King Fahd University of Petroleum and Minerals

College of Environmental Design

CEM 520: Construction Contracting

Determination of Construction Contract Duration for Public Projects in Saudi Arabia

By: Ahmed Saleh Al-Sultan

Thesis Summary

Prepared by

Sameh Elish

ID # 965341

Prepared for

Dr. Sadi Assaf

January 2004

Abstract

This thesis investigated and evaluated the current practice applied by Government Authorities to determine construction contract duration (CCD) for public projects. A total of 47 Government Agencies were participates in this study. It was found that there is no specific engineering methods or formal procedures followed by Government Agencies to determine CCD. However, CCD was found to be set or determined by three cases. Theses cases are: CCD is set or determined by environmental constraints (budget allocations, certain needs, etc.), CCD is set by owner (based on subjective or objective judgment), and CCD is set by other parties (consultants, contractors). Concerned Government Authorities are urged to develop engineering methods and written procedures to help engineers to determine a reasonable CCD. A model for CCD determination is recommended at the end of this study.

Introduction

Construction Contract Duration (CCD) is a very important issue of any construction contract documents. It is the amount of time given to the contractor to execute the work described by the plans and specifications. The issue of time in construction projects is vital for both the owner and the contractor. It determines the date on which the project will be in use, the cost to be paid, and the amount and density of resources needed to execute the job in the specified time.

Public tendering on construction is governed by "Government Procurement Regulations". It includes 14 articles establishing the basic rules for government tendering. As far as CCD is concerned, there is no reference in the above regulation regarding the setting of CCD. This issue seems to be left to the project proponent to decide. However, once the government and the contractor sign the construction contract, the CCD specified in the contract becomes binding and enforceable. It is not within the authority of the Government Agency (project owner) to change it. In brief, it seems that the current government regulations do not address the issue of CCD before signing the contact, but only afterwards, when contract duration becomes the subject of tight control.

CCD is directly related to the cost. Therefore, it is important to review and evaluate the practices related to the determination of CCD of concerned government authorities.

This study is organized as follow: literature concerning the determination of CCD and its relationship with project cost is reviewed. Then, a survey of the current practice applied to set CCD for public project is performed through a questionnaire. The data gathered are

presented, analyzed and discussed after that. Finally, conclusions drawn from the research and recommendations related to the research subject are shown.

Objective

The main objectives of this research are:

- To investigate the available methods used to set CCD and the factors affecting the determination process.
- To study and evaluate the current practice applied for set CCD for public projects in Saudi Arabia.
- To make recommendations related to the practice of setting CCD in the Kingdom.

In addition to above, this study raises several research questions such as Who set CCD and How? And what are the consequences of the applied practice?

The scope of this research will be limited to public construction projects in Saudi Arabia. The treatment is limited to the owner's point of view. The scope is also limited to projects that the Government Department (project owner) has authority to decide on the setting of CCD. Regarding the cost of construction, construction projects that have value of SR 100 million or less will be under discussion in this research. Projects that cost more than this value (SR 100 million) are excluded since they need special attention and further considerations. In Government procurement regulations, projects costing more that SR 100 million are the authority of the Council of Ministers to award.

Literature Review

a. Time/ Cost tradeoff in Construction

The cost of construction project can be classified into two main categories. These two categories are direct and indirect cost. Direct cost are the sum of expenses of labor, equipment, materials and other cost that are directly associated with the physical completion of an activity. Construction projects have what is called normal time/cost as far as these costs are concerned. The normal cost, in the normal time/cost term, is the minimum direct cost required to complete the project. The normal time is the time associated with the minimum direct cost. Crash time/cost is the minimum possible time to construct a project (Ronocli, 1986). The crash time is shorter than normal time, while crash cost is more than the normal cost.

The other category of cost is indirect cost. The indirect cost could be divided into two types: general overhead and job overhead. The general overhead cost is the cost that is not affected by the duration of a construction project. Examples are the salaries of company executives and cost of the utilities of the main office. Job overhead cost is those cost that are traceable to a certain project but not to a specific construction activity. The costs of job overhead can be dependent or independent of time. Examples of job overhead costs that are independent of time are fencing and haul roads. Some are time dependent such as the cost of supervision, site office utilities and so on. In general, these time dependent costs increase linearly with the passage of time.

b. Setting Construction Contract Duration

According to report no. 97 of the National Cooperative Highway Research Program, USA, titled "Contract Time Determination", there are four methods used by transportation agencies in determination of contract time. These four methods are:

1. Construction season limits. This method is used for project that must be finished prior to a certain season, such as surfacing and paving operations. This method is suitable for Hajj projects in the Kingdome.
2. Quantity or production rate. This method involves breaking the project down into the major controlling work items, then using production tables to calculate the construction duration.
3. Work flow technique. This method is used for large complicated projects where a lot of coordination effort is needed. CPM is an example of work flow technique.
4. Estimated cost. For less complicated projects, the estimated cost may be used to determine the construction duration. The estimated project cost is related to contract time or working days required to complete a particular project. This method is the easiest of the four but not the most accurate.

Gates and Scarpe are among the most important researchers who wrote several papers about this subject. They concluded in their paper "Optimum Working Time" that "the optimum working time for a construction operation is when the total cost for variable overheads equals the total cost to mobilize and demobilize all of the crew".

Several studies have also been conducted to evaluate the uncertainty factors affecting CCD. Hair and Nandakumar (1984) identified 21 different uncertainty variables but the list was later reduced to eight significant variables. These are: (1) learning curve, (2) weather, (3)

space congestion, (4) crew absenteeism, (5) regulatory requirements, (6) design changes and rework, (7) economic conditions, and (8) labor unrest.

c. Specifications of Construction Contract Duration

CCD is normally expressed in working days, calendar days, or a fixed date for completion. The working days policy involves specifying a certain number of working days to complete the project. The criteria for charging the contactor a work day must be defined very clearly in the contract documents. The owner's site representative has the authority to charge working days. The working days method removes some of the risks the contactor has to assume for unforeseen problems. However, this method lead to high potential of disputes between the contractor and the owner's representative in defining the working day. Another drawback of this method is the extra effort needed form the owner to supervise the project.

The calendar days contract is an alternative system to the working days contract. In this system, CCD is expressed as a number of calendar days or months. The calendar days method places more risks on the contractor than the working days in regard to CCD. On the other hand, it decreases the disputes potential between the contractor and the owners' site representative.

The completion date method is the third method used to specify CCD time. When the owner needs the project at a certain date, this method is used. In addition to that, completion date method is used when the owner is not willing or does not have the facilities to estimate a reasonable CCD. The completion date method places more risks on the contractor than the other two methods mentioned above. The reason for that is the low probability that a time extension is granted in cases of delay.

Regarding the Saudi public construction environment, the granting time extension for construction projects is limited, by law, to very high authorities (Ministers). This fact makes the working days method impractical, if not impossible. The standard Government construction contract does not specify (or necessarily requires) a certain system to be followed in expressing CCD. A space is left for project owners to fill the duration in the contract.

Research Methodology

In order to expand the knowledge about this subject in Saudi Arabia, interviews were performed with some of government officials that are heavily involved in construction

activities. Beside interviews, telephone calls were also made to some of the engineers working in the design and supervision activities of the public construction projects.

Based on above knowledge, a questionnaire was developed in order to collect the data needed for the research. The questionnaire was designed to cover the following issues:

- Current practices of setting CCD
- Factors affecting the setting of CCD
- Consequences of short and long CCD
- Suggested methods of setting CCD
- Personal information of the respondents
- Construction projects time performance

The questionnaire consists of 18 questions. It was written in Arabic in order to be understandable to all respondents. Also, there was an English version of the questionnaire. At the end of the questionnaire, time performance table was provided. The purpose of this table was to evaluate the performance of construction projects timewise. Each respondent was required to fill the table with information related to five construction projects already constructed and handed over to owners. This information include total cost of the project, CCD set by Government Agency (owner), actual CCD, and time extensions claimed by contactor.

Before the questionnaire was distributed, pre-test was performed. A sample of 10 government engineers involved in public construction activities was selected. They were asked to fill the questionnaire. The pre-test was useful to incorporate more possible answers and increase lists of factors and items. The pre-test also point out the places of ambiguity in the questionnaire.

Population

The population of this study is defined to be all Government departments responsible for executing public construction projects. Government departments have the authority to design (in house or through a consultant), tender, and supervise (in house or through a consultant). The Government Annual Budget allocation is used as the source of identifying those departments. 42 agencies satisfy the population definition. Among 42 agencies, four ministries were found to have more than one department satisfying the definition of the study population. These ministries are the Ministry of Municipal and Rural Affairs (12 authorities), Ministry of Public Works (8 authorities), Ministry of Communication (7 authorities), and Ministry of Post, Telephone, and Telegraph (4 authorities).

As a result, the total population consists of 70 authorities. Given that the population is relatively small, no sampling scheme was used in the study. So, it was decided to survey the whole population. Sine the population is dispersed in all over the Kingdom that is a very large country, mail survey were adopt.

Results and analysis

A total of 47 completed questionnaires were used for analysis. SAS (Statistical Analysis Systems) package was used to analyze the data in this study. Regarding participants characteristics, 50% of the returned questionnaires were filled out by persons who are directors of the projects departments or similar positions. Other participants include eight general directors, nine design/ construction engineers and seven respondents occupied other positions. All respondents have at least a bachelor degree. Seven of them have Masters and two have Ph. Ds. The average years of experience of respondents are 10.5 years.

The results of the survey were grouped into three main issues: the current practice of setting CCD, the subsequences of setting short or long CCD, and alternatives approaches to setting CCD.

Current practice of setting CCD

The result related to the current practice of setting CCD will be presented in four related areas: responsible agency for setting CCD, methods of setting CCD, attention paid to setting CCD, and adequacy of set CCD.

Responsible agency for setting CCD

The results showed that 91% of the respondents reported that CCD is set at their department by either top management, engineering department, or by hired consultant. About 2% reported: “CCD is set by different departments and by organized manner”. The remaining of respondents (about 7%) reported that they don’t know who sets CCD or how. The result support the preliminary assumption stated at the research design stage that CCD is set by either top management, engineering department, or by hired consultant.

Methods of setting CCD

Here the respondents were requested to explain the methods applied at their departments to set CCD. The following table shows these methods.

Method	Percentage
Budget allocations	30%
Urgency or the need for the project	18%
Past experience obtained from finished projects	13%
Critical Path Model (CPM)	8%
Joint work of the engineering department and a consultant	8%
Contractors are requested to submit CCD with their bids	6%

Table 1: Methods used to set CCD.

The respondents indicate that budget allocation constrains seem to be one of the most important factors affecting the decision on CCD. It can be concluded from the respondents' comments on methods applied to set CCD that, there seems to be no systematic engineering approach or a formal written procedure adopted by government authorities to set CCD.

Attention paid to setting CCD

The respondents' opinions toward the consideration given to the setting of CCD were collected. Forty-five respondents participated and their responses are summarized in the following diagram.

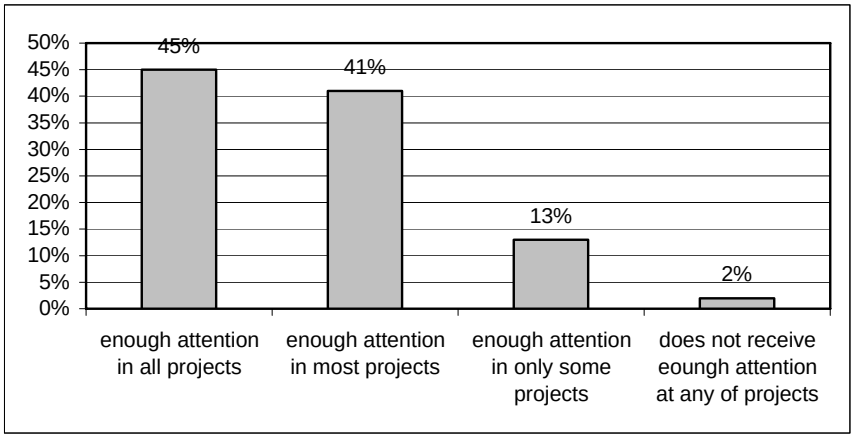

Figure 1: Attention paid to setting CCD.

The results show that the majority of respondents think that the setting of CCD is given high consideration. The mean response is 4.24 on 1-5 scale with standard deviation of 0.86 meaning that the average evaluation of the attention is little more than "enough attention in most of the projects".

Adequacy of set CCD

Respondents were asked to evaluate the CCD set in their departments in the survey (i.e. is it very short, short, reasonable, long, or very long). Table 2 summarizes the results. Figure 2 represents the percentage of projects fall into each category. The results of table 2 and figure 2 clearly suggest that the assessment of CCD as being reasonable dominates respondents' opinions.

Category	Percentage of responses
Very Short	3%
Short	21%
Reasonable	56%
Long	20%
Very Long	0%

Table 2: Adequacy of set CCD.

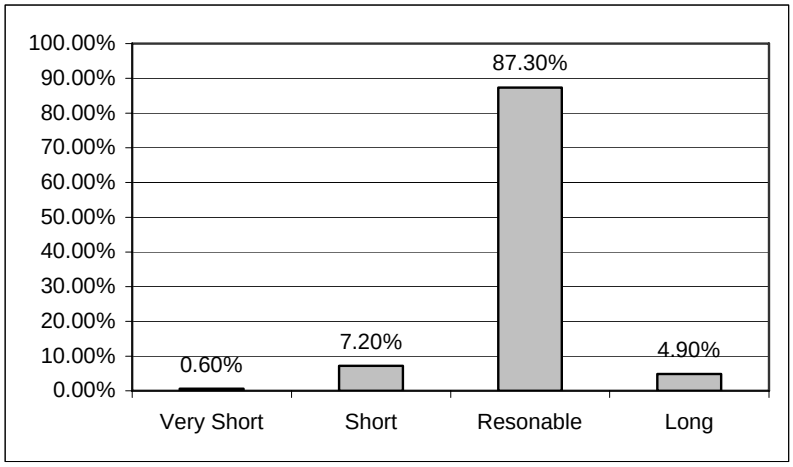

Figure 2: Adequacy of set CCD.

Consequences of setting short /long CCD

The questionnaire lists negative and positive consequences of short and long CCD. The respondents were asked to evaluate these consequences using a range consisting of five levels of negatively/ positively.

Consequences of Short CCD: there were seven negative consequences and three positive consequences of short CCD given in the questionnaire. Each respondent were asked to give his evaluation on each consequences. In addition to that, he can add other consequences if he wants. Table 3 lists the negative consequences of short CCD while table 5 lists the positive consequences.

Consequences	Mean Response	Rank
Poor performance by contractors resulting from inadequate time allocation to work items	4.00	1
Excessive administrative burden resulting from delay claims	3.89	2
High bid prices	3.82	3
Coordination difficulties	3.17	4
Disruption of budget planning	3.05	5
Contractor's unwillingness to bid, because they know the project cannot be done in the specified time	2.97	6
Supervision difficulties	2.39	7

Table 3: Negative consequences for short CCD (originally listed in the questionnaire).

Consequences	No. Respondents
Difficulties in issuing change orders	2
Have damaging effects on contractors	2
Contractor's carelessness beyond the completion due date since liquidated damages maximum is reached	2
High potential for disputes	1
Difficult to manage	1
Too much subcontracting	1
Economically unfeasible	1

Table 4: Negative consequences for short CCD (added by respondents).

Consequences	Mean Response	Rank
Raising contractor's awareness of the importance of time	2.85	1
Promoting effective management	2.38	2
Low prices due to short CCD	1.72	3

Table 5: Positive consequences for short CCD (originally listed in the questionnaire).

Consequences	No. Respondents
Fast project use	12
Best utilization of budget allocations	2
Less coordination efforts needed	1
Less design change	1
Waving unqualified contactors	1
Saving supervision time to other projects	1

Table 6: Positive consequences for short CCD (added by respondents).

By examining the above tables, we can see the respondents expressed stronger attitudes towards negative consequences than positive consequence of short CCD. Six out of

the listed seven negative consequences had higher mean response than the highest mean response for the positive consequences. This suggests that respondents felt that the disadvantages of short CCD outweigh its advantages.

Consequences of Long CCD: the same approach applied to survey consequences of short CCD was applied to survey consequences of long CCD. The questionnaire listed three negative and three positive consequences of long CCD. Table 7 and table 9 show both negative and positive consequences of long CCD.

Consequences	Mean Response	Rank
Encouraging contractors to bid more work than can be handle in a timely manner.	3.59	1
Discourage effective management and innovation	3.21	2
Leading to poor performance resulting from discontinuous operations (relaxed schedule)	2.61	3

Table 7: Negative consequences for long CCD (originally listed in the questionnaire).

Consequences	No. Respondents
Delaying project utilization	13
Increase in supervision costs	6
Increase in cost	2
Delaying other dependent projects	1
Contractor's relaxation in execution	1
Contractor's high potential for losses	1

Table 8: Negative consequences for long CCD (added by respondents).

Consequences	Mean Response	Rank
Good coordination with other agencies	3.27	1
Permitting more contractors to bid	2.75	2
Low bid prices	2.47	3

Table 9: Positive consequences for long CCD (originally listed in the questionnaire).

Consequences	No. Respondents
Helps to cover budget deficit	8
Makes design revision/ changes possible	4
Improve quality control	3
Flexibility in change orders especially extra quantities change order	1
Enough time for importing materials	1
Enough time fro preparation for operation	1

Table 10: Positive consequences for short CCD (added by respondents).

The above tables show that the respondents expressed stronger attitudes towards negative consequences more than positive consequences which is the same conclusion drawn from respondents' assessment of consequences of short CCD.

Alternatives approaches to setting CCD

This section presents the alternative approaches to the current practice of CCD. It starts by measuring the need for alternatives approaches followed by identifying these factors affecting the setting of CCD. Then, respondents' opinion towards responsible agency for setting CCD is presented. Finally respondents' ideas and recommendations related to the setting of CCD (other approaches to setting CCD) are presented.

The need for a method to set CCD

The importance of applying a systematic engineering method to set CCD is evaluated in the questionnaire. Five degree of importance ranging from 5 (extremely important) to 1 (not important) are listed for the choice of respondents. The results are summarized in the following table.

	Percentage
Extremely important to apply a systematic engineering method to set CCD	44%
Very important	26%
Important	17%
Somewhat important	11%
Not important	2%

Table 11: The need for a method to set CCD.

As the above table shows, the majority of respondents (87%) expressed the need to apply a method to set CCD. however, the results from earlier sections conclude that there is no systematic engineering methods seems to be applied to set CCD.

Factors affecting the setting of CCD

This study originally identified eight factors deemed to affect the setting of CCD. The questionnaire asked the respondents to assess the importance of these factors utilizing a five point Likert scale ranging from 1 (not important) to 5 (extremely important). Table 12 lists the results.

Factor	Mean Response	Rank
Project size	4.60	1
Site conditions	3.72	2
Project design	3.71	3
Top management assessment of the city need of the project	3.33	4
Project type	3.29	5
Project estimated cost	3.22	6
Expected qualifications of prospective bidders	2.77	7
Weather	2.11	8

Table 12: Factors affecting the setting of CCD.

There were some other factors added by the respondents (e.g. budget allocations, availability of materials, availability of supervision staff). 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 fist by respondents. This is a natural result since project size is a general term describing the area the project will occupy and the amount of materials and equipment to be used in the construction.

Contractor characteristics are the second major group of factors affecting CCD. The resources available to a contractor (finance, qualified staff, equipment, etc.), degree of technology he uses, and his experience in executing similar projects are basic factors affecting the time he needs to construct a project.

The environmental characteristics category includes all factors affecting CCD, which cannot be attributed to the project or to the contractor. Site conditions are the major factor in this category. The term “site condition” is generally used to describe the topography, the soil conditions, the availability of facilities at the construction site, and the ease of access to the site. This explains the respondents’ evaluation of “sit conditions” between “important” and “very important” with a mean response of 3.72 which is closer to “very important”. Setting CCD needs an integrated look into the above categories of factors. These factors should be incorporated in any method developed to determine CCD. If CCD is determined based on only the project characteristics, for example, CCD is expected to be underestimated.

Responsible agency for setting CCD

It was shown earlier that, based on respondents’ report, CCD is currently set by either top management of the Government Agency (project owner), engineering department, or by hired consultants. Respondents’ opinions towards who should be responsiable for setting

CCD were surveyed in the questionnaire. The following table shows the results. It seems that respondents are almost in agreement that the engineering department of the Government Agency (project owner) should always take part on the determination of CCD. This is a natural result since the engineering departments are expected to know the most about CCD and factors affecting its determination.

Responsible agency for setting CCD	Percentage
Joint effort of top management, engineering department and a consultant	48%
Engineering department	37%
Engineering department and a consultant	9%
Other combinations	6%

Table 13: Responsible agency for setting CCD.

Other approaches

To identify other approaches to setting CCD, respondents were asked the following open-ended question, "what method do you consider the best for considering CCD?". An example of response to this question include "use the experienced gained from similar projects in determining actual time and check construction time with the nature of the project, its circumstances, and the urgent need for it". Another stated, " The concerned department should study the quantity of each work items and determine time to execute it and the interdependency between work items". Respondents' ideas were examined and summarized as follow:

- 13 respondents suggested using CPM or any other secluding technique to estimate CCD.
- 11 respondents reported, "budget allocations constraints should be considered before any decision on CCD".
- 10 respondents thought that past experience of finished projects is a very important input to the determination process.
- 4 respondents suggested the development of a method to determine CCD. One of respondents stated that a mathematical model might be developed to estimate CCD.

Conclusions

The following points summarizes the findings and conclusions of the study:

- There seems to be no systematic engineering methods or at least formal procedures followed by Government Authorities to set CCD for public projects.

- CCD is currently set by engineering department, hired consultant, or top management of the government agencies. There parties are ordered in a descending level of participation.

- Several factors affects setting CCD. Among the most important factors are project size, design, budget allocations, type, and site conditions. These and other related factors could be grouped into three main categories: project characteristics, contractor's characteristics, and environmental characteristics.

- There is a strong need for engineering methods to be used to set CCD. Theses methods should incorporate all factors affecting CCD.

Recommendations

General recommendations

- The Government procurement Regulations should address the setting of CCD. Articles have to be written to establish guidelines to improve the current practice of setting CCD.

- Engineering methods should be developed and used to set CCD. Concerned Government Authorities such as Ministry of Housing and Public Works, Ministry of Municipal and Rural Affairs, and the Ministry of Communications are urged to take the initiatives of developing such methods.

- The engineering department of concerned Authorities should participate in the setting of CCD. This is accomplished by either coordination with top management or using the expertise of a hired consultant.

- CCD should be considered in the budget allocation process.

- A review of the budget allocations must be performed before setting CCD. This is to insure that the set CCD is compatible with these allocations.

Recommended guidelines to set CCD

Based on the results of the study and the conclusions drawn, the following guidelines are suggested to be followed be engineering departments of public projects owners in setting CCD.

Step #1: Determine a CCD range. The inputs to the determination process consists of the following items:

- The project's tender documents.
- The factors affecting CCD which were addressed earlier in the study.
- The uncertainty variables affecting CCD were addressed in the literature.

- The experience gained from constructed projects.

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

Step #2: Check weather 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 decision makers based on the range established in step #1, the set CCD is to be incorporate in the tender documents.

Step #3: If the project owner is authorized to set CCD, then he can proceed to check weather 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 his objectives of CCD. Three alternatives objectives exist:

- Constructing project at least possible bid price. When this objective is selected, the recommended policy is to let contractors set CCD within the established range.
- Constructing the project at shortest possible CCD. If the project owner selects this objective, then he may set CCD at crash time.
- Set an optimal total cost CCD. This objective is selected when the owner is to tradeoff between time and cost, considering the tangible and non-tangible costs associated with the various completion date.

Step #5: The set CCD, produced by either steps #3 and 4, should be reported to top management for approval.

Step #6: The approved CCD is to be 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 applicability of approach used to determine CCD should be documented and incorporated in the inputs discussed in step #1.