

THE DETAILED ESTIMATE MODEL FOR CONSTRUCTION PROJECTS IN YEMEN

Waled Gaber M. Hakami, Dr. Awad Saad Hassn, Dr. Adil Abdallah Mohammed

Abstract— The construction industry is one the largest industries in most of the countries throughout the global world. The important problem that faces the estimators is an inaccurate estimate in tender stage. The knowledge of the cost estimate formulates the base of engineers' mentalities in cost estimate in order to gain most highly accurate cost estimate. In this study, the detailed cost estimate was adopted to study in Yemen country which is considered as one of the developing country. Other variables were obtained from previous researchers' model were contributed with the knowledge to introduce the model. The research methodology was adopted is a qualitative method. This qualitative was obtained from the literature review. After the authors have taken a wide over look on the literature review; the knowledge and other variables constructs were formulated the qualitative model. This model can measure the situation of detailed cost estimate of Yemeni's construction projects.

Keywords- Cost estimate, inaccurate, knowledge, Qualitative

I. INTRODUCTION

Most of the firms have tried to achieve the maximum sufficiently of cost estimate in bedding stage as well as the success detailed estimate avoid the firms the failure in the market. Furthermore, the knowledge of construction cost estimate support the detailed cost estimate, because this knowledge were ignored and not understood by most estimators in the field of construction industry in Yemen. Cost is one of the three main challenges for the construction manager, where the success of a project is according to the criteria of cost with budget, schedule on time, and quality [1]. Tendering process and effective estimating is considered a key to the success of a construction project. The detailed cost estimate for a project is one of the most difficult tasks in project management (al-shanty, 2003). Further, detailed cost estimate is one of the most important processes during tender stage which is a very competitive process in the construction industry. This study aims to formulate a qualitative model of detailed

estimate which leads the Yemeni's estimators to estimate their projects successfully. Furthermore, they would be proactive in their firms to raise their firms' performance.

II. KNOWLEDGE OF CONSTRUCTION COST ESTIMATE

Many researchers have studied the construction industry in which is one the largest industries in most of the countries throughout the global world. It is the creator of the built environment within which most other economic activities take place. It is also one of the most volatile in economic terms with extreme behaviour in both good and bad times. Thus, the construction has a pervasive influence on social activity in modern society. Therefore, understanding the nature of such behaviour is crucial at both macro and micro levels in the management of the industry and its constituent organisations [2]-[3].

The Standard Industrial Classification Manual (1987) (SIC) divides construction into three broad types: building construction done by general contractors or operative builders, heavy construction done by general contractors and selected specialty trade contractors (highways, power plants, etc.), and construction done by specialty trade contractors such as electricians, plumbers, and painters [4]. In addition, the construction industry is vast and varied, considering from homes to highways to hospitals, built political capitals, great cities bustling [5].

A. Construction's GDP and the Level of Per Capita National Income

The construction industry in developing countries may be viewed as a sector of the economy which is responsible for the planning, design, construction, maintenance and eventual demolition of buildings and works [6]. A number of authors who have investigated the relationship between the construction sector and economic development have found a positive relationship between the share of construction in GDP and the level of per capita national income as well as there is a relationship between construction activity and economic development [7]-[8].

B. Construction Industry in Yemen

Yemen, situated along the south-eastern edge of the Arabian Peninsula, has an area of some 531,870 square kilometers and an increasing population of over 24.4 million people. There are unique heritage of buildings, urban centres and civil construction. Reference [9] conducted for explaining the Yemeni situation briefly which referred that Yemen is the one of the poorest countries in the world with a low standard of public health and education, and high

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population growth rate. As well as housing for low income was inadequate.

Some other features of society in Yemen which affect the construction industry are the tribes which are not ethnically diverse but, rather, culturally homogenous units. They share the same functions both in terms of their role in promoting the welfare of their members and in conflict management mechanisms and systems. Due to the political instability that Yemen experienced for long periods of its history, tribes came to function as states [10]. Furthermore, the difficulties associated with the Yemen construction industry which may be the high construction cost, unstable prices, inefficient planning and weak contribution to the socio-economic development [9].

C. Construction Project's Cost Estimate

Reference [11] defined the cost estimate which is "an assessment of the probable total cost of some future activity". Another definition was obtained that the estimate is "a summary and an educated guess which was based on the best information available of probable quantities and costs of materials, labour, equipment, and subcontractors to complete a project, including taxes, overhead, and profit." Consequently, they are used to develop the project bid price. [5].

D. Classification of Construction Costs

Construction cost is classified in most construction projects into direct cost (variable cost) and indirect costs (fixed cost) in which the estimator has to distinguish all the types of those two classifications. According to the direct costs are those costs that are directly attributable to the project, such as salaries, travel, and buying or renting equipment for the explicit use of the project. The following items are considered as direct costs: Material, Labour, Equipment, and Subcontractors [12].

Furthermore, the indirect costs are the expenses incurred in order to manage and deliver the materials, labour, equipment, and subcontracts employed on any given job. They are much more than expected according to the given project but some of the common items include the following but is not limited to: supervision, job trailer expense, building permits, temporary utilities, scaffolding, freight charges, sales tax, testing and inspections, job photographs, safety supplies, chemical toilets, security fencing and barricades, trash and debris removal, cleanup, and bonds and insurance [5]. On the other hand, the indirect cost was discussed to include the costs of infrastructure for human and physical resources, sick leave, vacation, training, retirement benefits for the employees, portions of the salary of supervisory personnel, and again to the extent that the resources are indirectly associated with the project [12]. Some other researchers stated that the construction costs can be classified into five types, which constitute the total cost of the project; they can be classified as follows: material cost, labour cost, equipment cost, overheads, and markup (Risk allowance & Profit) [13]-[14]-[15].

E. Types of Construction's Cost Estimate

There are different types of estimates which vary according to several factors including the purpose of estimates, available quantity and quality of information,

range of accuracy desired in the estimate, calculation techniques used to prepare the estimate, time allotted to produce the estimate, phase of project, and perspective of estimate preparer [16]-[17].

1) Conceptual and preliminary estimate

A top-down, order of magnitude, ballpark, feasibility, quickie, analogous, or preliminary estimates are also defined as Conceptual estimate. The accuracy range is expected to be +50% to -30%. It is a pre-design estimate which usually performed with limited or no design and engineering information. The information availability in these early stages is usually high-level information, such as number of building occupants, gross square footage area, or building enclosed volume. Importantly, the historical information is used to predict future cost of the new project [18]. The Conceptual estimate is also a rough approximation of cost within a reasonable range of values, prepared for information purposes only, and it precedes design drawings [14].

In addition, a discussion referred to the conceptual (preliminary) estimate which is often called ballpark estimates when the project is an idea or in concept stage in order to advise the owner to accept the project economically and technically [5].

2) Engineers estimate

Engineers estimate was defined in which based on detailed design where all drawings are ready, prepared to ensure design is within financial resources and it assists in bids evaluating. The accuracy in this stage is -15% to +30% [14].

3) Detailed estimate

The detailed estimate which is called also bid estimate is done by contractor during tendering phase to price the contract. The accuracy in this stage is -5% to +15% [14].

4) Definitive estimate

This type of estimation is also performed during the project's construction phase or after the construction phase or after the construction completion to assess the final actual cost of the project [18].

F. Techniques of Cost Estimation

Cost estimation techniques can be categorized into several techniques as:

1- Qualitative technique

Qualitative approaches rely on expert judgment or heuristic rules [19]-[20]. The expert judgment may use combined methods for estimating depending on the expert experience [21].

2- Quantitative technique

Quantitative approaches classified into statistical models, analogous models and generative-analytical models [19]-[20]. Quantitative approach has mainly been divided into three main techniques according to [22]: Analogy-Based Techniques, Parametric Models, and Engineering Approaches.

G. Methods of Cost Estimation

There are numerous methods and levels of accuracy for preparing cost estimates for a construction project. The preliminary and detailed cost estimations are adopted for the

early stage in order to satisfy the client desires about his/her project as well as in the tender stage to assist the contractors to estimate the cost of the project accurately in order to avoid cost overruns and delays. For both preliminary and detailed technique its own methods, especially since preliminary methods are less numeric than detailed methods. Most commonly preliminary methods that are divided into two sets qualitative preliminary methods as opinion, conference, and comparison similarity or analogy and quantitative preliminary methods as unit method, unit quantity, linear regression, etc [13]. Clearly, a detailed estimate based on computed quantities after design work is complete and also known by Bottom -up estimate [18].

H. Project Delivery Systems AND Estimating

Different project delivery systems have been related to different types of estimates preliminary, and detailed at various stages. Reference [11] discussed from a wide knowledge of experience and science, in order to relate between the delivery system and estimate depending on how well the scope of work is defined at that particular stage. Design-bid-build delivery system is considered as traditional approach and is still used extensively. Furthermore, construction management organisation is the one alternative traditional system of project delivery in which to facilitate overlap between project stages used fast tracking technique. Design- Build Delivery, this approach, the owner deals with a single firm which are the responsible about both design and execution. It is known as turnkey and package forms that used in many type of projects, especially, the public private partnership or P3.

I. Estimates for Different Types of Contracts

A free discussion indicated that the firm-price lump-sum contracts may be used on most construction projects, owners may usually adopt a cost-plus alternative for reasons of the scope of work is ambiguous to define or when there is insufficient time to finish the design documents before work begins. Most important types of contracts are as following: Lump-Sum Contracts, Cost- Plus Contracts, and Unit- Price Contracts [11].

J. The Factors Affecting Construction Cost Estimate

Most important factors were discussed by many researchers from their point of view and investigation. Many factors affected the estimation cost in the construction projects are complexity of the project, the site location, and time of construction [5]-[23]. Another study suggested that two important factors were project type and material costs [23]. As well as, some crucial factors were added in which are quality of the work, market conditions, and management factors [5].

Geographic considerations were adopted as critical factor that affect the construction project estimate [24]. Moreover, many factors which caused inaccurate cost estimates were insufficient time for estimate development, inadequate specification, incomplete drawings, quality of project management, lack of historical cost data, and then a lack of confidence in structured site feedback [25].

Furthermore, the following factors which have also related to estimate are technological requirements, project information, project team requirement, contract

requirement, project duration, and finally, market requirements [26]. In general, a conducted study about the factors affecting cost estimate of contingencies in order to filtrate those important factors which were political and regulatory risks [27]. In addition, an allowance is a very important factor has affected the accuracy of estimate and mostly ignored by inexperienced estimators. Thus, these factors must take into consideration by estimators which are quantity allowance, escalation, contingencies, risks, and fees [12]-[28].

K. Cost Control

A definition of cost control is “to ensure that no preventable wastage of money or unauthorized increase in expenditure is allowed to happen”, as well as the understanding of cost elements are very important to control cost. Therefore, the project manager has to be deal with variable cost and fixed cost [29]. Another important issue explained that the cost code which is assigned to budget is used to track all items of work contributing to the overall project costs by manager [5]. The very important outcomes by control cost were indicated are (1) identification of any work items whose actual costs are exceeding their budgeted costs, and (2) estimating the total cost of the project at completion, based on the cost record so far and expectations of the cost to complete unfinished items [30].

L. Estimating and Construction Safety

The major occupational Safety and Health Administration (OSHA) safety standards have to be complied with the requirements of this legislation and may face possible fines or even imprisonment. Some important hidden costs with regard to safety were but are not limited to [11]:

1. Tool and equipment repair and maintenance costs
2. Production interruptions and delay costs
3. Legal expenses
4. Expenditure on emergency supplies and equipment
5. Replacement equipment rentals
6. Investigative and administrative expenses
7. Cost of hiring and training replacement personnel

M. Construction cost index

A definition of cost index is “the ratio of cost or price for a given commodity or service or set of commodities or services at a given time and place compared to the cost or price at a base or standard time and place”. Furthermore, cost indexes are based on present costs compared with cost history ignored the future escalation [31]. Consequently, the use of construction cost indexes provides valuable information to get the perfect success [32].

III. DETAILED ESTIMATE

Many of researcher discussed this issue from wide of models and experience in order to achieve a highly project efficient. Moreover, cost estimate is a great importance in tendering phase. Therefore, estimators have followed many processes in detailed estimate.

A. Decision to Tender

It is mainly the responsibility of senior management for both public and private projects after getting the information of the bidding to decide which the winner [11]-[23].

B. Base Estimate

The most important of bid documents mainly includes, but aren't limited to, drawings, specification, form of the contract, as well as some others documents have been prepared by contractor team and submitted to estimators to ensure the accuracy of cost estimate as following: (scope baseline, Resource calendars, Project schedule, Human resource plan, Risk register, Enterprise environmental factors, and Organizational process assets) which must be obtained and reviewed [34]-[24]-[21].

C. Measuring the quantities

According to reference [11], a quantity take-off has mostly been measured in "net in place" for Consistency, Objectivity, and Unit Price Contracts. Furthermore, the construction project consists of components, which must be measured as following but aren't limited to : sitework, excavation and piling, concrete work, masonry, metals, wood, thermal and moisture protection, doors and windows, finishes, mechanical work, electrical work, and jobsite overhead.

D. Site Visit

After the bid documents have been reviewed, the good idea and specific questions has been obtained about the project by the estimator is the site. The environment investigation may determine the financial risk, which can be added to the bid [11].

E. The Query List

After reviewing the drawings and the specification, some uncovered details will be shown. Thus, the query list must be prepared and submitted to designer to clarify those ambiguous matters [11].

F. Pricing the Quantities

There are five pricing categories that need to be considered labour, equipment, materials, subcontractors, and job overheads [11].

G. Management Review

Generally, all documents may be reviewed by top management before closing the bid in order to check the validity of estimate.

H. Closing the Bid

At the final of this period, the estimate prices are summarised all the documents of the bid and submitted to the place designated for the bid closing for summary sheets [11].

IV. RESEARCH METHODOLOGY

A. Research design

The qualitative research was debated in which is a means that is used to explore and understand the process of research in order to collect typically data which also analysed inductively. After that, the researcher making interpretation of the meaning the data [34].

B. Research Strategies

There are two methods of data collection: Qualitative and quantitative. In this research, the qualitative method was adopted. Thus, the qualitative method permits researchers to study selected issues in depth and detail. Approaching fieldwork without being constrained by predetermined categories of analysis contributes to the depth, openness, and detail of qualitative inquiry. A qualitative method typically produces a wealth of detailed information about a much smaller number of people and cases. This increases understanding of the cases and situations studied [35].

C. Literature review

In this study, the literature review was adopted as strategy for qualitative methods. Thus, a descriptive study sets out to collect, organize, and summarize information about the matter being studied; it is concerned with making complicated things understandable. The literature review on all aspects of construction cost helped to provide a detailed understanding of the state of cost estimate in terms of its research and its application within projects [36]. The literature review identified also the major factors which formulate the knowledge of construction cost in Yemen. In addition, the literature shares the results of other researchers between them, filling the gaps, as well as provides the frameworks and benchmarking which helps to compare the results with other findings [37]. For important concept in this study, suggested the literature can be a theoretical review in which the researcher could focus on the extent theory which relates to the problem of the study [38].

Some characteristics are suggested and adopted in this research as the following [37]:

- 1- The interpretive qualitative research in which researchers make interpretations of what they see, hear, and understand according to their own backgrounds, history, contexts, and prior understanding.
- 2- Holistic account which is a qualitative research that tries to make a complex picture of the problem or issues under the study. These involve multiple perspectives, identifying many factors affecting those problems.

In this research, the combined of the last two characteristics of the qualitative research were adopted to analyse and interpret the literature review in order to construct the big holistic qualitative model of this study.

V. RESULTS AND DISCUSSION

Numerous studies have shown the process of detailed estimate through models. This detailed estimate in tender stage is very important for contractors in order to offer bidding as success as they wanted. Most of researchers built their models depending on the process of estimate ignoring the knowledge of the cost estimate. Leng developed an estimation model depending on past models and knowledge transfer. Furthermore, those models were also developed in their process of estimate [18].

The following process were adopted in the literature review (decision to tender, base estimate, measuring the quantities, site visit, the query list, pricing the quantities, and closing the bid) which have taken partially or totally by most of researchers to estimate the detailed estimation. In this research, these processes were improved to formulate the optimum strong model. For these reasons, the knowledge of cost estimate model also contributed as a part of detailed estimate model in Yemen to ensure the correct results of estimate.

This first model of knowledge of cost estimate which was discussed and summarized in fig (1) according to reference [2]. In essence, the detailed estimate model was constructed to investigate this model in Yemen. Firstly, Decision to tender as choice for senior manager for bidding or not. Then, Base Estimate to collect and review all documents regarding to the project and the firm including but aren't limited to scope baseline, resource calendars, project schedule, human resource plan, risk register, enterprise environmental factors, and Organizational process assets. This process importantly considered as a base for estimating. Further, measuring the quantities formulates a specific important process in order to calculate all quantities, which determine the size of the work.

After that, some ambiguous points may be cleared on the ground of the site. Consequently, the site visit is one of the model components.

As well as, many questions may be generated and the query list would be prepared for the consultant to answer it. Then, all quantities will be ready to price and close the bid. Generally, all documents may be reviewed by top management before closing the bid in order to check the validity of estimate.

Another important key in this model the contribution of cost estimate's knowledge, which may affect the Base estimate, Measure quantities, Pricing, and Final detailed cost to avoid the mistakes by support with this knowledge fig (2).

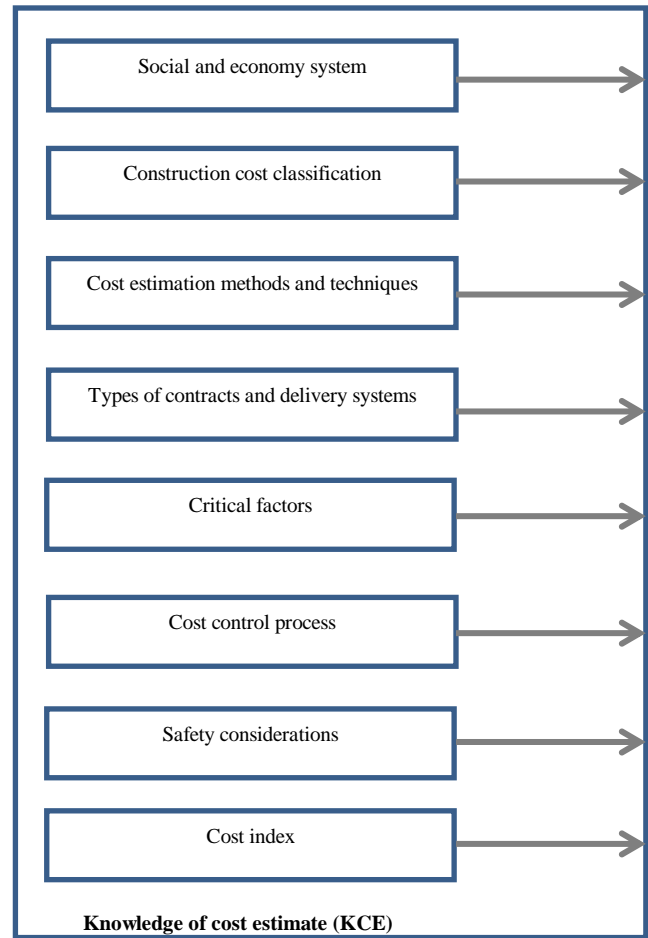


Fig.1 Qualitative model of knowledge of construction cost estimate.

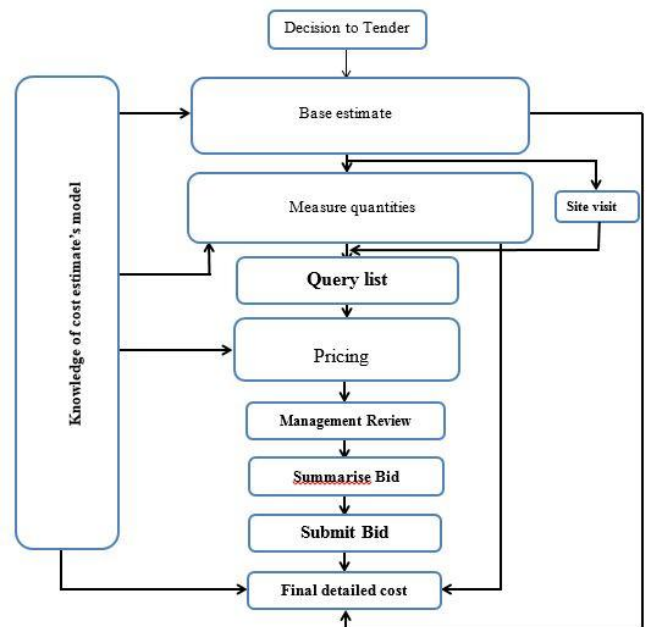


Fig.2 Detailed estimate model for construction projects in Yemen.

VI. CONCLUSIONS

A number of conclusions have been obtained from this research as following:

- 1- The model of the detailed cost estimate has mainly combined of two constructs that affect directly the estimate processes.
- 2- The model of detailed cost estimate can be used by the firms to raise their estimators' performance to assure more accuracy.
- 3- This model can be transformed to quantitative model.

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