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The Challenges of Quantifying Construction Works for Project Control in Ghana

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ABSTRACT

Project control is undertaken throughout a construction process and it involves planning, monitoring, comparing actual with planned and taking actions. The three major areas of control in construction are 'cost control', 'Quality control' and 'Schedule or progress control'. In all planning/ setting target and monitoring, work quantity information is used within the control mechanism to provide vital information. The paper therefore identifies the challenges of accurately quantifying construction work and organising the quantified information for control processes in Ghana. A structured questionnaire was administered to Quantity Surveyors and Project Managers on phone (not a common research practice in Ghana) to rate pre-identified challenges quantity surveyor face in quantification of construction work. Poor quality of drawings, limited time to carryout measurement, lack of adequate quantification skills, poor specification, poor remuneration, difficulty in interpretation of standard method of measurement, and difficulty in measuring work on site in that order were identified as the major challenges to quantification in Ghana. The major impact of these challenges is on cost control of project which is vital to developing countries.

Keywords: Quantification, Challenges, Project, Control

1. INTRODUCTION

Quantities of construction work are used for several purposes in construction. Pickens and Jaggar (2005) who are Quantity Surveyors described 'measurement (quantification)' as 'a process concerned with converting construction drawings into words and numbers in accordance

with a strict set of rules. Usually the quantities are compiled into bill of quantities which is used to establish the estimate for construction cost and subsequent control of the construction work. Many researchers have investigated the use of bill of quantities in post tender procedures by contractors (Kodikara *et al.*, 1993b). This paper advance this work by looking at the challenges encountered in quantifying work for construction control in developing countries using Ghana as a case-study.

According to Kazi and Charoenngam (1999) project control has three components which are cost control, quality/ specification control and time or schedule control. These three aspects of project control could be represented in control triangle as shown on fig 1. Together cost, quality and progress control results in the total project control.

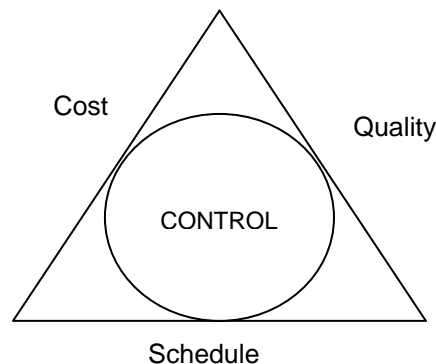


Fig 1.1 Project Control Triangles
Source: (Kazi *et al.*, 1999)

Controlling consists of setting target, monitoring comparing and taking actions to ensure the project goes as planned (Harris *et al.*, 2005). Effective control of construction works involves acquisition of information related to the volume or quantity of work which is used to set the budget and monitor it. Out of the three steps of control (which are setting target, monitoring and actions), setting of target and monitoring often require quantification of the works. The document in which the quantity of work is present is referred to in this paper as the quantity document.

The quantity document comprises of both numeric quantities and description with all the inherent specifications. The descriptive component of the document (e.g. Bill of Quantities) is used to identify the work item under consideration while the numeric component communicates the amount of work involved. This is illustrated in fig 2.

It can be inferred from Kodikara *et al* (1993a) that the quantity document used for control in construction organisations include bill of quantities, material schedules, and labour schedules. Other quantity documents in use include elemental cost plan (and quantities), superficial floor areas, cubic volume, storey enclosure value etc (Ashworth, 2004, Brook, 2004).

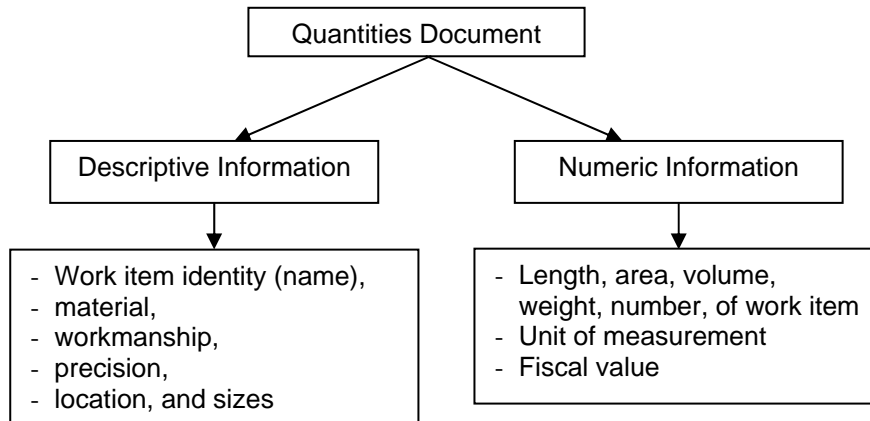


Fig. 1.2 Components of Quantities Document

2. CONCEPT FOR MEASURING CHALLENGE OF QUANTIFICATION

The challenge of quantifying construction work is identified as directly related to the severity of problem encountered and frequency at which it occurs. The following mathematical relation is adopted to explain the challenge that quantity surveyors and project managers face in quantifying construction work for the purpose of project control.

$$\text{Degree of Challenge} = \frac{\sum (\text{Severity of problem} \times \text{Frequency})}{\sum \text{frequency}} \quad (1.1)$$

The severity of a problem encountered during measurement takes into consideration the contribution of the problem to the distortion of the information provided by the quantity document resulting from the quantification process as well as the ease with which the problem could be avoided or fixed. The frequency of occurrence of the problem therefore acts as a weighting of the challenge posed by the problem. The challenges posed by the various problems as well as the problems themselves are therefore described as 'very severe', 'severe', 'moderate', 'minor' and 'insignificant'. The frequency of occurrence of a problem is described as 'always', 'very often', 'often', 'sometimes' and 'never'. These descriptors are assigned numbers on a five point interval scale of 1 to 5. Similar approach is used to measure the severity of a problem. The assigned numbers are used to carry out quantitative calculations and the results interpreted with the descriptors

The level of impact of these challenges on construction project control is measured by the frequency of use of quantity document for the various aspects of construction control. The level of impact of a challenge on construction project control is therefore assumed to be directly related to the degree of challenge and the intensity of use of quantity document (QD) for the control process.

$$\text{Level of Impact on Control} = \frac{\text{Degree Challenge}}{\text{Average Frequency of use of QD}} \times \quad (1.2)$$

The degree of impact of the challenge on project control is also described as *very high*, *high*, *moderate*, *minor* and *insignificant*. These descriptors are also assigned numbers on a five grouped interval scale of 25-20, 19-15, 14-10, 9-5, and 4-0 representing *very high*, *high*, *moderate*, *minor* and *insignificant* respectively in that order.

3. METHODOLOGY

The problems or difficulties encountered during quantification of construction works were first identified by a process of informal interaction and interview of quantity surveyors and project managers over a period of three months. The major problems identified are poor quality of drawings, poor specification, low remuneration, difficulty in interpretation of standard methods of measurement, difficulty in carrying out measurement on site and limited time to carry-out measurement.

The severity and frequency of these problems were measured on a five point interval scale as explained above, based on the rating of Quantity Surveyors and Project Managers who perform measurement functions.

Telephone was used as a medium for administering the questionnaire which took seven to ten minutes to complete per respondent. The rationale for choosing this medium was to save cost, time and to assess the response rate of telephone interview in Ghana. The methods used in previous researches in the Ghanaian construction industry include face to face, post and e-mail questionnaire administration which often yields a response rate of about 50% (Badu et al., 2004, Dansoh and Akyempim, 2004, Hohoabu, 2003).

Purposive sampling was adopted using the snowball approach. Known Quantity Surveyors were first approach who after responding to the questionnaire suggested other Quantity Surveyors who have the capacity to provide the required information. The snowball sampling approach was used so as to obtain the phone numbers and cordial introduction to the respondents. This was after an initial attempt to randomly interview quantity surveyors from companies that are members of the Association of Building and Civil engineering Contractors of Ghana yielded almost 0% response

rate on the phone. This initial attempt was met with phone contacts that could not go through and reluctance on the part of respondents to answer questionnaire on the phone as they do not know the researcher in person.

In the snowball approach, 20 quantity surveyors and project managers were interviewed and the response rate was 100%. The interview was conducted on a weekend and respondents were ready to answer questionnaire once they know the person who provided their phone contact to the questionnaire administrator. Respondents who were busy at the time of first call, called back when they were free to respond to the questionnaire. Though this approach introduces some bias by excluding potential respondents that were not captured by the snowball net, it allows respondents to feel at ease and co-operate fully with the researcher. It also saves time and cost as the questionnaire was completed within 2 days.

To ensure internal validity respondents were asked to explain how they understood each question before they responded to it. Where a respondent understood the question differently it was further explained to him on the phone. The reliability of the survey instrument was evidenced in percentage of modal responses in results tables (table 1.2 and table 1.3)

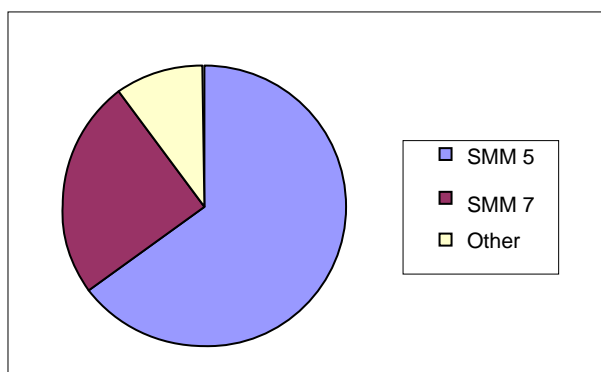
4. RESULTS AND DISCUSSIONS

Generally the results indicate that the fifth edition of the Standard Method of Measurement of Building Works (SMM 5) published by the Royal Institution of Chartered Surveyors is most commonly used in Ghana followed by the seventh edition (SMM 7) of the same document (Table 1.1, Fig. 1. 3). While these standards are used in quantifying building works the civil engineering standard method of measurement was used in quantifying civil engineering works.

Among common challenges faced by quantity surveyors in measurement in Ghana, the most severe of them is poor quality of drawings followed by limited time, lack of skills to quantify certain work items (usually engineering and mechanical installations), poor specifications, low remuneration difficulty in interpreting the SMM and difficulty in measuring work on site. whereas the challenges posed by poor quality of drawings, limited time, lack of quantification skills to measure certain items of work, and poor specification are severe; low remuneration, difficulty in interpretation of SMM and measurement of work on site pose moderate challenges (Table 1.2). The impact of these challenges is found to have the highest effect on cost control followed by time control and quality control of construction projects (Table 1.3).

Table1.1. Standard Methods of Measurements used in Ghana

SMM	SMM 5	SMM 7	Other	Total
Frequency	13	5	2	20
Percentage	65%	25%	10%	100%

**Fig.1.3** Standard Method of measurements used in Ghana

4.1 Poor Quality of Drawings

Poor quality of drawings posed the greatest challenge because most Quantity Surveyors (QS) were of the view that whenever drawings are not properly presented they find it difficult to obtain the information from any other source for quantification purposes. The aspects of drawings complained about include poor dimensioning, poor harmony between architectural, structural and services drawings, lack detail drawings for construction. These problems often compel the QS to guess, or allow provisional quantities for certain aspects of work during measurement. The net effect is distortion of the information provided by the quantity document. The challenge is often minimised when the QS finds himself on such projects of repetitive nature as he uses his experience from previous projects to determine what quantities are expected from other projects. Since drawings are not produced by QS and Project Managers (who quantify the work), designers such as Architects, Civil Engineers and other engineers should always have a feed back on the effect of the deficiency in drawings on project control.

4.2 Limited Time to Carry out Measurement

Short time provided to QS to quantify work is seen by the respondents as a canker that takes away the QS social life. It is therefore rated as one of the

severe challenges the QS face. The respondents criticized clients for giving ample time to other design professionals, while QS are required to produce the quantities almost immediately. Similarly during construction, they are occasionally required to provide quantities within unrealistic time periods. The result of this was, low productivity, as well as quantification errors, and stress.

Table 1. 2. Degree of Challenge of Quantifying Construction Works

Problem	Mean Severity of Problem	Mean Frequency of Problem	Modal Response		Modal Response as Percentage of Total Responses (%)		Degree of Challenge	Degree of Challenge
			Severity	Frequency	Severity	Frequency		
Poor Quality of Drawings	4.25	2.9	5	2	45	40	4.26	severe
Poor Specification	3.6	3.06	4	2	40	50	3.59	severe
lack of Quantification Skills	3.6	3.2	4	2	30	80	3.68	severe
Low remuneration	3.25	3.1	3	2	60	35	3.39	moderate
Difficulty in Interpreting the SMM	2.8	2.05	3	2	35	80	2.83	moderate
Difficulty in measuring Work on Site	2.7	2.1	3	2	45	65	2.64	moderate
Limited Time to Quantify Work	3.7	3.25	3	3	45	35	3.85	severe

Table 1.3. The level of impact of problems on construction project control

PROBLEMS	Degree of Challenge	Cost			Time			Quality		
		Mean Frequency of Use of QD	Level of Impact on Control	Interpretation	Frequency of Use of QD	Level of Impact on Control	Interpretation	Frequency of Use of QD	Level of Impact on Control	Interpretation
Poor Quality of Drawings	4.26	4.30	18.32	high	3.60	15.34	high	2.75	11.72	moderate
Poor Specification	3.59	4.30	15.44	high	3.60	12.92	moderate	2.75	9.87	minor
lack of Quantification Skills	3.68	4.30	15.82	high	3.60	13.25	moderate	2.75	10.12	moderate
Low remuneration	3.39	4.30	14.58	high	3.60	12.20	moderate	2.75	9.32	minor
Difficulty in Interpreting the SMM	2.83	4.30	12.17	moderate	3.60	10.19	moderate	2.75	7.78	minor
Difficulty in measuring Work on Site	2.64	4.30	11.35	moderate	3.60	9.50	minor	2.75	7.26	minor
Limited Time to Quantify Work	3.85	4.30	16.56	high	3.60	13.86	moderate	2.75	10.59	moderate
Average Impact			14.89	high		12.47	moderate		9.52	Minor

4.3 Lack of Adequate Quantification Skills

Most respondents stated Electrical and other Engineering Installations in building as the aspects in which they lack quantification skills. They often give provisional sums for these sections of work while materials used and day-works are employed to quantify these sections of the work during construction. Most Services Engineers capitalise on this lapse to produce Building Services Bill of Quantities, which do not conform to any of the standard methods used in quantifying construction work in Ghana. The usual result is confusion as to the comprehension of the services bill of quantities. The effect is difficulty in controlling the cost of building services. The academia and the industry require putting in further effort in training QS and Project Managers in quantification of construction so as to allay this problem (Fortune *et al.*, 1994) (Fortune C. and Skitmore, 1994). The introduction of simplified standard method of measurement could provide an alternative solution to this problem.

4.4 Poor Specification

Similar to poor quality of drawings, specification is hardly provided by designers. Most respondents indicated they request specification at the time of quantification, which often is provided verbally or they use their discretion to provide the necessary specification during quantification of work items. To overcome this challenge the industry need to adopt a new attitude which requires the compulsory provision of all details of specification.

4.5 Poor Remuneration

Respondents point out that this challenge is moderate as levels of remuneration are generally low in developing countries. However this should not be overlooked as respondents indicated they are much more motivated and cautious with the quantities they measure whenever they are well remunerated for their quantification work. Minimum remuneration level need to be enforced or alternative methods of motivating Quantity Surveyors could be adopted to improve the quality of quantities they produce for controlling construction work.

4.6 Difficulty in Interpretation of the Standard Method of Measurement

The respondents reveal this is a moderate challenge to them as they study the standard method of measurement during their training. The problem of interpreting the standard method of measurement arises when certain

ambiguous clauses are encountered. However they do come to an agreement as to the interpretation of the clause, hence it does not pose serious challenges. The standard methods of measurement in use in Ghana now need to be reviewed to conform to the Ghanaian practices and jargons in order to avoid this difficulty (Ofori, 2000).

4.7 Difficulty in Measuring Work on Site

This challenge is encountered whenever workmen want to conceal certain items of work as a result of some undesirable activities (such as poor workmanship, poor material quality etc), which was overlooked by supervisors, and might surface during on-site quantification of works. Other items are difficult to measure due to the fact that they were covered up at the time of measurement, or the QS could not identify the item at the time of quantifying the work. Often drawings are used or the assistance of the site supervisor is sought to quantify the work where it could be measured on site. Timely measurement in conjunction with site representative/supervisor could provide a solution.

4.8 Impact on Project Control

As shown in table 1.3, the major impact is on the project cost control which relies heavily on the information provided by the quantity of works. In developing countries project cost control is prime hence the impact of the challenges is worthy of concern (Kazi and Charoenngam, 1999). Where adequate control of cost is required these challenges must be adequately addressed in order to achieve it. Though the impact on time and quality is less, alleviating the effect of the impact on cost control will improve time and quality control of the project as well.

5. CONCLUSION

In summary, Quantity surveyors in developing countries face several challenges of which the major ones are poor quality of drawings, limited time to carryout measurement, lack of adequate quantification skills, poor specification, poor remuneration, difficulty in interpretation of standard method of measurement, and difficulty in measuring work on site. Of these, poor quality of drawings and limited time (to carry out quantification) are of greatest concern as they pose greatest challenge. The greatest impact of these challenges is on cost control. The effects of these challenges are of high consideration in developing countries since they are much more concerned with cost as compared to time and quality. Therefore, to ensure effective control of cost as well as time and quality enough attention should be paid to mitigating the effect of the above mentioned challenges.

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