

Adoption of Standard Based Pricing Method for the Procurement of Mechanical and Electrical Engineering Services in Malaysia

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Abstract: Adoption of standard – based pricing method for building services could improve the reliability and consistency of its early budget estimate. This study evaluates the provisions of the standard method of measurement in use in Malaysia in relation to current building services cost management. The study found that the reliability of building services budget estimates could be enhanced if the detailed rules of measurement is adopted as the basis for preparing its bills of quantities. However, this may require the development and adoption of the building service standard method of measurement that would reflect local practices, adoption of value engineering and enhancement of quantity surveyors capacity in the technology of building services.

Index Terms: Adoption; Building Services; Budget Estimate

I. INTRODUCTION

Mechanical and Electrical Services (M&E) is an important subsector of the construction industry that requires improvement in the procurement and cost management process. This will enable the Subsector to meet up with construction Industry Development Board's (CIDB) plans to bring together all the players along the supply chain to collaborate in delivering cost effective solutions as stated in the Construction Industry Master Plan (CIMP 2006 - 2015). Meanwhile, the M&E services cost according to [1] constitute about 40 percent of total building cost in Malaysia, but in a more developed countries, the cost of M & E services according to [2], can make up between 10 to 70 percent of total construction costs. Construction Industry Development Board [3] expressed concern on non adoption of uniform method in preparing bills of quantities for this complex and ever increasing element of buildings. In addition to lack of generally accepted standard method of measurement for M&E services, [4] opined that the major cause of this problem

includes a reluctance to change, lack of regulating and enforcement body, very slow learning curve, attitude and clients insufficient knowledge of the benefits of adopting the standard method in preparing bills of quantities for M&E services.

It is essential to state that, adoption of Standard Method of Measurement (SMM) for preparing Bill of Quantities (BoQ) for M&E services in buildings is essential in order to achieve better value for client's money in a transforming economy. This argument is underpinned by the fact that the value and complexity of M&E services in modern buildings are becoming more complex and practitioners have failed to adopt Standard Method of Measurement as a basis for forecasting contract price of M&E services as used for building fabrics and finishes [3]. As part of a larger and ongoing research work, on M&E services estimating process improvement through SMM, this paper provides a brief explanation of M&E services systems in buildings. Analysis of some SMM clauses and current practice in Malaysia was carried out. Lastly, for this to be accomplished, the study suggested measures to facilitate the adoption of SMM for preparing M&E services BoQ in Malaysian Construction Industry.

II. STANDARD METHOD OF MEASUREMENT (SMM)

Standard Method of Measurement (SMM) according to [5, 6] is a document that provides "a uniform basis for measuring building works and the purpose is to ensure that bills of quantities (BoQ) fully describe and accurately represent the quantity and quality of the works to be carried out". It is also described as a document that contains a standard format for the presentation of a measured work and set of rules which are mutually known and accepted [7]. According to [8], SMM set out detailed rules for the measurement of commonly occurring works and provides guidelines as to what a tendering contractor is to allow for against each measured item. One important purpose of Standard Method of Measurement is set out in section A (General Rules) of Malaysian Standard Method of Measurement (MYSMM2) [9] clause A.1 which states that

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"this Standard Method of Measurement provides a uniform basis for measuring building works and embodies the essentials of good practice....."

Clause A.2 further states that

"Bills of quantities shall fully describe and accurately represent the quantity and quality of the works to be carried out....."

However, the Standard – Based BoQs are more than mere physical quantities of the work to be executed as the description of measured work items provides the economic and legal framework under which the work would be executed [10, 11]. Moreover, it is widely accepted in the industry that measurement is central to the financial management of construction projects and it involves the Quantity Surveyor in measuring different types of work as shown on the drawings produced by the architect or engineer. The quantities are prepared in line with the rules of accepted SMM and the tender document prepared is referred to as BoQ. The completed BoQ is normally forwarded along with other documents for the contractor to price [12]. In essence, the purpose of BoQ according to [8] will fail unless there is agreement as to the exact manner in which the items in the BoQ are to be measured and; the exact requirements as to what is to be included in the rate for each item. Therefore, for a successful procurement to occur, the bidding information must possess the following attributes [10]:

- The contents of the information must convey equal meaning to all the parties involved with the project at the various stages of its implementation.
- The information must have clear and unambiguous rules with respect to the authority and responsibility of all parties involved with the project.
- The extent and quality of work envisaged should always be visible, and the various parts or sections of the information should at all points in time be consistent with each other.

The bills of quantities that is based on or prepared in line with detail rules of Standard Method of Measurement (SMM) actually contain data and information that have been effectively coded by the regulation of the said SMM and stored in the open pages of the bills, ready for retrieval by the estimators for further analysis as an integral part of the process of contract procurement [13, 8].

III. CURRENT PRACTICES IN MALAYSIA

The Malaysian Standard Method of Measurement of Building Works (MYSMM2) currently in use in Malaysia published in 2001 and it constitutes key aspects in the preparation of tender documents for new buildings in Malaysia Construction Industry (ISM, 2001). However, in MYSMM2, the rules for measuring building services are referred to under section Q (Plumbing and Mechanical Engineering Installations) and Section R (Electrical Installations). While section Q covers rule for measuring plumbing and mechanical engineering installations, section R provides rules for measuring electrical installations. The rules of measuring Plumbing and

Mechanical Engineering Installations in buildings are given under a total of 32 clauses while the rules for measuring electrical services installations are given under a total of 24 clauses. All the clauses and sub – clauses are arranged under the following headings:

- Q.1 & R.1 – Generally (information)
- Q.2& R.2 – Classification of work
- Q.3 & R3 - Location of work, the remaining key clauses of section Q and R with their respective unit of measurements are shown in Figures 1 and 2 [14].

In addition to the provisions of sections Q and R, the rules in sections A – General rules and B - Preliminaries of MYSMM2 are also applicable. Moreover, some of the clauses under sections Q and R provided cross references which require measurement to be done in accordance with the rules of some other sections. A typical example is in clause Q.32.1 and R.24.1 which requires trench excavation for pipes to be given in accordance with clause D.12.9 and V.2. Similarly, clause B.8 (1-2) of MYSMM2 required works to be carried out by a nominated sub – contractor to be given as prime cost sum (PC sum). It provided an item for general attendance which is deemed to include the use of main contractor's temporary roads, pavings and paths, standing scaffolding, subcontractor's site office security among others and all these shall be without charge to the sub – contractor. However, the provisions in some of the M&E tender documents currently used for the procurement and cost administration of M&E service projects often require among others that:

"the sub – contractor shall be responsible for the provision, erection, maintenance and removal of all his temporary office and payment of other charges; reimburse all expenses by the contractor for the repair of roads in proportionate amounts of his contract sum to the total contract sum"

This kind of provisions will make the items of attendance to be priced twice (first by main contractor under PC sums and secondly by nominated sub – contractors) at the expense of the employer. In addition, sub-contractors are subjected to unnecessary pressure of having to construct temporary structures that are not part of core specialist work. Contradictions of this nature could be avoided if the rules of measurement are strictly adhered to and clients will not be made to bear the risk of the likely disputes resulting from this kind of inconsistencies.

Generally, the Implication of the Provisions of MYSMM2 is that tender documents prepared on its basis must be priced in accordance with the rules of the method and requires that the estimator should have full working knowledge of the method concerned. Some of the rules in standard method may not be adequate for measuring some types of work items and it is in view of this that MYSMM2 provided in clause A.2.2 that

"rules of measurement adopted for work not covered by these rules shall be stated and such rules shall as far as possible conform with those given in this document for similar work".

This provision is essentially necessary in the context of Malaysian Construction Industry because, the construction

methods and cultures from different corners of the world are significantly in use in addition to local practices and construction procedures in Malaysia as against the system of construction in the United Kingdom (UK) construction industry where SMM originated from.

Furthermore, there are some “deemed included items” which requires estimators to be conversant with the rules of MYSMM2 because underestimation of deemed to be included items could lead to under pricing, similarly, overestimation of ‘deemed to be included items’ could lead to overpricing of work items.

However, the provisions of this important document are not used in the preparation of BoQ for M&E Services in Malaysian Construction Industry. In the study conducted by [15] on the Consulting Engineers perspective on the Standard Method of Measurement in Malaysia, he stated that: schedule of prices is often used rather than bills of quantities for M&E services works; and where BoQ is used the method of Measurement are usually spelt out either in the preamble to the BoQ or in specifications and different consultant may have different bills of quantities. The lump sum contract is stated to be the most popular for procurement of M&E services in Malaysia [16, 17, 18]. Clients’ interests are often protected with a disclaimer and similar contractual provisions such as:

“the successful tenderer shall provide all materials and necessary fittings and perform any work which is necessary for the proper and efficient function of the complete electrical system even though such materials, fittings or works may not be explicitly mentioned in this specification or shown on the drawings attached to this specification.....” [16].

Although, according to [19] this type of provisions will safeguard the interest of the employer from being held accountable to the contractor for any inaccuracies in tender documents. Nevertheless, [8] opined that such provisions are “short – sighted in the extreme and serve only to destroy the primary functions of BoQ”. Molloy further argued that if the engineer does not know for certain what is allowed for in each rate, how can he use those rates for the valuation of variations? Similarly, if one of the “deemed included” item is omitted how can such omission be valued? [20] observed that a financial vacuum that is difficult to manage is created when building services tenders are invited on the basis of the lump sum and schedules because this often give rise to a wide difference between the highest and the lowest tender and it is subject to manipulation by experienced contractors.

Furthermore, where BoQ are used, the method of measurement is rarely detailed enough to provide a uniform basis for contractors to submit tenders on a uniform basis. For instance, Table 1 shows a brief comparison of MYSMM2 requirements for measuring cables and what is currently practiced in Malaysia.

In the first place, the type of provision in “**PB.1**” above will make tender preparation more complex because it shows that the BoQ is not comprehensive enough and the contractor must re –check for any omitted items, perhaps by engaging a quantity surveyor, consequently, increasing the time and cost required by contractors to submit tenders. In addition, the

descriptions of items in “BoQ.1 and BoQ.2” as shown in Table 1 are inadequate and cannot be said to have provided a uniform basis for tendering contractors to submit a quotation. Similarly, at post contract stage, cost control exercise is complicated. The overall effects of these are:

Table 1: Current Practice in Measuring cable and SMM2 Provision.

| Current Practices | SMM requirements |
|--|--|
| BoQ.1 Supply and install 70 x 4 core pvc/swa/pvc cable laid underground complete with excavation and backfilling and cable slabs from substation to main switchboard and any other necessary specification | Cables R15.2f: 70x4 core pvc/swa/pvc copper conductor; laid in trenches (trench and duct measured separately) (Lin.m) Builders’s Work R.24.1: Excavate trench for cables commencing from existing ground level, width not exceeding 250mm, average depth 250 – 500mm and backfill with clean river sharp sand and remove surplus from site (Lin.m). R.24.2 : 450mm long x 150mm wide x 50 mm thick plain precast concrete mix (1:2:4) cable protection tiles overlay on armoured cable (Lin.m). |
| BoQ.2 Supply and install 25mm ² single core PVC cable on cable tray/ladder/trunking in accordance with the drawings and specification | Cables R.15.2b: 25mm ² single core pvc cables drawn into trunking. Trunking and fittings R.10: 200mm wide x 75mm deep overall purpose made trunking in 16SWG galvanized steel sheet, divided into 3 compartments with cable belt loops and 3no. Screwed access cover in accordance with drawing no..... (Lin.m) R.10.2 : Extra over stop end; Bend etc (enumerate) |

In the first place, the type of provision in “**PB.1**” above will make tender preparation more complex because it shows that the BoQ is not comprehensive enough and the contractor must re –check for any omitted items, perhaps by engaging a quantity surveyor, consequently, increasing the time and cost required by contractors to submit tenders. In addition, the descriptions of items in “BoQ.1 and BoQ.2” as shown in Table 1 are inadequate and cannot be said to have provided a uniform basis for tendering contractors to submit a quotation.

Similarly, at post contract stage, cost control exercise is complicated. The overall effects of these are:

A. Difficulty in tender evaluation.

Tender assessment is complicated because items in the bills of quantities are not comprehensive and the contractor is deemed to have allowed for all required items whether or not they are measured. For instance, the description in “BoQ.1” comprises of three measurable items that are required to be quantified in linear meters according to MYSMM2 (Cable, Excavation and cable cover). The problems that can arise in this situation are in two folds

The first problem is that it becomes impossible to know the items the contractor actually allowed for and those items that were not allowed for during the tender assessment.

Secondly, even when contractors allowed for these items, different contractors can price for these items in different ways – the width and depth of excavation, the type of covering materials (if concrete, what mix ratio) the contractors have assumed. Under “BQ.2” however, there are various sizes, make and quality of trunking materials – the price of tenderer quoting for coated steel trunking will be different from the contractor quoting for galvanized trunking. Fair judgement during evaluation under these circumstances is questionable and difficult for consultants to claim that analysis of tenders have been carried out on the same basis [8].

B. Problems in assessing the amount due in interim valuation

Interim valuation becomes difficult to prepare since there was no proper breakdown of items of work at tender stage. Just as enunciated above, during progress of work, if the contractor has carried out excavations and supplied cable. The exact amount due to the contractor is disputable and the contractor may not agree because the basis for valuation was not properly defined at tender stage [8].

C. Difficulty in agreeing value of Variation

Establishing a basis for valuing change order during the progress of work is complicated. The conditions in the standard forms of contracts require that the variation be valued using the “rate stated in contract bill for such work”. If the description and measurement unit of a particular item is omitted or not properly described, there is a possibility that contractor will claim for variation which might be high in cost. Under this type of arrangement, determining the impacts that variations can have on the contract price and time can be arduous due to the interconnected nature of the construction work and the difficulty in isolating factors M&E services to quantify them. Nevertheless, the most frequent effects of variation order have been identified as: increase in project cost; rework and demolition; delay and possible time overrun; increase in overhead expenses [18]. Sometimes when not properly administered, it can result to disputes

between the contractor and the client. This could result into more cost being incurred by the client as highlighted below:

- i. Delay to overall programme leading to extension of time, - another problem that can arise is time taking to resolve contractual problems arising from incomplete pricing information. It should be noted that time would be required to order for materials when variation is finally agreed, the lead time and time to fix these will again impact on other works in the line. For instance, owing to the nature of M&E services finishing work cannot commence until the completion of variation work, and if already done, then, a rework will be considered in the part affected.
- ii. Probable loss and/ expense by the contractor - the cost of delay lost of profit and additional overhead cost will have to be claimed by the main contractor. In addition, claims will also be made on the cumulative impact of the changes on other work and associated builder's work.
- iii. Disputes on methods of measurement – another problem is that the standard forms of contract in use in Malaysia (CIDB 2000; PAM2006 and PWD 203A) require that bills of quantities for construction project be prepared using approved Standard Method of Measurement in Malaysia, therefore, if an allegation of under - measurement or inadequate information for pricing purposes arises on a contract against the employer. The court will likely take account of the contents of and exact interpretation of the Standard Method of Measurement in use at the time the tender document is prepared [6]. It should be noted that these can have a negative effect on the progress and consequently lead to time and cost overrun.

Another important factor under the current M&E services procurement is that, contractors are given liberty to select the brand and country of origin of most equipment. Although, it is argued by practitioners that, they are not allowed to name a specific suppliers or components manufacturer, however, the problem with this is that, in the Malaysian Construction Industry, there are significant variations in material quality and costs and it is possible to find a range of materials and plant with similar design capabilities, quality attributes and manufacturing standards, but with significant variation in the efficient life cycle and market prices. It will be difficult to assess the most responsive tender price when bids are being evaluated. It is therefore reasonable to state that, forecasting cost of M&E services is therefore unrealistic unless the component design, quality and market place attributes and in some cases the manufacturer can be fixed. The mechanisms traditionally employed by quantity surveyors to achieve the communication of project quality specification and uncertainty attached to a proposed project are the adoption of Standard Method of Measurement to prepare detail bills of quantities. It is therefore desirable and reasonable to suggest that, practitioners should be allowed to specify M&E service

components of required make or equal and approved specifications in order to safeguard wide variants from anticipated quality and quality actually supplied and installed by contractors.

In modern day buildings where building services had expanded into building intelligence, coupled with pre-fabricated and pre-assembled building services components. There would be more items and categories of building services components in the procurement of building services. Therefore, a detailed BoQ, based on the rules of measurement would be fairly easy for the quantity surveyors to detect extremely high or extremely low rates entered by the tenderer as all the tenders can be tabulated comparatively under similar guidelines. This will also create good opportunities for the adoption of value engineering. Analyzing and comparing item rates in BQ will be of great help during the negotiation for a discount with the successful tenderer. Similarly, at the post-contract stage, progress billing can be monitored with more understanding between parties. Variations can be easily and consistently assessed with less time and dispute. In addition, in the context of handling overseas projects where there are cultural differences in language communication, building service book is most advisable to avoid misunderstanding. The primary interest of all clients of the industry is to get the project implemented according to plan and within budget. Clients will be assured that their contract with the prospective contractor has been subjected to thorough and fair evaluation and they will get more definite value for his money.

IV. CONCLUSION

In order to overcome the problems of data quality and the absence of M&E services cost information in a standard and required format, it is necessary to create a framework that will enable the construction industry to maintain M&E service project cost information in a common format.

As a starting point, the adoption of Standard Method of Measurement for M&E services can make a considerable contribution in this direction. In essence, there is an urgent need for the industry stakeholders to develop and adopt SMM for preparing BoQ for M&E services so as to reduce the risk of price uncertainty and achieve better value for client's money in a rapidly transforming economy. SMM for M&E services will provide home-ground advantage for practitioners and will go a long way in preparing building services sub-sector of Malaysian Construction Industry for the challenges of planned liberalization of the services sector of the economy. However, to achieve this, the following should be considered:

- There should be a concerted effort from industry stakeholders and academia to develop an academic framework to underpin cost management of M&E services in buildings. Specifically, there is need for M&E quantity surveyors take charge of the cost management of building services in collaboration with M&E design

consultants, this is the current trend in countries like the United Kingdom, Australia and Hong Kong. Some multidisciplinary consultancy organizations in Singapore and Malaysia are already leading the way in this practice, by employing specialist M&E quantity surveyors and providing these services to their clients as part of cost management service. Therefore, integration of this type of practices should be encouraged by the appropriate policy framework in the context of Malaysian Construction Industry. In addition, there is a need to improve on the background training of engineers in the areas of building services as the current university curriculum in the country does not give adequate consideration to the specific knowledge of building services and therefore the subject of building services was not fully delved into in the background training of engineers. It is therefore, important, to emphasize on developing building services as a special discipline away from current practices where knowledge of building services is only fully acquired in practice. This will make it possible to institutionalize professional body like Chattered Institute of Building Services Engineers (CIBSE) as obtains in the United Kingdom.

- Development of national standards for uniformity in pricing items of M&E services is essential. This will require high level collaboration between key industry stakeholders to come up with a Standard Method of Measurement that will reflect local practices and standards. Strategies to encourage practitioners to adopt SMM for M&E services should also be instituted. This standpoint is necessary because, the current MYSMM2 is still in prose format which is years behind what is obtainable in other countries like Singapore, United Kingdom, Australia, South Africa and Honk Kong where the Common Arrangement of Work Sections (CAWS) has been adopted as framework to classify SMM information in tabular format that will aid application of Information and Computer Technology (ICT). Similarly, the use of Building Information Modelling (BIM) for estimating purposes will require filtering BIM data to comply with the rules of Standard Method of Measurement.
- A strategy should also be developed to involve the major downstream supply chain at the inception of the M&E service project to reduce the risk of incomplete design information.
- The application of Value engineering is essential in processing clients' requirements on major M&E components at the inception stage of building projects. This will ensure that quantity surveyors and M&E design consultants collaborate early on building services projects to consider the cost implications of various design alternatives before the selection of the best alternative that will meet clients' value criteria. This constitutes a useful approach for M&E services and will minimize buildability problems at post contract stage

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