

Time Overrun in Construction of Road Projects in Developing Countries: Saudi Arabia as a Case Study

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Abstract: *The study aims at identifying the factors affecting time overrun in public construction projects in Saudi Arabia from consultants' viewpoint. To do so, 70 consultants working in public construction completed a structured questionnaire survey and the factors were ranked according to their levels of severity, frequency, and importance. 34 factors were identified through deep literature review and discussion with some local construction experts. The analysis of the identified 34 factors indicates that the top five important factors affecting time overrun in public construction projects are: improper planning, poor labor productivity, additional works, rework, and lack of contractor experience. Results also illustrate that the top five severe factors affecting time overrun in public construction projects in Saudi Arabia are: bid award for lowest price, poor labor productivity, improper planning, additional work, and lack of contractor experience. While the top five frequent factors are: rework, improper planning, changes in material types and specifications during construction, poor contract management, and poor resource management.*

Keywords: time overrun, delay, public, construction, ranking.

Introduction

Time overrun is defined as the time difference between the actual completion time and the estimated completion time, agreed by and between the client and the contractor during signing of the contract (Mahamid et al., 2012). The history of the construction industry worldwide is full of projects that were completed with significant time overrun (Amhel et al., 2010). A World Bank report confirmed an average of 70% overrun of initial time in 88% of 1627 projects during the last 15 years (World Bank, 1990).

Saudi Arabia has experienced a construction boom during the past three decades, attracting construction professionals from all over the world. According to the Saudi Ministry of Planning, the construction industry contributed between 30% to 40% of the non-oil productive sectors at the end of each National Development Plan from 1980 to 2000 (Cordsman, 2000). However, time overrun in public construction projects is considered to be one of the main problems in the Saudi Arabian construction industry (Faridi and El-sayegh, 2006). Assaf and Al-Hejji (2006) found that only 30% of construction projects in Saudi Arabia were completed within the scheduled completion dates and that the average time delay was between 10% and 30%. Thus, it appears that the problem of time overrun in public construction projects in Saudi Arabia is critical and should be studied more to alleviate this problem. This paper presents the findings of a survey that aims at identifying the factors affecting time overrun in public construction projects in Saudi Arabia from consultants' view. It is hoped that these findings will guide efforts to enhance the performance of the construction industry in Saudi Arabia and other developing countries.

Literature review

Size of time overrun in construction projects

Researches on construction projects in some developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30% (Al-Momani, 1996). Omoregie and Radford (2006) reported a minimum average percentage escalation period of projects in Nigeria was found to be 188%. Battaineh (1999) evaluated the progress reports of 164 building and 28 highway projects constructed during the period 1996-1999 in Jordan. He found that delays are extensive: the average ratio of actual completion time to the planned contract duration is 160% for road construction projects and 120% for building projects.

Factors affecting time overrun in construction projects:

Many studies have been conducted to examine the factors affecting time overrun in construction projects. Mahamid et al. (2012) conducted a study to identify and rank delay causes in road construction projects in the West Bank in Palestine. They found that the top five delay causes from contractors' view are: segmentation of the West Bank and limited movement between areas, political situation, progress payments delay by owner, delays in decision making by owner, and low productivity of labors. While the consultants indicated that the top five affecting causes are: political situation, segmentation of the West Bank and limited movement between areas, awarding project to lowest bid price, shortage in equipments, and ineffective scheduling of project by

contractor. Odeh and Battaineh (2002) found that contractors and consultants agreed that owner interference, inadequate contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and incompetence of subcontractors are the most important causes of construction delay in Jordan. Mahamid (2011) indicated that the most severe factors affecting time delay in road construction projects in the West Bank in Palestine from the owner perspective are: poor communication between construction parties, poor resource management, delay in commencement, insufficient inspectors, and rework.

Al-Momani (2000) investigated contributors of delay in 130 public building projects constructed in Jordan during the period of 1990-1997. He concluded that the main causes of construction delay are related to designer, user changes, weather, site conditions, late deliveries, economic conditions and increase in quantity. Frimpong et al. (2003) conducted a survey to identify the relative importance of significant causes contributing to delay and cost overruns in Ghana groundwater construction projects. A questionnaire with 26 causes was designed. The result of the study revealed the main contributors to delay and cost overruns in construction of groundwater projects are: monthly payment difficulties from agencies; poor contractor management; material procurement; poor technical performance, and escalation of material prices. Koushki et al. (2005) conducted a study in Kuwait to identify and rank the main time and cost overrun causes in construction projects. They concluded that the factors affecting time overrun are changing orders, owners' financial constraints, and owners' lack of experience.

Kaliba et al. (2009) studied the schedule delays in road construction projects in Zambia, they concluded that the most affecting factors are: delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, problems in national economy, materials procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications and labor disputes and strikes. Sambasivan and Soon (2007) concluded that the top ten important causes of delay in Malaysian construction industry are: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, incompetence of subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage. They also found that the six main effects of delay are: time overrun, cost overrun, disputes, arbitration, litigation, and total abandonment. Faridi and El-sayegh (2006) studied the delay in construction projects in UAE and concluded that 50% of the construction projects encounter delays and are not completed on time. The top significant causes of construction delays are approval of drawings, inadequate early planning and slowness of the owners' decision-making process.

Effects of time overrun in construction projects:

Table 1 summarizes the main effects of time overrun in construction projects as presented in 6 selected previous studies. The table shows that the most common effect of time overrun in construction projects are: cost overrun (100% of studies), litigation (66% of studies), disputes (66% of studies), and arbitration (66% of studies).

Table 1: Main effects of time overrun in construction projects through previous studies

Effect Author	Less profit to contractor	Less profit to client	Cost overrun	Arbitration	Disputes	Litigation	Poor quality
Ahmed et al. (2003)			✓	✓	✓	✓	
Sambasivan et al. (2007)			✓	✓	✓	✓	
Aibinu et al. (2002)			✓	✓	✓	✓	
Faridi et al. (2006)			✓				✓
ALkharashi et al. (2009)	✓	✓	✓				
Kaliba et al. (2009)			✓	✓	✓	✓	✓

Research method

34 factors that might affect the time overrun in public construction projects in Saudi Arabia have been compiled through making interviews with some local construction experts (contractors, engineers, supervisors, consultants and owners), also by reviewing some related previous studies. The identified factors were tabulated in a questionnaire form. The questionnaire was developed in order to evaluate the severity, frequency, and importance of the identified factors. Data were gathered through a survey, analyzed by using severity index, frequency index, and importance index, taking in the view of consultants.

Questionnaire Design

The collected factors were used in developing a questionnaire with the objective of investigating the main factors affecting time overrun in public construction projects in Saudi Arabia. The questionnaire is divided into two main parts. Part I is related to general information for the company. The surveyed consultants were further requested to answer questions pertaining to their experience in the construction industry. Part II includes the list of the identified factors affecting time overrun in public construction projects. For each factor two questions were asked: (1) what is the frequency of occurrence for this factor? (2) what is the degree of severity of this factor on project delay?. Both frequency of occurrence and severity were categorized on a five-point scale. Frequency of occurrence is categorized as follows: always, often, sometimes, rarely, very rarely (on 5 to 1 point scale). Similarly, degree of severity was categorized as follows: very high, high, moderate, low and very low (on 5 to 1 point scale). Then, the designed questionnaire was sent to some local construction experts to check its content and its validation. Some amendments were conducted that improved the questionnaire prior to sending it to the representative research sample.

Data analysis

The collected data were analyzed and ranked through the following statistical techniques and indices:

Frequency index: A formula is used to rank factors affecting time overrun in public construction based on frequency of occurrence as identified by the participants

$$\text{Frequency Index (F.I) (\%)} = \sum a (n/N) * 100/5 \quad (1)$$

Where, a is the constant expressing weighting given to each response (ranges from 1, for very rarely, to 5 for always).
 n is the frequency of the responses.
 N is total number of responses.

Severity index: A formula is used to rank the identified factors based on their severity as indicated by the participants.

$$\text{Severity Index (S.I) (\%)} = \sum a (n/N) * 100/5 \quad (2)$$

Where, a is the constant expressing weighting given to each response (ranges from 1, for very low, to 5 for very high).
 n is the frequency of the responses.
 N is total number of responses.

Importance index: The importance index of each factor is calculated as a function of both frequency index and severity index, as follows:

$$\text{Importance Index (IMP.I) (\%)} = [(F.I) (\%) * (S.I) (\%)] / 100 \quad (3)$$

Results and discussion

In this study, 34 factors affecting time overrun in public construction projects in Saudi Arabia have been identified and ranked by measurement of severity index, frequency index, and importance index according to equation (1), equation (2), and equation (3).

Participants

The target populations in this study are the consulting firms of construction projects in the Northern Province of Saudi Arabia. Simple random sampling was used. The questionnaire was sent out to a total of 83 consultants asking them to rank the identified 34 factors in terms of severity and frequency using an ordinal scale. A total of 70 consultants filled the questionnaire. The response rate by the consultants is 84%. On average, the respondents have experience of more than 10 years in public construction projects.

Factors ranking

Table 1 shows the indexes value (importance index, severity index and frequency index) and ranking of 34 factors affecting time overrun in public construction projects in Saudi Arabia from consultants' view. The table illustrates that the top five severe factors

affecting time overrun in public construction projects in Saudi Arabia are: bid award for lowest price, poor labor productivity, improper planning, additional work, and lack of contractor experience (with severity index of value 79.12, 78.69, 76.13, 75.67, and 74.06 respectively). While the top five frequent factors are: rework, improper planning, changes in material types and specifications during construction, poor contract management, and poor resource management (with frequency index of value 65.88, 64.28, 62.10, 62.00, and 61.95 respectively).

Results show that the top five important factors affecting time overrun in public construction projects in Saudi Arabia are:

1. **Improper planning:** proper planning is one of the main keys for project success. It includes managing natural and human resources of a project from its early stages up to project closeout. Thus, it is obvious that improper planning will affect project progress and lead to time overrun. This result is in line with Sambasivan and Soon (2007) and Faridi and El-sayegh (2006).
2. **Poor labor productivity:** labor productivity affects the activity duration and consequently the total project duration. Poor productivity increases the actual time of a specific activity to be completed. Accordingly, the project will delay. Labor productivity could be affected by many factors such as: motivations, relation between labors and management team, relations among labors, payment delay, wages, ..etc. Interviews with number of consultants in the studied sample illustrate that low labor wages in construction projects in Saudi Arabia (less than \$200 per month) is highly affect their motivation to work which lead to poor productivity. This result is in line with Mahamid et al. (2012).
3. **Additional work:** it can be defined as a deviation from an agreed upon well-defined scope and schedule. In general, initiation of additional work could be summarized as follows: owner may request a change, engineer may originate a change because of differing site condition or new governmental regulation, and contractor may initiate a change due to design errors or field requirement. Thus, additional work requires adding or removing of construction items that will affect project duration. This result is in line with Koushki et al. (2005).
4. **Rework:** it can be simply defined as redoing the same activity for more than one time. It might be as a result of many reasons such as improper planning, additional works, poor workmanship, poor material quality, late changes, scope changes, mistakes in design, .. etc. It is clead that redoing the same duty again and again will lead to project delay. This result is supported by Mahamid (2011)
5. **Lack of contractor experience:** it is established fact from learning effect that if you do the same task or project more than one time, you will control it better with less time and less cost. Interviews with number of consultants in the studied sample illustrate that the public projects are awarded by the owner (i.e. Governmental Departments) to the bidder with lowest price who are, in general, not technically and financially sound. This affects the contractor ability to do his job as agreed and to complete the project on time. This result is in line with Odeh and Battaineh (2002).

Table 1: Ranking of factors affecting time overrun in public construction projects

Factor	S.I	F.I	IMP.I	Rank
improper planning	76.13	64.28	48.94	1
poor labor productivity	78.69	59.93	47.16	2
additional work	75.67	60.62	45.87	3
rework	69.58	65.88	45.84	4
lack of contractor experience	74.06	61.26	45.37	5
poor resource management	73.04	61.95	45.25	6
poor contract management	72.22	62.00	44.78	7
bid award for lowest price	79.12	51.66	40.87	8
changes in material types and specifications during construction	65.32	62.10	40.56	9
duration of contract period	67.39	59.93	40.39	10

inflationary pressure	68.20	58.50	39.90	11
frequent changes in design	68.54	57.17	39.18	12
lack of adequate manpower	69.23	56.43	39.07	13
payments delay	67.51	57.81	39.03	14
long period between design and time of implementation	67.85	55.05	37.35	15
unreasonable project time frame	61.30	57.60	35.31	16
late design work	65.78	52.98	34.85	17
inadequate production of raw materials by the country	63.02	50.22	31.65	18
lack of coordination between design and contractors	62.33	49.53	30.87	19
mistakes in design	60.96	48.16	29.36	20
poor financial control on site	59.23	49.53	29.34	21
poor relationship between managers and labors	58.54	48.84	28.59	22
economic instability	49.31	56.48	27.85	23
disputes on site	59.12	46.14	27.28	24
manipulation of suppliers	58.89	46.09	27.14	25
level of competitors	57.51	44.71	25.71	26
number of projects going at the same time	55.10	45.40	25.02	27
number of competitors	56.13	43.33	24.32	28
contractual procedure	57.05	42.00	23.96	29
government policies	48.54	48.90	23.74	30
high interest rates by bankers	49.92	42.69	21.31	31
project location	47.51	43.81	20.81	32
effects of weather	46.55	43.38	20.19	33
social and cultural impacts	41.30	37.60	15.53	34

Conclusion

The study aims at identifying the factors affecting time overrun in public construction projects in Saudi Arabia from consultants' viewpoint. To do so, 70 consultants working in public construction completed a structured questionnaire survey and the factors were ranked according to their levels of severity, frequency, and importance. 34 factors were identified through interview with local construction experts and deep literature review. The results show that the top five important factors affecting time overrun in public construction projects are: improper planning, poor labor productivity, additional works, rework, and lack of contractor experience (with importance index of value 48.94, 47.16, 45.87, 45.84, and 45.37 respectively).

The results indicate that the top five severe factors affecting time overrun in public construction projects in Saudi Arabia are: bid award for lowest price, poor labor productivity, improper planning, additional work, and lack of contractor experience (with severity index of value 79.12, 78.69, 76.13, 75.67, and 74.06 respectively). While the top five frequent factors are: rework, improper planning, changes in material types and specifications during construction, poor contract management, and poor resource management (with frequency index of value 65.88, 64.28, 62.10, 62.00, and 61.95 respectively).

The following conclusions derived from the statistical analyses of the data thus come to the following conclusion: (1) The minimum severity index is 41% (2) the minimum frequency index is 37% (3) No factor was ruled out by any of the respondents. These all indicate that the identified factors are highly relevant to the problem of time overrun in public construction projects in Saudi Arabia.

Based on the study findings, the following points are recommended to minimize time overrun in public construction projects:

- Workshops and training programs should be developed to improve managerial skills of construction parties as well as labor skills.
- Contractors are recommended to assign enough number of labors and to motivate them to improve productivity.
- Detailed and comprehensive site investigation should be done at early project phases to avoid variations and late changes during construction phase.
- Owners are recommended to check for resources and capabilities of bidders before awarding the contract to the lowest bidder.

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