</td>
<td>7= 4.00</td>
<td>5= 5.00</td>
</tr>
<tr>
<td>12 - Oth</td>
<td>Basis for Fee Calculation</td>
<td>15= 2.00</td>
<td>16= 1.00</td>
<td>15= 2.00</td>
</tr>
<tr>
<td>13 - Oth</td>
<td>Provides Data for Insurance Purposes</td>
<td>13= 3.40</td>
<td>13= 3.00</td>
<td>16= 1.00</td>
</tr>
<tr>
<td>14 - Oth</td>
<td>Asset Management</td>
<td>7= 4.20</td>
<td>12= 3.50</td>
<td>11= 3.00</td>
</tr>
<tr>
<td>15 - Oth</td>
<td>Cost Reporting</td>
<td>5= 4.40</td>
<td>12= 3.50</td>
<td>5= 5.00</td>
</tr>
<tr>
<td>16 - Oth</td>
<td>Procurement</td>
<td>11= 4.00</td>
<td>12= 3.50</td>
<td>11= 3.00</td>
</tr>
</tbody>
</table>

The ranking of participants’ perceptions on the effectiveness of SOQ’s in achieving financial management by their occupation is shown in Table 3 above. Quantity Surveyors equally rate ‘variation management’, ‘unit rates’ and ‘provides cost database’ the most effective with a mean rating score of 4.80. The next most effective characteristic/use with a mean rating score of 4.60 was ‘progress payment evaluation’, followed closely by ‘cost reporting’ with a mean rating score of 4.40. The least effective characteristic/use perceived by Quantity Surveyors with a mean rating score of 1.60 was ‘increases overall project cost’.

Project Managers equally ranked ‘variation management’ and ‘design documentation quality’ the most effective with a mean rating score of 4.50. Five characteristics/uses were ranked the next most effective with a mean rating score of 4.00 as seen in Table 3 above. The least effective characteristic/use perceived by Project Managers with a mean rating score of 1.00 was ‘basis for fee calculation’.

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As shown in Figure 1 above, only one participant selected their occupation as other, specifically describing themselves as a Contract Administrator. Therefore the top ranked characteristics/uses are those rated by the participant as 5’s and are shown in Table 3. They notably include ‘variation management’ and ‘cost reporting’. The least effective characteristic/use perceived by this participant was ‘provides data for insurance purposes’.

4.3.4 Comparison by Experience

Table 4 SOQ characteristic/use efficiency ratings by experience cohort (n=7)

<table>
<thead>
<tr>
<th>Code</th>
<th>SOQ Characteristic/Use</th>
<th>Under 5 years</th>
<th>5 to 10 years</th>
<th>11 to 20 years</th>
<th>Over 20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Value</td>
<td>Ranking Mean</td>
<td>Ranking Mean</td>
<td>Ranking Mean</td>
<td>Ranking Mean</td>
</tr>
<tr>
<td>1 - Pre</td>
<td>Facilitates design Quality Management</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>12= 3.33</td>
<td>10= 4.00</td>
</tr>
<tr>
<td>2 - Pre</td>
<td>Facilitates Tender Assessment</td>
<td>N/A</td>
<td>4= 5.00</td>
<td>10= 3.67</td>
<td>8= 4.33</td>
</tr>
<tr>
<td>3 - Pre</td>
<td>Increases Overall Project Cost</td>
<td>N/A</td>
<td>14= 2.00</td>
<td>15= 2.00</td>
<td>16= 1.33</td>
</tr>
<tr>
<td>4 - Pre</td>
<td>Increases Overall Project Time</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>10= 3.67</td>
<td>14= 2.67</td>
</tr>
<tr>
<td>5 - Pre</td>
<td>Preparation Cost</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>6= 4.33</td>
<td>10= 4.00</td>
</tr>
<tr>
<td>6 - Pre</td>
<td>Design Documentation Quality</td>
<td>N/A</td>
<td>4= 5.00</td>
<td>7= 4.00</td>
<td>11= 3.67</td>
</tr>
<tr>
<td>7 - Pre</td>
<td>Variation Management</td>
<td>N/A</td>
<td>4= 5.00</td>
<td>4= 4.67</td>
<td>3= 5.00</td>
</tr>
<tr>
<td>8 - Pre</td>
<td>Progress Payment Evaluation</td>
<td>N/A</td>
<td>12= 3.00</td>
<td>4= 4.67</td>
<td>5= 4.67</td>
</tr>
<tr>
<td>9 - Pre</td>
<td>Unit Rates</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>4= 4.67</td>
<td>3= 5.00</td>
</tr>
<tr>
<td>10 - Pre</td>
<td>SOQ Errors</td>
<td>N/A</td>
<td>16= 1.00</td>
<td>15= 2.00</td>
<td>15= 2.33</td>
</tr>
<tr>
<td>11 - Oth</td>
<td>Provides Cost Database</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>4= 4.67</td>
<td>3= 5.00</td>
</tr>
<tr>
<td>12 - Oth</td>
<td>Basis for Fee Calculation</td>
<td>N/A</td>
<td>16= 1.00</td>
<td>16= 1.33</td>
<td>14= 2.67</td>
</tr>
<tr>
<td>13 - Oth</td>
<td>Provides Data for Insurance Purposes</td>
<td>N/A</td>
<td>14= 2.00</td>
<td>13= 2.67</td>
<td>12= 3.33</td>
</tr>
<tr>
<td>14 - Oth</td>
<td>Asset Management</td>
<td>N/A</td>
<td>12= 3.00</td>
<td>10= 3.67</td>
<td>8= 4.33</td>
</tr>
<tr>
<td>15 - Oth</td>
<td>Cost Reporting</td>
<td>N/A</td>
<td>10= 4.00</td>
<td>6= 4.33</td>
<td>5= 4.67</td>
</tr>
<tr>
<td>16 - Oth</td>
<td>Procurement</td>
<td>N/A</td>
<td>4= 5.00</td>
<td>12= 3.33</td>
<td>8= 4.33</td>
</tr>
</tbody>
</table>

The ranking of participants’ perceptions on the effectiveness of SOQ’s in achieving financial management by their construction industry experience is shown in Table 4 above. As shown in Figure 2 above, no participants interviewed fell into the under 5 years experience cohort. Also as shown in Figure 2 above, only one participant had 5 to 10 years experience. Therefore the top ranked characteristics/uses are those rated by the participant as 5’s and are shown in Table 4. They notably include ‘variation management’ and ‘facilitates tender assessment’. The least effective characteristics/uses perceived by this participant were ‘SOQ errors’ and ‘basis for fee calculation’.
The 11 to 20 years experience cohort equally ranked ‘variation management’, ‘progress payment evaluation’, ‘units rates’ and ‘provides cost database’ the most effective with a mean rating score of 4.67. The next most effective characteristics/uses with a mean rating score of 4.33 were ‘preparation cost’ and ‘cost reporting’, followed closely by ‘design documentation quality’ with a mean rating score of 4.00. The least effective characteristic/use perceived by the 11 to 20 years experience cohort with a mean rating score of 1.33 was ‘basis for fee calculation’.

The over 20 years experience cohort equally ranked ‘variation management’, ‘unit rates’ and ‘provides cost database’ the most effective with a mean rating score of 5.00. The next most effective characteristics/uses with a mean rating score of 4.67 were ‘progress payment evaluation’ and ‘cost reporting’. The least effective characteristic/use perceived by the over 20 years experience cohort with a mean rating score of 1.33 was ‘increases overall project cost’.
4.3.5 Comparison by Sector

Table 5 SOQ characteristic/use efficiency ratings by sector (n=7)

The ranking of participants’ perceptions on the effectiveness of SOQ’s in achieving financial management by their SOQ sector (public, private or mix) experience in the last 5 years is shown in Table 5 above. As discussed in section 4.2 above, participants either had experience over the last 5 years with SOQ’s in 100% private or 100% public. Only one participant had a mix, being 73% private and 27% public.

The participants who noted 100% private sector equally ranked ‘variation management’, ‘progress payment evaluation’, ‘units rates’, ‘provides cost database’ and ‘cost reporting’ as the most effective with a mean rating score of 5.00. The next most effective characteristics/uses with a mean rating score of 4.33 were ‘facilitates tender assessment’ and ‘asset management’, followed closely by ‘procurement tool’ with a mean rating score of 4.00. The least effective characteristics/uses perceived by those who noted 100% private sector with a mean rating score of 2.67 were ‘increases overall project cost’ and ‘SOQ errors’.

The participants who noted 100% public sector ranked ‘variation management’ as the most effective with a mean rating score of 4.67. The next most effective characteristics/uses with a mean rating score of 4.33 were ‘preparation cost’, ‘unit
rates’ and ‘provides cost database’. The least effective characteristic/use perceived by those who noted 100% public sector with a mean rating score of 1.00 was ‘basis for fee calculation’.

4.4 Summary

This chapter presented the preliminary data collected from the questionnaire semi-structured interviews. The demographic data was displayed. The participants’ perceptions on the efficacy of a SOQ for effective financial management of a project were presented. The next chapter will discuss these results.
5 DISCUSSION

5.1 Introduction

The chapter contains discussion on the quantitative and qualitative results of the current study. It compares findings with existing research, particularly Davis et al (2009).

5.2 Questions

As discussed in chapter 3, the questionnaire (refer appendix A) comprised nine questions. Questions one to five collected demographic information on the participants. Question six asked participants to rate the effectiveness of sixteen SOQ characteristics/uses in achieving financial management. Three open ended questions completed the questionnaire asking participants why they had given each characteristic a specific rating. Through the use of face-to-face semi-structured interviews every participant answered all of the demographic questions and rated all the characteristics/uses in the Likert scale. The majority of all participants provided a qualitative response to justify their rating given to each characteristic/use in question six. The proposed order of the interview was as per the questionnaire (refer Appendix A) however participants answered questions eight and nine during question six immediately after they had rated the SOQ characteristic/use.

It must be noted that some of the characteristics/uses contained within the Likert scale of Davis et al (2009) research were not relevant to this study and therefore excluded. However the ratings to those which are relevant are acceptable as they are based on participants’ perceptions.

5.3 Schedule of Quantities Effectiveness

Table 1 (page 33) shows the rating of SOQ characteristic/uses. The most effective characteristic/use perceived by the participants of this study was ‘variation management’ with a mean rating score of 4.86. ‘Unit rates’ and ‘provides cost database’ received the equal third highest mean rating score with 4.71. The least
effective characteristic/use was ‘increases overall project cost’ with a mean rating score of 1.71.

5.3.1 Pre-Contract Schedule of Quantity Characteristics/Uses

5.3.1.1 Facilitates Design Quality Management

The use of a SOQ as a ‘design quality management’ tool was perceived as moderately effective to effective in achieving financial management with a mean rating score of 3.71. The result is almost identical to the research carried out by Davis et al (2009) that found a mean rating score of 3.41. This result is not surprising considering Blyth (2001) described the process as a de-facto quality assurance audit on behalf of all design consultants, while participant No. 2 a QS called it effective but “not very effective... because it’s not our job, when measuring a schedule we’re not looking specifically at quality management issues, we pick them up as we come across them”. This suggests that facilitating design quality management is not the core use of a SOQ but merely a beneficial bi-product to the design team. The benefits of the process are that the QS measuring the schedule can identify discrepancies and errors not only within individual design disciplines (i.e. specification versus drawings; drawing A versus drawing B) but also between different design disciplines (i.e. architectural versus structural) (Blyth, 2001). Because of these benefits, Participant No. 3 rates the use as the “biggest single value of the schedule” despite only rating the use a ‘4’ (their highest rating). The participant adds that the process also allows the QS to flag poor material choices by the architect and the opportunity to comment on buildability. Buildability is also mentioned by Participant No. 7 in terms of design quality management and adds that “if you can’t measure it, you can’t build it”. The perception of Participant No. 6, rating the use a ‘2’ (refer Appendix B) requires noting as it is represents a clear outlier. The participant believes “it is good but it’s not a reliable tool because every QS does it slightly different and the depth of it is different” therefore limiting its effectiveness. The significance of the findings is the de-facto quality assurance audit has the ability to improve cost certainty to the client through the subsequent reduction in post contract problems (Davis et al., 2009) such as variations due to errors and discrepancies in tender documentation being eliminated at the SOQ production stage of the buildings procurement.
5.3.1.2 Tender Assessment

The use of a SOQ as a ‘tender assessment’ tool was perceived as effective to very effective in achieving financial management with a mean rating score of 4.14. The result was practically identical to the research carried out by Davis et al (2009) that found a mean rating score of 4.11. The result is not surprising considering Blyth (2001) believes a SOQ provides contractors with a common source of quantity and quality (SOQ descriptions) to price the proposed scope of works and ultimately win the contract, while participant No. 1 shares a similar perception. The participant believes that “because the trade summary is defined by the QS, who measured the schedule” the scope is defined creating “an apples for apples comparison” of contractors tender submissions. The comparison of contractors tender submissions is simplified due to the structured format of the SOQ (Davis et al, 2009). This suggests that the SOQ creates clarity on the scope of the project and a fair tendering process. The perception of participant No. 3, rating the use a ‘2’ (refer Appendix B) requires noting as it represents a clear outlier. The participant has “never had or insisted on having a (priced) schedule while... evaluating tenders... it’s... something thats followed later”. From this response it can be assumed that the participant has taken the use of a SOQ as literally having the bidding contractors priced schedules available during the tender assessment process. It suggests that for this particular participant to rate a SOQ for this selected use a priced schedule is required. The tender assessment process truly becomes difficult when a SOQ is not available because each contractor has individually measured and priced the work scope meaning the client is unable to compare tender submissions on the same basis exposing them to more risk (Davis et al, 2009). The significance of the findings is the SOQ provides the client and their representatives with improved cost certainty as they know what every contractors tender price includes and therefore the bidding contractors are competing on their ability to price the job competitively. Subsequently this provides the client with value for money and a possible reduction in contract value.

5.3.1.3 Increases overall project cost

Participants were asked whether the use of a SOQ ‘increases overall project cost’ and perceived this characteristic to be of limited effectiveness in achieving financial
management with a mean rating score of 1.71. The result was close to the research carried out by Davis et al (2009) that found a mean rating score of 2.24. The literature found perceptions from both viewpoints; a SOQ increases overall project cost and a SOQ decreases overall project cost. The result above suggests that participants believe that the SOQ is neutral or even possibly decreases the overall project cost. The characteristic comes from Davis et al (2009) who believe the overall project cost increases because contractors tendering for the project do not price the SOQ in amplification to the specification later leading to the contractor attempting to limit their losses through frivolous variation claims and a reduction in quality. From the participants interviewed, participant No. 3 gave this characteristic the highest rating with a ‘3’ as they have had “examples where the schedule... decreased (the) project cost” and “other examples where the schedule has increased project cost” due to the reason mentioned by Davis et al (2009). The result of this questionnaire is not surprising considering there was a lot more support in the literature suggesting the SOQ was cost neutral or possibly decreased the overall project cost as contractors did not have to measure the works (Blyth, 2001). Participant No. 2 adds that “someone’s got to... measure the scope of the works at tender time anyway” and that cost comes at a cost which the “contractors will put... into their tender price” if they are tendering directly from drawings. However “if a job has been scheduled, it’s easier to price and they won’t necessarily put that cost into it, so I think on any project you’ll pay for it one way or the other”. The participant goes onto state that when a SOQ is utilised PQS administration fees should be reduced as the process of administrating the job is made easier by using a SOQ which “create(s) an argument that it reduces overall project cost”. The significance of the findings was a resounding disagreement with the stated characteristic. The participants believed that a SOQ is cost neutral to the overall project and even argument that it reduces the overall project cost ultimately providing the client with the benefits of a SOQ and a potential reduction in overall project cost.

5.3.1.4 Increases overall project time

Participants were asked whether the additional time spent pre-tender on preparing a SOQ was effective in achieving financial management. The characteristic was
perceived to be moderately effective with a mean rating score of 3.29. The result was different to the research carried out by Davis et al (2009) that found a mean rating score of 2.33. The trend amongst participants is the time spent preparing a SOQ is an investment that is effective in achieving financial management. The benefit according to Participant No. 2 is through cost savings, while the benefit according to Davis et al (2009) is a reduction in tendering time. The findings suggest that the additional time preparing a SOQ has a benefit to the client one way or the other. The significance of the findings are that client representatives see the time preparing a SOQ to be an investment rather than a hindrance in the process of procuring their project. They recognise that the investment of time now will achieve benefits later in the project in the form of potential cost savings and a tool to speed up post contract administration processes including variation management and progress payment evaluation.

5.3.1.5 Preparation Cost

The participants of the questionnaire were asked whether the additional expenditure at pre-tender stage on preparing a SOQ was effective in achieving financial management. The characteristic was perceived to be effective with a mean rating score of 4.14. Six out of seven participants perceived this use to be effective or very effective. The perceived trend is clients “have got no idea” (Participant No. 4) or “get lost, saying I don’t want to spend $50k on a schedule” (Participant No. 5). However, according to Participant No. 5 when the rationale of preparing a schedule is explained to the client, most buy into it. When the client does buy into having a SOQ prepared, Participant No. 4 believes “they are buying certainty... buying the knowledge that at the end of... two weeks (scheduling period) they should have a really accurate document so when a tender (price) comes in its going to be accurate”. The participant believes that clients who commission a SOQ are prepared to pay a premium at pre-tender stage as opposed to variations later. Participant No. 5 continues the trend suggesting that “the preparation cost will be far greatly recompensed through the project in terms of good cost control”. The literature supporting the preparation of a SOQ only identified the potential to bring savings in tender prices. This suggests that even though the characteristic is defined as a pre-tender activity, participants perceived that the benefits of paying for a SOQ are realised post contract with
certainty and good cost control. Not only is there the monetary cost involved with preparing a SOQ but the time cost. The literature argued that the preparation of a SOQ extends the pre-tender documentation stage. This point was not raised by any of the participants interviewed. The significance of the findings is that client representatives generally believe the expenditure to commission the preparation of a SOQ is an effective method of project procurement supplying the client (and consultants) with a document that provides cost certainty and good cost control.

5.3.1.6 Design Documentation Quality

Participants were asked whether allowing the design team sufficient time to complete tender documentation and subsequently a quality SOQ that reflects the finished project was effective in achieving financial management. The characteristic was perceived to be effective with a mean rating score of 4.00. The trend amongst participants was they wanted the design consultants to spend the most time possible preparing tender documentation so it is complete and to a high quality. However in reality, Participant No. 5 noted that a lot of the time design documentation is of poor quality, but believes the documentation quality is improved when a SOQ has been commissioned. This perception is similar to Potts (2004) who believe that when a SOQ is part of the procurement method, the design team is forced to complete their documentation before SOQ preparation can commence. The literature argued that the preparation of a SOQ has become a problematic activity due to in-complete and poor quality tender documentation. This point was not raised by any of the participants interviewed. The significance of the findings is that client representatives generally believe that allowing the design team to complete tender documentation is effective at achieving cost certainty as it subsequently allows a quality SOQ to prepared that reflects the actual proposed scope of works.

5.3.2 Post Contract Schedule of Quantity Characteristics/Uses

5.3.2.1 Variation Management

The use of a SOQ as a ‘variation management’ tool was perceived as effective to very effective in achieving financial management with a mean rating score of 4.86. The result was similar to the research carried out by Davis et al (2009) that found a mean
rating score of 4.27. This is not surprising as the SOQ is a key document in the valuation of variation orders (Blyth, 2001; Davis et al., 2009; Potts, 2004; Rashid, 2006), while “it just makes variation management and the valuing of variation orders pretty simple” according to Participant No. 3. In addition, Participant No. 4 believes it is “extremely important. Variation management is critical to achieving financial management”. Participant No. 5 rates it “right up their”. This suggests that ‘variation management’ is the most effective use of a SOQ in achieving financial management. The benefits are that the SOQ reduces variation disputes, negotiation time and costs (Blyth, 2001 and Davis et al., 2009). Participant No. 6 believes it reduces disputes as changes are “quantifiable and there’s no argument whether there is a decrease in scope or increase in scope”. Participant No. 5 believes it reduces variation negotiation time as the PQS can measure and rate the variation change from the SOQ and agree the value with the contractor’s QS. Participant No. 4 believes it reduces the cost of variations because the contractor is held to rates included in the priced SOQ. The significance of the findings is that the document contains substantial quantity and cost information allowing contract changes to be effectively and efficiently managed during the construction contract phase of the project. This provides the client with certainty that changes in scope are accurately quantified against the original tender scope and at a fair cost.

5.3.2.2 Progress Payment Evaluation

The use of a SOQ as a ‘progress payment evaluation’ tool was perceived as effective to very effective in achieving financial management with a mean rating score of 4.43. The result was comparable to the research carried out by Davis et al (2009) that found a mean rating score of 4.19. The result was not surprising as the SOQ is a useful document in the valuation of interim progress payments (Blyth, 2001; Davis et al., 2009), while Participant No. 6 believes progress can be measured quite clearly against the SOQ. In addition, Participant No. 5 believes it “not so important as variation management”. Participant No. 4 rates it effective (rating 3) and perceives that “at the end of the day you’re not going to pay them anymore than what they’re going to get (contract value)”. This suggests that ‘progress payment evaluation’ is not as effective as variation management in achieving financial management. The benefits are that the SOQ demonstrates the financial structure of the contract allowing accurate progress
payment valuation (Blyth, 2001). Participant No. 2 echoes this perception and explains that “you basically know how the contractors price is put together and if you know how its put together then you can easily assess how much they’ve done”. Another benefit of the SOQ is it provides certainty to the client that the progress payment certification matches work complete on site (Davis et al., 2009). Participant No. 6 echoes this perception and adds that it “provides clarity and assurance to the client that what's been valued is fair right throughout the whole project”. The significance of the findings is that the SOQ is a documented price providing clarity to all parties regarding how the contract price is arrived at in terms of scope and value.

This provides the client with certainty that the contractor is being paid a fair and reasonable interim payment. The client’s risk exposure is also reduced because if the contractor went into liquidation part way through the contract, the client can be assured that the contractor has only been paid what they have completed.

5.3.2.3 Unit Rates

Participants were asked whether the use of a SOQ providing ‘unit rates’ prevented contractors from front end loading projects was effective in achieving financial management. The characteristic was perceived as effective to very effective with a mean rating score of 4.71. The result was contrary to the research carried out by Davis et al (2009) that found a mean rating score of 2.93. The result was not surprising as the unit rates forming the priced SOQ can be questionable (Davis et al, 2009). The perceptions of participants are different and best explained by Participant No. 2 who believes an SOQ prevents front end loading trades because the PQS can scrutinise the “rates and make sure they are reasonable and therefore limiting the opportunity for a contractor to put a lot of the value of the contract work into the earlier trades”. They go on to state that the reason this is done because there is:

“nothing worse than having a project where the contractor has front end loaded and they've got two thirds the way through the project and they can't complete it because they say go into liquidation... and you find that the end of the day there is not enough money left in the pot to complete that trade or the project.”
When a project has been front end loaded and the PQS has not picked up on this, the client is potentially exposed to more risk and subsequently inaccurate progress payment and variation valuations. The significance of the findings suggest the participants of this study strongly agree a SOQ prevents contractors front end loading therefore improving the financial management of the project by reducing the client’s potential risk exposure. This perception may be held due to the tough economic times and the risk that struggling contractors and sub-contractors may front end load projects as an effort to improve cash flow.

5.3.2.4 SOQ Errors

The participants of the questionnaire were asked whether ‘SOQ errors’ were effective in achieving financial management. The characteristic was perceived to be of limited effectiveness with a mean rating score of 2.00. The result was slightly different to the research carried out by Davis et al (2009) that found a mean rating score of 3.20. The results from this research study are not surprising as SOQ errors expose the client to increased risk (Davis et al, 2009) and “outweigh the advantages of BOQ’s (SOQ)” (NSW legislative Council, 1991 as cited in Davis et al., 2009, p. 104). Blyth (2001) took the argument in a new direction and pointed out that errors which the clients perceive as a complete extra, when in fact they are not paying again for something they already have. There is no doubting the perception amongst participants is ‘SOQ errors’ are a negative factor associated with using a SOQ. However the client representatives interviewed agree with the argument presented by Blyth (2001) which is best explained by Participant No. 2 who points out to their clients that:

“whether something was under measured or missed (from the SOQ)... it still leaves the client... in a position that they’re not paying for anything they’re not getting... he’ll be paying for it anyway whether the PQS measured it upfront or whether its picked up later as an error”
They state the client normally comes back at this point and argues that “if we went to a contractor and they missed it out of their tender its their tough luck” and in response participant No. 2 would typically point out that a contractor in that situation would attempt to “recover that money through variation claims and if you don’t have a schedule how can you tell if it is actually a legitimate claim”. The participant notes that SOQ errors always occur due to the human factor. Participant No. 5 agrees that “theres always going to be some errors” because “nobody’s perfect, particularly in the building game”. They add that clients shouldn’t be put off engaging a PQS firm to prepare a SOQ because the “weight shouldn’t fall on whether there is going to be error(s) or not, you’ve got to be positive about putting the document together and its up to the people doing that to convince them”. The significance of the findings suggest that of the client representatives interviewed all are aware every SOQ contains some sort of error. However they note not having a SOQ is a bigger disadvantage in achieving financial management because the client does not know how the contract price is formed. Therefore when the contractor comes across errors in their tender price they have the ability to recover this by inflating genuine variations without the knowledge of the client as the scope is potentially unclear and rates are not available.

5.3.3 Other Schedule of Quantity Characteristics/Uses

5.3.3.1 Provides cost database

The use of a SOQ as a tool that ‘provides cost database’ was perceived as effective to very effective in achieving financial management with a mean rating score of 4.71. The result was equivalent to the research carried out by Davis et al (2009) that found a mean rating score of 4.07. This result is not surprising considering Davis et al (2009) believe a priced SOQ becomes a cost database for future estimating purposes, while Participant No. 1 noted priced SOQ assist with estimating proposed projects as “the schedule provides up to date market rate information”. The significance of this finding for clients, particularly those who are continually undertaking projects of a similar nature, is the cost data from previous jobs can be used to estimate future projects. This provides the client with a high level of financial management. The use
of the SOQ on the current project is extended representing value for money. While the estimates on future projects are accurate as they are based on up to date market rates.

5.3.3.2 Basis for fee calculation

The use of a SOQ as a ‘basis for fee calculation’ was perceived as not at all effective to of limited effectiveness in achieving financial management with a mean rating score of 1.86. The result was slightly different to the research carried out by Davis et al (2009) that found a mean rating score of 2.65. The majority of participants believed that their professional fees on large projects were calculated on a percentage of the contract value while for smaller projects they tender for the work with lump sum based on the amount of time they believe it will take. The use of a SOQ is not mentioned as a way to calculate their fees. The perception of Participant No. 1 rating the use a ‘5’ (refer Appendix B) suggests they might be thinking that the as the SOQ forms the contract price, their professional fee can be calculated on a percentage basis from that. The significance of this result suggests this use does not achieve financial management because a SOQ is not used for this purpose in any capacity.

5.3.3.3 Provides data for insurance purposes

Participants were asked whether the use of a SOQ ‘providing data for insurance purposes’ was effective in achieving financial management. The characteristic was perceived as of limited effectiveness to moderately effective with a mean rating score of 2.86. The result was similar to the research carried out by Davis et al (2009) that found a mean rating score of 3.07. The findings show that this characteristic was the only one that received ratings ranging from 1 to 5. The participants that perceived its effectiveness a ‘1’ or ‘2’ appear to have a reasonable amount of experience carrying out valuations for insurance purposes. Participant No. 6 best explained the low rating noting they “don’t use things like the construction cost” instead they “go back and use that as a check to make sure (they are) on the same page”. They follow this process:
“because what it cost to build it isn't necessarily what the cost is to build it again, cause quite often you are talking about in tender situations. So for a new building on a SOQ, just been built, it's probably been done in quite a competitive situation and that may not be the actual physical worth of that building.”

Participant No. 4 adds that clients often ask what the final cost for the project was including construction, professional fees, consents etc, “so having a schedule I don’t think helps in the norm”. The other lower rated perceptions were given by participants as they noted its effectiveness was not great compared to the other characteristics/uses. The findings suggest that participants perceptions are influenced based on their experience of undertaking insurance valuations. The significance of this result suggests this use does not achieve financial management because it is not one of the core uses of a SOQ and merely only used for this purpose as a cross check.

5.3.3.4 Asset Management

The use of a SOQ assisting with ‘asset management’ was perceived as moderately effective to effective in achieving financial management with a mean rating score of 3.86. The majority of participants believed that the use of SOQ was of assistance when undertaking this task for calculating depreciation factors. Among the participants there were varying reasons for its effectiveness. The perception of its effectiveness ranged from Participant No. 4 who believed the quantities (particularly areas for carpet) contained in the SOQ can easily be transferred to an Asset register, while Participant No. 6 believed the cost information for selected items was particularly useful. Participant No. 7 has had experience undertaking this task without the assistance of a SOQ and noted it was extremely difficult. The participant rated the use a ‘5’ (refer Appendix B) as they believed a SOQ would be “magic” because say for carpet “you can look up it up, how much is this, how many square metres, bang there’s your answer”. Blyth (2001) and Davis et al (2009) echo these thoughts by describing the priced SOQ as an accurate source of information that can be directly transferred between documents. The findings suggest that participants perceptions are dependent on their asset management experience, particularly preparing asset or
depreciation registers. The significance of the findings suggest that a SOQ life extends beyond the completion of the construction phase by providing financial management in the form of accurate cost information that is readily available. The SOQ extended use represents value-for-money to the client.

5.3.3.5 Cost Reporting

The use of a SOQ as a ‘cost reporting’ tool was perceived as effective to very effective in achieving financial management with a mean rating score of 4.43. The majority of participants believed that the use of a SOQ was effective when preparing costs reports for clients and is best summarised by Participant No. 7. They believe trying to do a cost report without a SOQ and just the trade summary becomes very difficult, but if a priced schedule is available the contract price is “broken down into... subtrade heading values (making) it a lot easier” to undertake an accurate cost report and advise the client where the costs are coming from and where the final cost is heading. Rashid et al (2006) echo this perception and believe the cost information contained within the SOQ allows the PQS to prepare regular accurate cash flow updates, periodic project account information and variation cost data. The significance of the findings is that because the client representative knows how the contract price is formulated in terms of scope, quantity and cost the accuracy and detail of information contained within the cost report is greatly improved.

5.3.3.6 Procurement

The use of a SOQ as a strict ‘procurement’ tool preventing contractors from submitting alternatives was perceived to be effective in achieving financial management with a mean rating score of 4.00. The majority of participants perceived the use of a SOQ was at least moderately effective. Davis et al (2009) believe this SOQ characteristic is a negative as it prevents the contractor from providing the client with cost savings on what was specified and scheduled. The qualitative responses suggest that only Participant No. 3 understood what was being asked. They rated the use of limited effectiveness; the lowest of all seven participants (refer Appendix B). They were however unaware that a job with a SOQ had limited this as “we’ve still
had them nominate alternative materials or methodology”, but rated it a ‘2’ because they believed a SOQ did not facilitate it. The significance of the findings are hard to suggest because only one participant has understood what characteristic they are actually rating.

5.3.4 SOQ Characteristics/Uses Activities

Table 2 (page 34) shows the groupings of SOQ characteristics/uses into activities and the consequent rankings of the activities based on mean effectiveness ratings. The characteristics/uses were grouped into activities to determine the project stage that is most effective in achieving financial management. The use of a SOQ post contract ranked the most effective, this result is not surprising considering Davis et al (2009) also believe a SOQ is only considered useful as a post contract tool.

5.4 Summary

This chapter has evaluated the data presented in chapter 4. The quantitative data has been analysed and expanded on with the qualitative responses. The findings show ‘variation management’, ‘provides cost database’ and ‘unit rates’ were the most effective characteristics/uses of a SOQ in achieving financial management. ‘Variation management’ and ‘provides cost database’ shared similar mean rating scores to Davis et al (2009) findings. However the mean rating score for ‘unit rates’ contradicted the findings of Davis et al (2009) possibly due to the very competitive market climate. The qualitative answers from client representatives showed the SOQ to be most effective because it provided a documented price containing the proposed scope, quantity and cost. The overall findings demonstrate the use of a SOQ to be effective in providing financial management plus other benefits to the project.
6 CONCLUSION

6.1 Introduction

This chapter presents a summary of the research including the methodology used, the significant findings, the overall conclusion, the limitations and areas of future study are suggested.

6.2 The Research

The literature review revealed that over the past 20 years the use of a SOQ has dramatically decreased. This decline in use is considered to be due to SOQ’s being outdated and no longer required in the current procurement market. The literature notes that SOQ are considered to be the greatest misunderstood facet of construction contracts and perceived to be an additional cost that produces no benefit to their project. This is further compounded by the belief that SOQ errors can become a key source of variations. Opposing perceptions are noted in some literature where there is a clear demonstration of the benefit of a SOQ. Such benefits include providing financial management throughout the project in the form of cost certainty and control.

The data collection method was in the form of semi-structured interviews containing a questionnaire based around Davis et al (2009) questionnaire. The questionnaire comprised demographic, Likert scale and open ended qualitative questions. The Likert scale questions allowed quantitative data to be collected from participants on their perceptions of various characteristics/uses of a SOQ in achieving financial management. This enabled the data to be analysed and compared with Davis et al (2009) findings. The open ended qualitative questions provided comprehensive justification of the quantitative results.

6.3 General Findings

The quantitative results of the questionnaire showed the most effective characteristics/uses of a SOQ in achieving financial management were ‘variation
management’, ‘provides cost database’ and ‘unit rates’. ‘Variation management’ and ‘provides cost database’ shared similar mean rating scores to Davis et al (2009) findings. However the mean rating score for ‘unit rates’ contradicted the findings of Davis et al (2009) possibly due to the very competitive market climate. The overall findings demonstrate the use of a SOQ to be effective for financial management because it provided a documented price containing the proposed scope, quantity and cost. Furthermore, the SOQ provided numerous financial management benefits which extend throughout the duration of the project. These include a de-facto quality assurance audit, a fair basis for the comparison of contractor’s tender submissions, an effective variation management tool, the basis for progress payment evaluation, provision of transparent unit rates preventing front end loading and a useful cost database for future estimation purposes.

6.4 Limitations

The research’s sample size comprised participants of three occupations all with past experience in representing clients. The sample was selected through convenience sampling. Because of the sample type and size, the results cannot be generalised for all client representatives in the construction industry as each client is unique with different objectives and project types.

The participants level and quality of experience with a SOQ may have influenced how they rated different characteristics/uses. For example, if a participant has had a positive experience converting a priced SOQ into an asset register they potentially could have rated it higher than someone who hasn’t used a SOQ for this purpose.

The researcher is currently involved on a project with one of the participants which may have influenced their perceptions.

Some of the characteristics/uses contained within the Likert scale of Davis et al (2009) research were not relevant to this study and therefore excluded. However the ratings to those which are relevant are acceptable as they are based on participants’ perceptions.
A further limitation, was the characteristics/uses included in the Likert scale questionnaire could have been worded better. This was acknowledged before the first interview took place. Supplementary information was prepared to assist the participants rate the SOQ characteristics/uses.

6.5 Future Study

From the literature and selected participants qualitative responses, the use of a SOQ as a contract document was raised. Further research could be undertaken to determine whether the use or effectiveness of a SOQ is affected by its status as a contract document.

6.6 Concluding Remarks

The research question presented in this study has been extensively reviewed and considered. The results demonstrate that a SOQ is an effective tool for the financial management of a project. Although the literature notes that clients believe a SOQ is a additional cost that produces no benefit to their project, client representatives interviewed as part this research hold the opposing view that the preparation cost of a SOQ will be far greatly recompensed with good cost control throughout the project. The literature also notes that there has been a sharp decline in the use of a SOQ in the last 20 years. The overall results suggest client representatives recognise the value of a SOQ and the numerous benefits such a document provides.

The results are significant because the existing literature presented conflicting views on the benefits of a SOQ. The findings add to the body of knowledge of SOQ from the viewpoint of a client representative and demonstrate the benefits of a SOQ and how such a document can be used in the financial management of a construction project throughout its duration.
REFRENCES


APPENDIX A – QUESTIONNAIRE

QUESTIONNAIRE: CLIENT REPRESENTATIVES’ PERCEPTIONS ON THE EFFICACY OF SCHEDULES OF QUANTITIES IN ACHIEVING FINANCIAL MANAGEMENT.

Section 1: Participant Information

1. What is your occupation in the construction industry?
   - Quantity Surveyor □
   - Project Manager □
   - Architect □
   - Engineer □
   - Other □ please state __________

2. How many years of experience do you have in the construction industry?
   - Under 5 years □
   - 5 to 10 years □
   - 11 to 20 years □
   - Over 20 years □

3. Approximately what percentage of projects have you been involved with over the last five years that have used a Schedule of Quantities?
   ———

4. What percentages of projects with a Schedule of Quantities are from?
   a) Private Sector _____
   b) Public Sector _____

5. Over the last 12 months please state the number of projects which have used a Schedule of Quantities in the following price ranges?
   - $0 to 1 million _____
   - $1 to 5 million _____
   - $5 to 10 million _____
   - $10+ million _____
Section 2: Efficacy of Schedules of Quantities in achieving Cost Management Objectives

6. How effective do you consider a Schedule of Quantities to be in achieving the following?
From the list below, please tick the level of effectiveness for each of the identified factors.

1. not at all effective
2. of limited effectiveness
3. moderately effective
4. effective
5. very effective

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<thead>
<tr>
<th>BOQ Use</th>
<th>Level of Effectiveness</th>
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<td>Pre-Contract</td>
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<td>1 Facilitates design Quality Management</td>
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<td>2 Facilitates Tender Assessment</td>
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<td>3 Increases Overall Project Cost</td>
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<td>4 Increases Overall Project Time</td>
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<td>5 Preparation Cost</td>
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<td>6 Documentation</td>
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<td>7 Variation Management</td>
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<td>8 Progress Payment Evaluation</td>
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<td>9 Provides Unit Rates</td>
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<td>10 SOQ Errors</td>
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<td>Other Activities</td>
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<td>11 Provides Cost Database</td>
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<td>12 Basis for Fee Calculation</td>
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<td>13 Provides Data for Insurance Purposes</td>
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<td>14 Asset Management</td>
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<td>15 Cost Reporting</td>
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<td>16 Provide a Procurement tool</td>
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</table>

7. Are there any additional characteristics of a Schedule of Quantities that you would consider effective in achieving cost management objectives? Please specify, with reasons.
8. Please explain why you have rated those factors in question 6 as 4 or 5, and how they achieve this effectiveness?

9. Please explain why you have rated those factors in question 6 as 1 or 2, and how they are not as effective as those factors rated 4 or 5?
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<tr>
<th>Code</th>
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<th>Participant Ratings</th>
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<td>Design Documentation Quality</td>
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APPENDIX C – DAVIS, LOVE AND BACCARINI’S (2009) STUDY
Bills of Quantities: nemesis or nirvana?

Peter R. Davis, Peter E.D. Love and David Baccarini
Curtin University of Technology, Perth, Australia

Abstract

Purpose – Traditional Lump Sum (TLS) methods have been the primary procurement method within Australia. Yet, their use is beginning to wane in states such as Queensland, New South Wales and Victoria where Design and Construct, Construction Management and hybrids thereof have become the norm. Considering the demands of clients, the increasing propensity to use non-traditional methods, the quality of drawings that are being produced, and the role of software applications such as Computer-Aided Design in directly generating quantities, this paper seeks to examine the role Bills of Quantities (BoQs) serve and how effective they are as a pre-contract and post-contract tool.

Design/methodology/approach – Only limited empirical research has addressed the role and effectiveness of BoQs, particularly in Australia. With this in mind, the research adopted an exploratory approach to gain insights from industry practitioners about BoQs. A questionnaire survey was developed from the literature and used to solicit the opinions of practitioners about their role and effectiveness as a pre-contract and post-contract tool.

Findings – The distributed questionnaire survey resulted in 86 responses from industry practitioners – quantity surveyors, building contractors, and project managers. The findings fundamentally reveal that the use of Bill of Quantities prepared in accordance with the standard method of measurement is on the decline and only useful as a tool for post-contract control.

Originality/value – The research has revealed that there is a need for industry to embrace alternative forms of measuring quantities in building projects. Abridged bills and builders’ quantities are being increasingly demanded in Australia. Thus, it is suggested that this demand could drive the need for alternative forms of pricing in building projects and lead to the increasing use of non-traditional methods of measurement.

Keywords Contracts, Construction industry, Australia

Paper type Research paper

Introduction

The Australian economy has experienced a significant period of economic growth, which has been founded on a demand for resources. As a result, unemployment is currently at an all time low of 4.1 per cent, and as low as 3.3 per cent in Western Australia. Strong growth in demand, output and employment have taken inflation to it highest level in nearly 20 years. After repeated warnings about the risk of inflation at 5.1 per cent and the current world economic crisis the Reserve Bank of Australia has, at the time of writing, reduced the official cash interest rate to 5.25 per cent. The lowering of interest rates has been in response to the collapses of the world’s financial markets. As a result of rising inflation, and the limited availability of finance, clients are placing increasing emphasis on price certainty and demanding their projects to be completed quicker to take advantage of the demand for their services and products. In addition, clients are demanding value for money, and technological innovation from their projects. To effectively meet such client demands invariably requires the use of non-traditional forms of procurement method as design and construction can commence in parallel and thus provide clients with timelier completion dates and...
improved constructability (NSWPWD (New South Wales Public Works Department), 1992; Morledge et al., 2006).

While Traditional Lump Sum (TLS) methods have been the primary procurement method within the Australian construction industry, their use is beginning to wane, particularly in states such as Queensland, New South Wales and Victoria where Design and Construct and Construction Management and hybrids thereof, have become the norm (Love et al., 2008). The use of such traditional procurement methods is heavily reliant on the design documentation being complete and a detailed Bill of Quantities (BoQ) being produced so that cost certainty can be provided to a client prior to construction commencing (Mills, 1991). The concept of cost certainty, however, is a fallacy in the context of traditional approaches that are based on full drawings and BoQ (Rowlinson, 1999). While in principle TLS can provide a public client with a firm, fixed price for construction, in practice very few projects are actually completed within the tendered price in Australia (Love et al., 2006). Moreover, complete drawings and BoQs are generally not available when a project goes to tender.

Within Australia, there are great concerns within the industry as to the quality of the contract documentation that is produced. Emphasising the level of quality in drawings, January (2003), p. 17) from the Australian Institute of Quantity Surveyors (AIQS) expressed the following viewpoint “some drawings are so bad they are simply not interpretable”. Considering this, the production of detailed BoQs becomes a problematic task for a quantity surveyor (QS) under a traditional arrangement. It has been suggested that the production of erroneous drawings by designers is attributed to clients demanding the design and documentation process to be completed within tighter timeframes and at a reduced fee level. Considering the demands of clients, the increasing propensity to use non-traditional methods, the quality of drawings that are being produced, and the role of software applications such as Computer-Aided Design in directly generating quantities, what purpose do BoQs serve and how effective are they as a pre-contract and post contract tool? In addressing this question the role of the BoQ is examined in the context of Australian construction projects by soliciting the opinions of industry practitioners through a questionnaire survey.

Bills of Quantities

Bills of Quantities (BoQs) have existed in one form or another for over 300 years (Milliken, 1996). It is claimed that the use of BoQs is perhaps the most misunderstood facet of building contracts today (Mills, 1991; AIQS (Australian Institute of Quantity Surveyors), 2001). Debate over the relative advantages and disadvantages of BoQs has been long standing and generates strongly held and conflicting views (NPWC/NBCC, 1990). The BoQ is a document that itemises the work in a construction project. It is usually prepared by a professional QS on behalf of the principal (otherwise known as client), based on detailed drawings and specifications (NSW Legislative Council, 1991; Marsden, 1998; Seeley, 1997). The BoQ has two primary uses (Brook, 1998):

1. **Pre-contract**: the BoQ assists contractors in the formulation of their tenders. The BoQ breaks down the contract works in a formal, detailed, structured manner for tendering (AIQS (Australian Institute of Quantity Surveyors), 2001).
2. **Post-contract**: the BoQ assists contractors and quantity surveyors in the valuing of progress payments and variations. The BoQ provides a financial structure
for contract administration (AIQS (Australian Institute of Quantity Surveyors), 2001).

A BoQ can be prepared using various alternative methods of measurement (AIQS (Australian Institute of Quantity Surveyors), 2001):

1. **Australian standard method of measurement of building works** (AIQS (Australian Institute of Quantity Surveyors), 1990) – This is commonly used for fully measured “guaranteed” BoQs;

2. **Abbreviated method of measurement** – These are published by larger quantity surveying firms and State governments. They are used on simple buildings and place greater requirement on contractors to refer closely to drawings; and

3. **Builders’ measurement** – This measurement method is used by contractors preparing tenders where a BoQ is not provided by the principal. No specific form of measurement exists.

The contractual status of the BoQ can vary (AIQS (Australian Institute of Quantity Surveyors), 2001):

- form part of the contract and be guaranteed;
- form part of the contract and not guaranteed; and
- not forming part of the contract and for information only

The term “guaranteed” means that the principal and contractor have a guarantee that they will only pay for/be paid for work tendered under the contract. It does not mean that the QS guarantee the accuracy of the BoQ (AIQS (Australian Institute of Quantity Surveyors), 2001). Contractors are skeptical of BoQs provided for “information only” because they present unreasonable risk (AIQS (Australian Institute of Quantity Surveyors), 2001). The AIQS recommends BoQs for projects (AIQS (Australian Institute of Quantity Surveyors), 2001):

- where the anticipated reduction in tender price is calculated to be greater than the fee for producing the BoQ;
- for all projects of a complex nature or alterations work; and
- for less complex projects with an estimated cost of greater than A$2 million.

The QS’s workload has been predominantly reliant on the production of BoQs and settlement of final accounts, with tender documentation accounting for a considerable proportion of their workload (Wood and Kenley, 1997; Wood, 2000). However, it would appear there has been a significant decline in professional QS’s workload associated with producing BoQs due to the increasing use of non-traditional forms of procurement method.

**Tendering**

The production of a BoQ juxtaposed with the associated design may require considerable time to prepare (Turner, 1983; NPWC/NBCC, 1990; Ramus and Birchall, 1996). Many clients do not understand that they need to allow the design team adequate time to prepare a detailed design and the subsequent documentation for tendering. In particular, the amount of additional time to prepare a BoQ can be offset by a reduction in tendering time, particularly on larger projects (AIQS (Australian Institute of Quantity Surveyors), 2001).
Institute of Quantity Surveyors), 2001). The process of producing a BoQ, however, requires the QS to interrogate the design and specification. This enables the QS to identify inaccuracies and inconsistencies in drawings and specification prior to tender, and the subsequent reduction in post-contract problems (Milliken, 1996; AIQS (Australian Institute of Quantity Surveyors), 2001).

The BoQ provides a common basis for the comparison of tenders (AIQS (Australian Institute of Quantity Surveyors), 2001). The structured format simplifies the assessment of tenders (AIQS (Australian Institute of Quantity Surveyors), 2001). Where a BoQ is not provided, each tenderer prepares its own quantities and the principal cannot be sure that tenders are being compared on the same basis (AIQS (Australian Institute of Quantity Surveyors), 2001). The absence of a BoQ may lead to greater variability, increased risk in estimating and consequently more disputes (Seeley, 1997). When a BoQ is not provided it is recommended that sufficient time should be allowed to enable tenderers to produce their own quantities (NPWC/NBCC, 1990). Without a BoQ, there is also the risk that the successful tenderer may underestimate the quantities and then be unable to complete the work, and/or cut corners in an attempt to recover the consequent loss (Ramus and Birchall, 1996).

It has been revealed that BoQs can reduce the costs of tendering (Economic Development Committee (Victoria), 1994; AIQS (Australian Institute of Quantity Surveyors), 2001; Seeley, 1997). For example, on simple projects of less than A$5 million tender prices can be reduced by as much as 2.5 per cent, and for projects in excess of A$5 million, 4.2 per cent (Slattery and Co., 1993). Cordell’s (1979, cited in Mills, 1991) studies indicated that the costs of tendering for head contractors was approximately 0.15 per cent of the tender value for projects with a BoQ, and 0.45 per cent for projects without a BoQ. Slattery and Co. (1993) found that 74 per cent of Australian contractors stated that guaranteed BoQs increase the competitiveness of tenders while non-guaranteed BoQs increased tender prices by 4.6 per cent due to increased risk. Tenderers can rely on the quantities within a guaranteed BoQ, resulting in lower tender prices from more competitive tendering (AIQS (Australian Institute of Quantity Surveyors), 2001).

When the principal provides a BoQ, a greater number of subcontractors are likely to submit tenders for works packages, which can result in savings of 12 per cent, compared with when there is no BoQ. If the principal does not arrange for a BoQ to be prepared, the tenderers will incorporate the cost of measuring the work within their tender thereby passing the cost onto the principal. Uher (1996) found that contractors consider the main benefits of BoQs to be speeding up the tendering process and simplify obtaining and analysing bids from subcontractors.

**Benefits and dis-benefits of BoQ**

An examination of the literature revealed that there are several benefits and dis-benefits of BoQs. The benefits of BoQ during the pre-contract phase of a project primarily relate to tendering but several other benefits include (AIQS (Australian Institute of Quantity Surveyors), 2001):

1. **Database** – The pricing details within the BoQ provides a cost database for future estimating.
2. **Fee calculation** – The BoQ provides an absolute basis for the calculation of consultants’ fees.
(3) **Asset management** – The BoQ provided readily available data for asset management of the completed building, life cycle costing studies, maintenance schedules, general insurance and insurance replacement costs.

(4) **Taxation** – BoQs provide a basis for quick and accurate preparation of depreciation schedules as part of a complete asset management plan for the project.

The dis-benefits, on the other hand, include:

(1) **Cost and time** – The preparation of a BoQ tends to increase the cost and lengthen the documentation period (NSW Legislative Council, 1991).

(2) **Estimating practice** – Tenderers may ignore the specification (e.g. workmanship requirements), pricing only according to the BoQ. This may lead to under pricing and the consequent risk of unsatisfactory performance as contractors try to avoid losing money (NSW Legislative Council, 1991).

(3) **Procurement** – The use of a detailed design and associated BoQ discourages contractors from submitting alternative design solutions, as alternatives will amend quantities (Turner, 1983). The BoQ is only suitable (if at all) to the traditional procurement system.

The benefits of BoQ during the post-contract phase of a project include:

(1) **Certainty of progress payments** – The BoQ provides a post-contract administration tool and becomes a basis for the evaluation of progress payments. The calculation of these progress claims is straightforward and reliable (AIQS (Australian Institute of Quantity Surveyors), 2001). This certainty offers contractor, principal and financiers peace of mind in the knowledge that all work is being carried out at prices fair and reasonable to all involved (AIQS (Australian Institute of Quantity Surveyors), 2001).

(2) **Change order management** – The BoQ provides a sound, common basis for the valuation of variations (NSW Legislative Council, 1991; Ramus and Birchall, 1996). Also, the prices for change orders are reduced by the use of BoQ unit rates (AIQS (Australian Institute of Quantity Surveyors), 2001). The Economic Development Committee (Victoria) (1994) found that where BoQs are provided, there was less scope for change orders in contract tendering to occur and where such change orders did occur they are more easily identified. Without a BoQ, the pricing of change orders leads to more protracted negotiations (Ramus and Birchall, 1996).

(3) **Risk management** – The prices in the BoQ can be used as a basis for comparing a contractor’s price with current trends in the marketplace. This provides a basis for management to determine the likely manifestation of risk factors (AIQS (Australian Institute of Quantity Surveyors), 2001).

(4) **BoQ errors** – Errors are not a major cause of change orders (AIQS (Australian Institute of Quantity Surveyors), 2001). Choy (1991) found the average change order to be 7.7 per cent of contract value with BoQ errors representing 4.5 per cent of total change orders.
The dis-benefits of BoQ during the post-contract phase of a project include:

1. **BoQ errors** – Because of the amount of detail required in a BoQ, there is a significant chance of finding errors, omissions and discrepancies between drawings and the BoQ, with consequent disputation (NSW Legislative Council, 1991). This risk of disputation arising from misinterpretation and error outweighs the advantages of BoQs (NSW Legislative Council, 1991). The NSW Public Works Department (NSWPWD (New South Wales Public Works Department), 1992) found discrepancies between BoQs and the rest of the contract documents to be common, and subject to substantial claims from contractors, in three areas: under measures; omitted items; and mis-described items.

2. **Australian standard method of measurement (ASMM)** – The ASMM is over complex and creates ambiguities (NSWPWD (New South Wales Public Works Department), 1992). It leaves avenues for different interpretation, and these may lead to disputes (NSW Legislative Council, 1991).

3. **Unit rates** – The cost data obtained from contractor-priced BoQs is often used by QSs for cost management, such as valuing progress payments. This data can be suspect for reasons such as: contractors increase rates on early trades above their real cost, and reduce the cost of later trades, to improve cash flows; some contractors may load later trades to gain benefits from rise and fall provisions (Yizhe and Youjie, 1994; NSWPWD (New South Wales Public Works Department), 1992). In fact some contractors detect errors in principal-provided BoQs and subjectively adjust the associated rates accordingly (Green, 1986).

4. **Builder’s BoQ** – Where a BoQ does not exist, contractors often seek a “Builder’s Bill”. Therefore, “if full scale Bills provide the economic benefits espoused by the QS, then surely contractors would be prepared to pay upfront cost in order to save them the claimed additional construction costs they supposedly encounter due to the so called lack of precise detail” (NSWPWD (New South Wales Public Works Department), 1992).

5. **Responsibilities** – BoQs involve a shift in, or “risk blurring” of, the contractor’s responsibility that results in claims and disputes (NPWC/NBCC, 1990).

**Research approach**

There has been limited empirical research that has addressed the role and effectiveness of BoQs, particularly in Australia. With this in mind, the research adopted an exploratory approach to gains insights from industry practitioners about BoQs. A questionnaire survey was developed from the literature presented previously and used to solicit the opinions of construction industry practitioners about their role and effectiveness as a pre-contract and post-contract tool.

Prior to determining the sample size for the main study, a pilot survey was conducted with five QSs. This was undertaken to test the potential response rate, suitability and comprehensibility of the questionnaire. Each respondent was contacted by telephone and informed of the aims of the research. On obtaining their consent, the questionnaire was mailed, with a stamped addressed return envelope enclosed, for respondents’ returns, comments, feedback and completion. The respondents were also
asked to review the design and structure of the survey. All comments received were positive, and as a result, the questionnaire remained unaltered for the main survey. The response rate for the pilot survey was 100 per cent.

With the assistance of the Australian Institute of Quantity Surveyors (AIQS) the questionnaire was then made available and hosted on their web site. The web site was established with directions to the survey’s location, instructions on its use and method of return to the researcher. A global e-mail was distributed to all AIQS members about the study. The questionnaire survey was made available for two weeks. A total of 86 responses were received.

Research results
Sample demographics
Of the 86 responses received 45 (54 per cent) were QS’s, 27 (31 per cent) were building contractors, 7 per cent project managers, and the remaining 7 per cent were others that included building clients, structural engineers and architects. It was revealed that 47 per cent of respondents undertook a combination of public and private sector work. The remaining 43 per cent undertook solely private sector work, as it was perceived that the financial rewards of so doing were considerably more beneficial. Of respondents 63 per cent had accrued more than 20 years’ experience within the construction industry.

BoQ measurement
There are various methods for measuring work for BoQs sponsored by a building principal and contractor. Respondents were asked which measurement method was most commonly used – abbreviated, Australian Standard Method of Measurement (ASMM) or builder’s quantities – were most frequently used to procure projects. There are also various reasons for deciding to produce a BoQ for a building project. In this instance the main criteria for selecting to use a BoQ reported by respondents (n = 78 per cent) related to project complexity and a project’s estimated contract value.

It was revealed that builder quantities were the most popular method used by clients and contractors (n = 78 per cent), followed by abbreviated and ASMM (n = 9 per cent). This is considered unexpected as clients have traditionally sponsored the production of ASMM-based BoQs. However, there is a perception that ASMM is overly complex for measuring work to be done. As a result, there is a desire for a more efficient approach to measuring work that still achieves the objective of facilitating the pricing of building work. Another important consideration is that BoQs do not typically form part of a contract and are provided for information only. In particular, only 5 per cent of respondents stated that BoQs formed part of the contract and 13 per cent stating they formed part of the contract but were not guaranteed. This indicates a risk adverse attitude by clients to avoid any possible claims from contractors for errors in BoQs by placing responsibility on contractors to determine the appropriateness of a BoQ for the basis of formulating a tender. Over the last five years 90 per cent of respondents stated that the use of ASMM based BoQ had declined and there was an increasing demand for abridged forms, particularly from contractors. This finding clearly indicates that BoQ creation does not form an integral part of quantity surveyors activities.

Table I provides a list of factors that respondents deemed to be important uses of BoQ. It can be seen that facilitating the cost of variations (post contract) was the most
The use of the Kruskal-Wallis test revealed that there were no significant differences between the rankings of criteria between respondents ($p > 0.05$).

The least important use/characteristics were all pre-contract activities. Variation cost management ranked as the highest mean score indicating its level of importance as a tool available for the use of a building developer to manage cost associated with changes to the scope of works. Respondents all concurred that a BoQ provides a sound common basis for the valuation of variations and reducing the ensuing protracted negotiations.

The evaluation of progress payments was ranked as the second highest. This is understandable considering that the calculation of a progress claim is a straightforward process when using a BoQ. Risk reduction to tenderers was ranked third (pre-contract activities). One respondent stated that a BoQ could reduce tendering risk by 95 per cent mainly by reducing general errors and ensuring that all the work has been priced. In addition, it was suggested by another respondent that more competitive tender prices could be assured with a BoQ.

**Conclusions**

This paper reports the results of a survey of 86 construction professions within the Australian building industry on issues related to the use of BoQs. There are clear arguments for and against BoQs, but very limited research to support them. Many of the arguments are based on anecdote, intuition or common sense. Where BoQs are sponsored, either by the principal or contractor, measurement is based on builder’s quantities. This indicates a strong desire to simplify the measurement process while
providing appropriate information for tendering purposes. However, there is a reluctance to make BoQs formally part of building contracts. This suggests that principals are more sensitive to the claimed disadvantages, rather than advantages of BoQs. From the evidence provided it is apparent that BoQs are only considered useful as a post-contract tool. Therefore, the questions remain: why is there a need for clients to pay for BoQ production if they do not form part of a contract? What use do BoQ’s really serve?

References
NPWC/NBCC (1990), No Dispute: Strategies for Improvement in the Australian Building and Construction Industry, NPWC, Canberra.


**Corresponding author**

Peter R. Davis can be contacted at: p.davis@curtin.edu.au

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