

Factors Affecting Project Cost and Time in Construction

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Abstract

Cost and time overruns are usual practices in most of construction projects. These problems should be removed via suitable methods. To find out a successful solution, factors affecting cost and time overruns should be first determined and their impacts on these overruns should then be analyzed. In this study, the factors that cause delays and cost extensions were considered. In order to pinpoint their negative effects on cost and time schedule, a questionnaires survey was applied to project managers of 45 construction firms in Antalya, Turkey. As a result, how frequent these factors are encountered in practice was presented by means of the relative importance index method.

Keywords

Overrun, Time extension, Cost extension, Antalya, Turkey

1. Introduction

Time and cost overruns are important problems of construction industries in developed and developing countries. They have considerable effects on country economies, and therefore, various solution techniques are required in overwhelming them.

The construction industry has a significant importance in the macro-economic structure of a country. It is directly related with about 200 different goods and services, and contributes to the socio-economic wealth of societies by its distinctive characteristics such as labor-intensive technology. These indicators point out the industry's utmost importance in a country (Kazaz and Koc, 2004; Kazaz *et al.*, 2005).

The construction industry is also one of the main components of the Turkish economy. Many countries of which economies suffer from recessions make it strong via construction investments.

Because of the importance of the sector in a country economy, cost and time overruns in construction projects are seen as very important problems in many developing and developed countries. Therefore, numerous studies on this domain of construction have been published to date. In some of these researches, percentage values of delays and cost extensions in projects have been obtained, while some of the studies have fixed the factors that cause the overruns. According to the findings of Bromilow *et al.*, (1988), only 12.5% of construction projects in Australia have been completed without experiencing any delay. Time extensions have had a mean of 40% in these projects. In India, a total of 184 completed projects have been investigated. The amount of time extension has been 200% in 119 projects, and the amount of cost overrun has been 700% in 68% of the projects (Chandra, 1990). In a USA-based research study (Baldwin and Manthei, 1971), adverse weather conditions, workforce requirements, and subcontractors have been found to be the most dominating causes of time extensions according to architects, engineers, and contractors. As a result of the Chalabi and Camp's (1984) study that examined project delays in developing countries, it has been found that employees are very skilful and that adequate planning efforts at inception can minimize overrun-sourced problems in projects.

In many construction projects, the completion duration may be extended due to clients, contractors, or some unanticipated technical, legal, and natural problems (Goren, 1998; Skitmore and Thomas, 2003). Delays can result in cost overruns in various ways. Although some modifications can be done in cost and time schedules according to the requests of client, a construction project should be completed in the planned duration, in the allocated budget, and in the desired quality standards to use resources in a productive manner and to add social utility to the society (Adeyinka and Okuwoga, 1998; Long *et al.*, 2004; Mezher and Tawil, 1998). In this study, the factors that cause cost and time overruns in construction projects in Turkey were determined, and how frequent these factors affect the overruns was evaluated by means of the relative importance index method.

2. Methodology

A total of 34 factors were divided into 7 groups in this study, considering their ways of effect on delays and cost extensions. All the factors and categories are as follows:

1- Financial Factors

- Payment delays of completed works
- Financial problems of contractors
- Inflation
- Cash flow difficulties during construction
- Fluctuations in material prices

2- Environmental Factors

- Adverse weather conditions
- Geological problems
- Site location and layout
- Occupational accidents in site

3- Planning, Management and Contractor Related Factors

- Poor site management
- Incorrect project duration
- Frequent changes in material and design
- Manager- labor relationships
- Disputes in the job site
- Weak coordination between contractor and design group
- Excessive workload of contractor
- Poor quality control, and inadequate follow-up activities
- Lack of contractor experience
- Legal conflicts on contract

4- Human Resources Related Factors

- Unbalanced number of manpower
- Poor labor productivity
- Construction errors and uncompleted works

5- Material-Equipment Related Factors

- Material procurement and usage problems
- Inefficient usage of material and equipment
- Improper material selection
- Delivery of material and equipment
- Material warehouse problems

6- Governmental Factors

- Government policy
- Bureaucracy

7- Project and Application Related Factors

- Project size
- Rarely used construction methods
- Old construction methods
- Lack of pre-construction studies
- Lack of maintenance of materials, equipment, and newly products

The questionnaire was composed of the above mentioned 34 factors, and it included two parts. The first part consisted of demographical characteristics of respondents, and the second part was about the factors. In evaluating the 34 factors, 5-point Likert scale changing between 0 and 4 was used.

The survey was made face-to-face with project managers of 45 construction firms in Antalya. Participants evaluated how frequent the 34 factors affect cost and time overruns in projects. The data obtained was analyzed using the SPSS package.

3. Analysis

Relative importance indices of the factors were calculated by means of the survey data. The related computations were performed via the following equation:

$$I = \frac{\sum_{i=1}^5 w_i \cdot x_i}{\sum_{i=1}^5 x_i} \quad (\text{Frimpong and Oluwoye, 2003})$$

in which I denotes relative importance index (RII); i - the index of response category, from 1 (never) to 5 (always); w_i - numerical equivalent of the response i ($i=1 \rightarrow 0$, $i=2 \rightarrow 1$, $i=3 \rightarrow 2$, $i=4 \rightarrow 3$, $i=5 \rightarrow 4$); and x_i – percentage value of the response i.

The 34 factors were arranged in a decreasing order, considering the relative importance index (RII) values. The RII results and the related orderings were shown in Table 1.

Table 1: Index Values and Rank Orderings of the Factors Causing Cost and Time Overruns

FACTOR GROUPS	FACTORS THAT CAUSE COST AND TIME OVERRUNS	INDEX	RANK
Financial Factors	1- Payment delays of completed works	2.62	2
	2- Financial problems of contractors	2.59	4
	3- Inflation	2.04	14
	4- Cash flow difficulties during construction	2.61	3
	5- Fluctuations in material prices	2.25	10
Environmental Factors	6- Adverse weather conditions	1.51	25
	7- Geological problems	1.11	28
	8- Site Location and layout	1.47	26
	9- Occupational accidents in site	0.95	29
Planning, Management and Contractor Related Factors	10- Poor site management	2.16	11
	11- Incorrect project duration	2.38	6
	12- Frequent changes in material and design	2.73	1
	13- Manager- labor relationships	1.58	24
	14- Disputes in the job site	1.84	19
	15- Weak coordination between contractor and design group	2.13	12
	16- Excessive workload of contractor	1.80	20
	17- Poor quality control, and inadequate follow-up activities	1.94	17
	18- Lack of contractor experience	2.05	13
	19- Legal conflicts on contract	1.64	23
Human Resources Related Factors	20- Unbalanced number of manpower	2.27	9
	21- Poor labor productivity	2.44	5
	22- Construction errors and uncompleted works	2.31	8
Material-Equipment Related Factors	23- Material procurement and usage problems	2.16	11
	24- Inefficient usage of material and equipment	1.96	16
	25- Improper material selection	1.91	18
	26- Delivery of material and equipment	1.42	27
	27- Material warehouse problems	1.58	24
Governmental Factors	28- Government policy	1.75	21
	29- Bureaucracy	2.13	12
Project and Application Related Factors	30- Project size	1.80	20
	31- Rarely used construction methods	1.67	22
	32- Old construction methods	1.42	27
	33- Lack of pre-construction studies	2.36	7
	34- Lack of maintenance of materials, equipment, and newly products	2.02	15

According to the survey data, the most important factor was found to be frequent changes in material and design, while the least important factor was occupational accidents in site. The verbal equivalents of RII results are as follows:

RII: 0.0 – 0.8 = Never

RII: 0.81-1.6 = Sometimes

RII: 1.61-2.4 = Often

RII: 2.41-3.2 = Very often

RII: 3.21-4.0 = Always

As a result, frequent changes in material and design are “very often” (RII=2.73) the case in projects, and have adverse effects on the planned cost and time schedules. Occupational accidents in site, the least important factor, sometimes (RII=0.95) affect cost and time negatively.

The highest RII value is four in theory. The index values calculated show that the effects of 34 factors on overruns change between “very often” and “sometimes”.

According to the survey results, the most important factor was found as “frequent changes in material and design” as a planning, management, and contractor related factor. The second, third, and fourth important factors were about monetary conditions of clients and contractors, and thus they were included in financial factors. The least important factor was found to be “occupational accidents in site”. Environmental group including this factor have similarly minimum adverse impact on cost and time.

Considering factor groups, the 34 factors were evaluated in a generalized manner. Importance rankings of seven groups are given in Table 2.

Table 2: Importance Levels of Factor Groups Causing Delays and Cost Overruns

FACTOR GROUPS	MEAN OF RELATED INDICES	RANK
Financial Factors	2.42	1
Human Resources Related Factors	2.34	2
Planning, Management and Contractor Related Factors	2.03	3
Governmental Factors	1.94	4
Project and Application Related Factors	1.85	5
Material-Equipment Related Factors	1.81	6
Environmental Factors	1.26	7

In terms of group rankings that was determined using means of RII values, financial factors “very often” (RII=2.42) affect cost and time overruns. They are the most influential group on the overruns, followed by human resources related factors (RII=2.34), planning, management and contractor related factors (RII=2.03), governmental factors (RII=1.94), project and application related factors (RII=1.85), and material-equipment related factors (RII=1.81). These five groups “often” lead to cost and time overruns, while environmental factors “sometimes” (RII=1.26) influence the overruns.

4. Analysis Results

4.1 Financial Factors

This group (RII=2.42) is in the first rank of importance, and “very often” affects cost and time overruns. In this group, the first and the second important factors are “payment delays of completed works” and “cash flow difficulties during construction”, respectively. These are dependent factors on each other. Cash flow difficulties can result in payment delays of completed works. “Financial problems of contractors”, the third important factor, creates some monetary difficulties both in the material procurement and in the payment of labor wages. In this group, the least important factors are “fluctuations in material prices” and “inflation”. These two factors have a linear relationship. Fluctuations in material prices mostly arise from an increase of inflation.

4.2 Human Resources Related Factors

This type of factors (RII=2.34) is in the second rank. In this group, poor labor productivity has the most negative effect on the planned cost and time schedules. As a result of low levels of productivity, slow paces of work adversely influence cost and time. “Construction errors and uncompleted works” and “unbalanced number of manpower” are among the most important factors both in the group and in the whole factors.

4.3 Planning, Management, and Contractor Related Factors

The factors in this group have various importance rankings. However, the factor group has the third rank of importance, when the mean values of indices are taken into account. “Frequent changes in material and design” is “very often” encountered in practice, and has the most adverse effect on cost and time when compared to 33 factors. “Incorrect project duration” is also among the factors that respondents attach considerable importance. These two factors prove how much important planning activities are in construction projects. In the group, the factors regarding legal disputes and relationships between contract sides have low index values which, in turn, decrease the mean index value of the group. This reveals that conflicts are rarely the cases in projects and that, when available, they do not negatively affect cost and time schedules.

4.4 Governmental Factors

This group is the fourth in the importance ranking. Bureaucracy has a more negative impact on schedules than government policy. Bureaucracy is related with the approval and the application of projects, and depends on regional and national authorities. Different practices of these authorities may affect projects, and this may cause cost overruns and delays.

4.5 Project and Application Related Factors

This type of groups is the fifth in the importance ranking of factor categories. Lack of pre-construction studies is the most dominant factor in this group. It is also among the most important factors, when 34 factors are considered. In the group, project size is another important factor. As the project size is larger, both the details and the numbers of trades and tasks increase. The other factors in the group were not found to be important issues. It is evident that factors related with construction methods do not have much influence on the overruns.

4.6 Material-Equipment Related Factors

In this group, material procurement and usage problems have the most negative impact on schedules, since site location and material quarries may lead to time losses. It may also be arisen from the complicated way of material usage. Inefficient usage of material and equipment is the second in importance in the group. The finding that this group is the sixth important category indicates that material warehouse problems and delivery of material and equipment have fewer effects on overruns than other factors. These two factors are among the least important factors when considering 34 factors.

4.7 Environmental Factors

This group has the lowest importance value of seven categories. Similarly, the factors of this group are at the bottom of the importance ranking. Adverse weather conditions are the most important factor of this group. However, this factor does not lead to serious problems due to today’s efficient planning techniques and detailed weather forecasting. The least important factor in the group was determined as occupational accidents in site. Although the accidents are frequently encountered and result in tangible and intangible damages in projects, they are usually concealed in Turkey.

5. Conclusion

In this study, 34 factors that cause time and cost overruns were determined and classified under seven categories. In order to find out how frequent they affect delays and cost overruns, a questionnaire survey was applied. The survey was made face-to-face with project managers of 45 contractors in Antalya.

According to the survey data, “frequent changes in material and design” was found to be the most frequently encountered factor, followed by “payment delays of completed works” and “cash flow difficulties during construction”. In terms of groupings, financial factors and human resources related factors are the leading categories, while environmental factors are the least effective group.

Various changes throughout the construction project, financial instability/deficit of client and contractor, and lack of workforce needed to execute the project are the most important factors that lead to delays and cost extensions.

In the Turkish construction industry, there is an inadequate and slow improvement about planning and site management issues. This results in large deviations in schedules. Except serious natural disasters, negative consequences of all the factors that adversely affect cost and time can be minimized by allocating sufficient budgets, by applying successful site/project management, and by employing qualified personnel.

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