

A Contingency Approach for Setting Construction Contract Duration for Public Projects in Saudi Arabia

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A very important provision of any construction contract is the duration specified, i.e., the amount of time given to the contractor to execute the work described in the project plans and specifications. This construction contract duration (CCD) is typically determined by the project owner or the owner's engineering consultant during the preparation of the contract documents.

The legal, economic, and managerial significance of the CCD is well documented in the construction literature [2] [3] [5] [10]. To a lesser degree is the literature treatment of the approaches (methods) of setting CCD. Among the limited reported studies on the latter issue is the one sponsored by the Indiana State Commission, which was directed toward studying current practices in setting highway CCD in limited mid-western states and developing an improved procedure for contract time determination in Indiana. The outcome of this research was a five-step process involving analysis of contract documents, identification of time-consuming activities, establishment of the construction logic, establishment of activity durations, and establishment of an overall duration [7]. Attempts to develop quantitative models for estimating the construction duration have been reported for different types of projects, including highways [6] [10], houses [8], and buildings [4] [10] [11].

The purpose of this article is to present the results of a study aimed at investigating issues

related to the determination of construction contract duration in public projects in Saudi Arabia. Specifically, this article will identify and assess the factors influencing the selection of CCD, and will propose a contingency approach in the selection process.

The Study

The data used in the above-mentioned study were collected via a survey using a mailed questionnaire. The questionnaire was sent to 70 government agencies comprising all the Saudi public agencies authorized to award construction contracts. Out of the 70 sent, 47 questionnaires were completed and received. The respondents included 23 directors of projects, 8 general directors, 9 design/construction engineers, and 7 occupying other positions.

Influencing Factors

In reviewing the literature, project cost was found to be the most addressed factor influencing CCD. Soeterite and Foster [11] investigated the possible relationship between time and cost of construction of New Zealand commercial building projects. They reported that contract cost can account for 65 percent of the variance of construction time. In an attempt to develop a mathematical model of the relationship between time and cost, Bromilow analyzed the actual construction time of over 300 buildings in Australia and by using the "best fit" technique he reported the following exponential relationship [4]:

$$T = KC^B$$

where:

T = construction time from possession of the site to practical completion, in working days

C = actual project cost in millions of Australian dollars

$K, B = \text{constants}$

The above relationship was reevaluated a decade later by Bromilow, Hinds, and Moody, who reported its continuing validity [4].

The above cost-time relation was recently investigated by Kaka and Price [10] who also considered the effect of four factors on its predictive ability. The four factors included type of contract (public vs. private), type of project (building vs. roads), type of bid (open vs. closed), and form of bid (fixed vs. adjusted). After examining the data of about 800 projects, the authors concluded that the predictive ability of the above formula was generally good but was stronger in public than in private projects (the correlation coefficient R ranged from 0.74 to 0.84 in public projects while R ranged from 0.49 to 0.61 in private projects). The authors also concluded that among the four factors considered, three were significant, including type of contract, type of project, and form of bid.

In an attempt to identify factors affecting construction time and delays, Hira and Nandakumar [9] investigated various potential factors and developed a forecasting model containing eight significant factors. These factors are learning curve, weather, space congestion, crew absenteeism, regulatory requirements, design changes, economic conditions, and labor unrest.

Using the above findings and considering the particular characteristics of constructing public projects in Saudi Arabia [1], eight factors were selected. In this selection process, some of the above factors identified by Kaka and Price, such as "type of bid" and "form of bid," were excluded because the Saudi procurement regulation requires public tendering to be open and fixed. Furthermore, most of the factors identified by Hira and Nandakumar were excluded because they were either internal contractor's factors influencing his productivity, or because they are

not of significance in the Saudi construction environment. The selected factors are:

- Project size
- Project design
- Site conditions
- Project type
- Project estimated cost
- Owner's assessment of project need
- Weather
- Qualifications of prospective bidders.

Respondents were asked to assess the importance of the above eight factors utilizing a five-point Likert scale ranging from 1 (not important) to 5 (extremely important). Furthermore, respondents were asked to add any other influencing factors not contained in the above list. Responses to these two questions are summarized in Tables 1 and 2.

Examination of Tables 1 and 2 indicates that the factors affecting CCD can be grouped into three main categories: project characteristics, contractor characteristics, and environmental characteristics.

Project characteristics include all factors attributed to the project itself. Project size, which belongs to this category, was ranked first by respondents. This is a natural result, since project size is a general term directly related to the amount of human resources, materials, and equipment to be used in the construction. Project design was ranked third. The complexity of the project design is a major factor determining the time needed for preparing shop drawings and constructing the project. Among other important factors in this category are project type (roads, buildings, electromechanical, etc.) and project estimated cost. Respondents also added, as can be seen in Table 2, other factors that belong to this category, i.e., mobilization period and type of construction materials.

Most of these factors are well explained by the project tender documents, which contain the

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Table 1. Factors Affecting the the Setting of CCD (originally listed in the questionnaire)

Factor	Mean Response (a)	Standard Deviation	Rank
Project size	4.60	.61	1
Site conditions	3.72	1.04	2
Project design	3.71	.78	3
Owner's assessment of the project need	3.33	1.33	4
Project type	3.29	1.13	5
Project estimated cost	3.22	1.30	6
Qualifications of prospective bidders	2.77	1.34	7
Weather	2.11	0.91	8

(a) Ranges from 5 (extremely important) to 1 (not important)

Table 2. Factors Affecting the Setting of CCD (added by respondents)

Factor	Frequency Number of Respondents
Budget allocations	8
Availability of materials	5
Availability of supervision staff	4
Interrelation of the project with other projects	4
Relocation of utilities	2
Mobilization period	2
Coordination with other parties	2
Types of construction materials	1
Technology used	1
Feasibility of completing the project	1

plans and specifications, bills of quantities, general and special conditions, and the agreement. A detailed study of the tender documents of a construction project is the basic step in determining CCD for that project.

Contractor characteristics are the second major group of factors affecting CCD. The resources available to a contractor, such as finance, qualified staff, equipment, etc., the degree of technology used, and experience in executing similar projects, are basic factors affecting the time needed to construct a project. The expected qualifications of prospective bidders are very important factors affecting CCD and should be taken into consideration in any method or procedure adopted to determine CCD.

The category of environmental characteristics includes all factors affecting CCD that cannot be attributed to the project or to the contractor. Site conditions are the major factor in this category. The term *site conditions* is generally used to describe the topography, soil conditions, facilities and accessibility of site. This explains the respondents' evaluation of site conditions between

“important” and “very important,” with a mean response of 3.72, which is closer to “very important.” Site conditions are sometimes described in the tender documents of the project and in other cases are left to the contractor to investigate. Accordingly, some of the implications of this factor are included in the first category, project characteristics. Another important factor in this category is top management assessment of need of the project. In many cases, this assessment establishes a specific completion date the project should meet. Respondents added factors other than those originally listed in the questionnaire. Eight respondents mentioned budget allocations as a very important factor affecting CCD. Coordination with other parties to secure work permits, relocate utilities on the site, and plan the interfacing of the project with other projects are examples of important factors affecting CCD.

Setting CCD needs an integrated view of the above categories of factors. These factors should be incorporated in any method developed to determine construction contract duration. If CCD is determined based on only the project

characteristics, for example, CCD is expected to be underestimated.

Methods of Setting CCD

In most of the methods of setting construction contract duration, the project owner determines this by using one or a combination of the following approaches: construction season limits, production rates, work flow techniques, and estimated cost [7] [13].

The construction season limits method is typically used for projects that must be finished prior to a certain season, e.g., paving operations. The production rates method involves breaking the project down into the major controlling work items, then using production tables to calculate the construction duration. For large, complicated projects, the use of work flow techniques such as CPM is often utilized. Finally the estimated cost method, described in the previous section, can be utilized to provide a quick estimate of the required time.

A rarely utilized approach in public projects is for the owner not to specify a CCD but to leave it to the bidding contractors. In this situation the owner evaluates each bid based on the contractor's proposed time and price.

To identify the methods of setting CCD in Saudi public projects and to assess the feasibility of utilizing the bidder's set CCD, respondents were asked open-ended questions to express their views on the subject. The responses regarding the methods of setting construction contract duration can be grouped into five categories:

- *Budget allocations* to govern the setting of CCD was reported by 30 percent of respondents. This method basically involves dividing the total project budget by the portion of the budget allocated for the first year of the project.
- *Urgency or the need for the project* was reported by 18 percent of the respondents.
- *Past experience obtained from similar completed projects* was reported by 13 percent of the respondents.
- *The application of the Critical Path Method* was reported by 8 percent of the respondents.
- *Contractors submitting CCD with their bids* was reported by 6 percent of the respondents.

The remaining respondents did not specify a method but rather provided some general considerations for setting CCD.

Examining the respondents' comments on their methods in setting construction contract duration, it became obvious that government authorities have adopted no systematic approaches or formal procedure to set CCD.

Examining the alternative approach for setting CCD, respondents were asked to assess the applicability of allowing the contractors to bid on time and price. The proposed method involves the inclusion of an owner-suggested CCD in the tendering documents, but contractors are allowed to submit alternative CCDs along with their prices for both CCDs. The owner then selects the best offer in terms of price and time.

Respondents were divided on the issue. The majority (60 percent) were not in favor of this method. Although most of this group of respondents did not provide any justification for their position, some identified two major disadvantages of the method. One disadvantage is the increasing difficulty of bid evaluation since time needs to be considered in the evaluation. Another disadvantage is that contractors may be tempted to propose too short a duration, which may result in poor project performance.

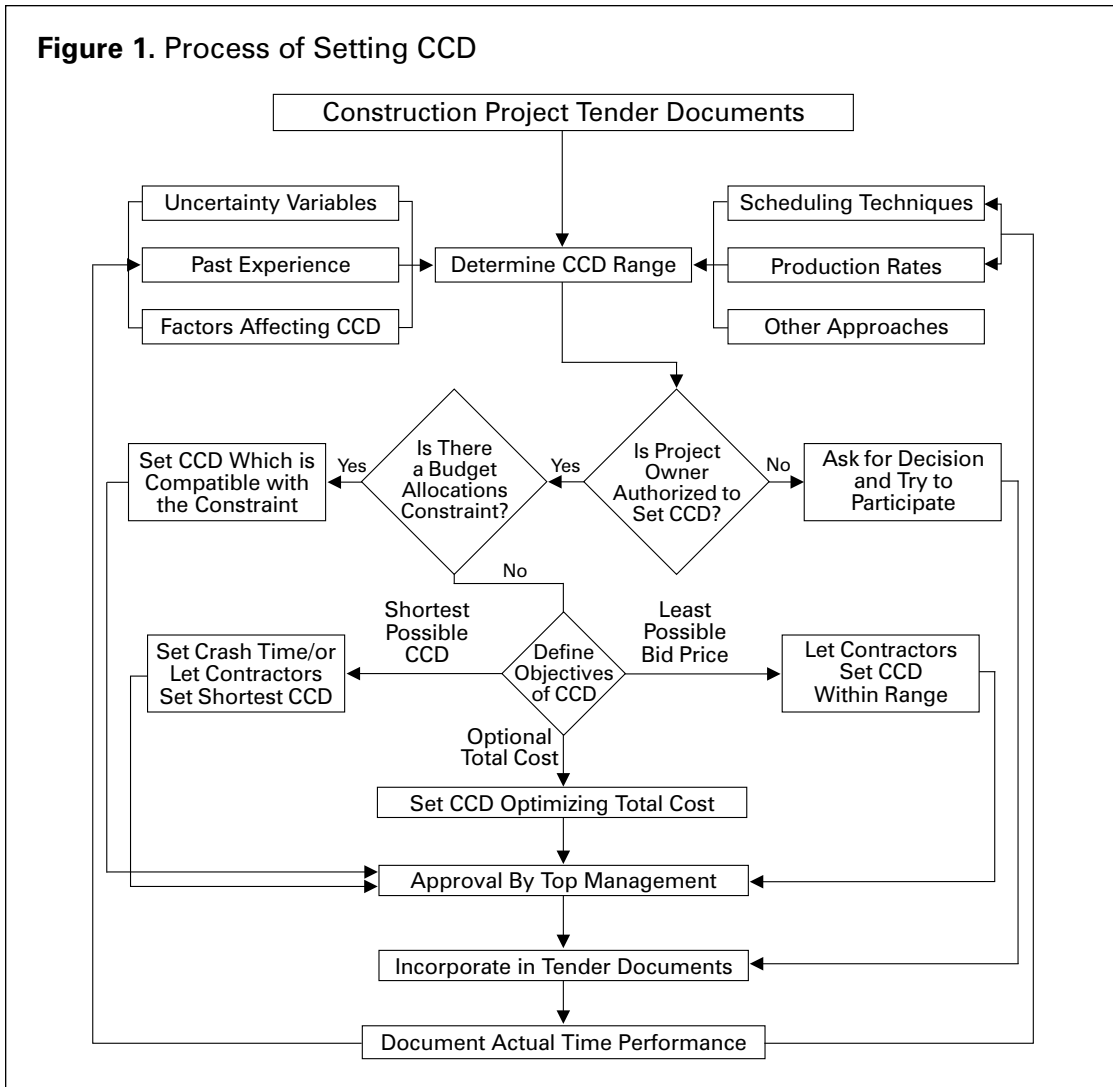
Those favoring the method (40 percent) provided suggestions to enhance the successful application of a contractor-set CCD system, which include the following:

- The method should be limited to those projects where the owner cannot determine a reasonable CCD.
- Contractors should submit a range or a maximum CCD.
- Contractors should submit a detailed schedule with their bids.
- Contractors should submit the qualifications of their technical staff who will work on the project.
- Negotiations with bidders regarding CCD should not be allowed after bid opening.
- Budget allocation constraints should be considered in bid selection.
- The current limit of liquidated damages (10 percent of bid price) should be increased since CCD is set by the contractor.
- Bid evaluation should be made by well-qualified personnel.

The comments from the respondents favoring the use of bidder-set CCD clearly indicate that care and caution must be exercised when utilizing the above approach. This is necessary in order to minimize the administrative problems arising from multiple CCD bids and to make sure that projects are not affected negatively by competition between contractors.

The practice of setting CCD by contractors is obviously recommended only when no specific completion date is required by the owner. This practice will generally lead to reducing bid prices

Figure 1. Process of Setting CCD



since contractors are allowed to schedule the execution at least cost. However, such potential of cost reduction should be viewed in light of the objectives of the project owner and the constraints governing CCD.

A Contingency Approach

The above discussion suggests that no single approach for setting construction contract duration is suitable for all public projects. The owner's objectives and the prevailing circumstances and constraints relevant to the project need to be considered in the process of determining CCD. To accommodate such a changing environment, the following contingency approach can be utilized by the engineering departments of public project owners. The flow chart in Figure 1 is a graphical depiction of the process.

Step 1. Determine a CCD range. The inputs to the determination process are:

- Project tender documents
- Factors affecting CCD discussed above
- Uncertainty variables affecting CCD
- Experience gained from previously constructed projects.

Using the above inputs and utilizing scheduling techniques (CPM, PERT, bar chart, etc.), production rates, or any other approach, a reasonable CCD range can be estimated.

Step 2. Check whether the setting of CCD is under the authority of the project owner. This is to find out if there is any preplanned completion date established by higher authorities to meet special operational or public needs. In such cases the project owner can discuss CCD with the decision makers based on the range established in Step 1. The set CCD is to be incorporated in the tender documents.

Step 3. If the project owner is authorized to set CCD, then the owner can proceed to check

whether budget allocation constraints exist or not. When there are budget allocation constraints, the set CCD should comply with these constraints.

Step 4. In the case where there is no budget allocation constraint, the project owner is to identify the objectives of CCD. Three alternative objectives exist:

- Construct the project at the least possible bid price. When this objective is selected, the recommended policy is to let contractors set CCD within the established range (developed in Step 1 above). Contractors should be informed that the criterion is least-bid-price. Contractors in this case are allowed to schedule the construction at the least possible cost.
- Construct the project at the shortest possible CCD. If this objective is selected, then the project owner may set CCD at crash time (the lower limit of the range established in Step 1). Alternatively, the project owner may also let the contractors set CCD and inform them about the criterion.
- Set at an optimal total cost CCD. This objective is selected when the owner has to trade off between time and cost, considering the tangible and non-tangible costs associated with the various completion dates.

Step 5. The set CCD, produced by either Steps 3 or 4, should be reported to top management for approval.

Step 6. The approved CCD is incorporated in the tender documents

Step 7. During project construction and after completion, the time performance of the project factors and uncertainty variables affecting CCD and the applicability of the approach used to determine CCD should be documented and incorporated in the inputs discussed in Step 1.

Conclusions

Although the research reported in this article targeted the public construction sector in Saudi Arabia, some of the findings can be integrated in two general observations deserving consideration in other construction sectors and countries.

The first observation is that a single and deterministic approach for determining construction contract duration may not be suitable in today's dynamic and complex project environment. The alternative for determining an optimal CCD prior to awarding the construction contract is a contingent multi-method approach based on a comprehensive assessment of the influencing factors, including the characteristics of the project, contractors, and the business environment. Some

of these characteristics can be identified and evaluated from the project documents and the contractor's prequalification system. This in turn underscores the importance of having complete project documents and a comprehensive prequalification system.

The second observation is that some of the factors affecting CCD are contractor-specific and best assessed by the contractor. Consequently, the contractor's input should be solicited. One approach to obtain this input is to allow contractors to suggest alternative CCDs as part of their bid proposals. The proposed CCD should be viewed by the project owner as one of the various inputs used in making contract award decisions.

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