Causes of Cost overrun in Construction Projects in Developing countries, Gas-Oil Construction Industry of Iran as a Case Study

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Abstract

Cost overrun in construction projects is a common issue affecting project performance, and Gas-Oil construction projects in Iran are no exception. This paper presents the results of a questionnaire conducted to identify and evaluate the relative importance of the significant factors contributing to the Gas-Oil construction industry of Iran as a case study for developing countries. The survey respondents included project owners, contractors and consultants involved in Iranian Gas-Oil construction projects. The results of the survey revealed that the main causes of cost overrun in this industry include inaccurate cost estimations, improper planning, frequent design changes, inadequate labour/skill availability, inflation of costs of machinery, labour, raw material and transportation prices. The first three factors are the project consultants' responsibilityand the appointment of qualified consultants and personnel training are strongly recommended to alleviate cost overrun. The paper also reviews and compares findings of a set of similar researches in a number of developing countries.

Keywords: Cost issues, Gas-Oil, developing countries, Iran

1.0 Introduction

Project success can be defined as meeting goals and objectives prescribed in the project plan. Frimpong (2003) describes a successful project as one that has accomplished its technical performance, maintained its schedule and remained within budgetary costs. Because of the extensive use of sophisticated equipment and modern construction methods, construction projects are generally complex. Due to this complexity, many projects suffer from cost increase (overrun) that may not necessarily lead to project failure, but may dramatically curb the project success. Project cost overrun is defined as the positive difference between the actual cost upon project completion and the agreed estimation of the project budget. Harisaweni (2007) reported that a construction project experiences cost overrun if it is completed in excess of the budget estimate which was included in the approved contract.

Cost overrun has obvious effects on project performance and most certainly causes significant inconvenience both to clients and project owners. The highest priority of project stakeholders is cost certainty, which is considered as a good and measurable indicator for project success and performance (Dey et.al, 1996). Additionally, client satisfaction is an important determinant of contractor performance evaluation and comparison. Contractors need to initiate and maintain client satisfaction in order to remain competent in this industry (Torbica & Stroh, 2001).

Delay and cost overrun are common phenomena in projects worldwide. However these are especially sever in developing countries (Le-Hoai, 2008). Managing construction projects in developing countries has its special properties as the structure of economy, effect of social and political changes, availability of human resources and the rate and effect of inflation in these countries generally differ from developed countries. Therefore it would be worthy to study a set of similar researches in this field and compare the main causes of cost and time escalation identified in them.

This research is carried out to find the root causes of cost escalation arising during construction phase in gas-oil projects in Iran. Additionally, it reviews a number of similar researches conducted in developing countries. A preliminary research in Iran showed that many petroleum construction projects suffer from cost overruns because many contractors lack managerial skills (Derakhshanalavijeh, 2012). In 2006, the project manager of the Iranian Offshore Engineering Company (IOEC) announced that the offshore segments of the

9th and 10th phases of the South Pars gas field development plan had cost$70 million in excess of the contract's initial price. These two phases were planned to cost $374 million, but the steel price increase, transportation costs, drilling rig costs and other expenditures resulted in the above cost overrun. At the time of his statement, the 9^{th} and 10^{th} offshore phases were 67 percent complete and it had been decided that the contractor should pay for project's cost overrun (Derakhshanalavijeh, 2012).

The emergence of these problems reveals the necessity for further research on cost overruns within the Iranian construction industry, evidenced with details of project cost issues specifically in the Gas-Oil industry, such as cited in the example above. Some of these problems occur as a result of ignorance in the basic principles of project management. Therefore, apperceiving project scope and project cost management plan seems necessary to mitigate problems of cost overrun.

2.0. Literature review

Time and cost are two common concerns of construction management. Many factors relate to delay and cost overruns and are placed in different in types of project, locations, sizes, and scopes. Large construction projects with their features of complexity and capital requirements have resulted interest to many researchers internationally and locally in Iran, addressing major issues of cost and time management methods and suggesting new techniques for cost and time control in construction projects in general.

In 2003, Frimpong et.al carried out a research about causes of delay and cost overrun in construction of groundwater projects in Ghana. Identifying 26 cost and time inducing factors, they distributed questionnaire to three groups of owners, consultants and contractors involved in construction projects. The results show that three groups of respondents-owners, consultants and contractors- show a good compromise on the top five factors which are monthly payment difficulties from agencies, poor contractor management, material procurement, poor technical performances and escalation of material prices (Frimpong et.al, 2003).

With face-to-face interview of 450 randomly selected project owners from private sector in Kuwait, Koushki et.al. (2005) identified time delays and cost extension causes, finding that the first three causes of delay in construction projects in Kuwait are changing orders, owner's financial constraints and owners' lack of experience. Three main causes of cost increase were introduced as contractor-related problems, material related problems and owner's financial

constraints. Recommendations from them for minimizing time and cost overruns are providing adequate funds from owners, allocation of sufficient time and cost at the design phase and selection of competent consultants and reliable contractors to carry out the work.

Azhar et.al in 2008 exploited questionnaire survey in Pakistan categorizing a set of 42 factors in three groups of macroeconomic factors, management factors and business and regulatory environment related factors to examine their value in cost issues of construction projects. Regarding their findings, unstable cost of both manufactured and raw materials paralleled with inefficient lowest bidding method for selection of potential contractors are the main factors affecting cost of construction projects in Pakistan.

In a similar research in Vietnam by Hoai et.al. (2008) the researchers meet a conclusion about developing countries that in these countries efforts have been spent on winning the contract and less is paid to contract itself. They recommend paying more attention to contractor selection stage. For design stage problems, applying ISO standard to design works might be a good solution, as authors recommend. They finally concluded that the key issues in time and cost of construction projects are related to human and management problems (Le-Hoai et.al., 2008).

Ameh et.al. in 2010 mentioned this fact during their research about cost issues in construction projects in Nigeria that in the developing countries, where the currency change rate of money against major currencies like the US Dollar is declining fast, enough attention should be paid to the cost estimation stage to have a better estimation of imported materials cost. According to their research, many developing countries are politically unstable; they recommend preparing permission from law enforcement agencies to beef up on site security. As Ameh et.al (2010) expressed, the issue of corruption is a predominant factor affecting many developing countries. They recommend contractors to make their stand on corruption known from the inception of the project to avoid kickbacks from the contractor as construction progresses (Ameh et.al. 2010).

Table 1 below, compares the top four ranked factors in the reviewed researches in Ghana, Kuwait, Pakistan, Vietnam and Nigeria.

Table 1: Top Four Ranked Factors in Some Reviewed Researches from Developing Countries

	Major Causes			
	1	2	3	4
Ghana (Frimpong et.al , 2003)	Poor Contract Management	Material Procurement	Planning and Scheduling Deficiencies	Escalation of Material Prices
Kuwait (Koushki	Change Orders	Financial	Owner's Lack	Materials

et.al, 2005)		Constraints	of Experience	
Pakistan (Azhar et.al, 2008)	Fluctuation of Costs of Raw Materials	Unstable Cost of Manufactured Materials	High Cost of Machineries	Lowest Bidding procurement Method
Vietnam (Le-Hoai et.al, 2008)	Poor Site Management	Poor Project Management Assistance	Financial Difficulties of Owner	Financial Difficulties of Contractor
Nigeria (Ameh et.al, 2010)	Economic Stability	Inadequate Production of Raw Materials	Government Policies	Lack of Contractor Experience

The empirical and theoretical investigations performed by some researchers concern different aspects of project management in the gas, oil and refinery industry. Lang (1990) studied the effect of engineering, procurement and construction contracts (EPC) in managing costs within the oil industry. Dey et.al (1996) tried to develop a hierarchical planing model which enables decision makers to take vital decisions during the changing environment of the pipeline construction period. Asrilhant et.al (2004 a, 2007b) explored decision support and strategic project management in the gas and oil sector, concentrating on management process elements: content, content and output which the researchers explained balanced across financial, internal business, external environment and learning and innovations perspectives. Pongsakdi et.al (2006) addressed issues of uncertainty and the financial risk aspects in the planning of refinery operations.

Focusing on financial management, other researchers tried to describe cost issues within the general construction industry of Iran, whereas most of them concentrated on time issues within Gas-Oil construction projects. A summary of some of them is outlined below.

Vafaiee (2010) described the Gas-Oil industry of Iran as very confusing, due to"lots of non-preplanned contracts with too many contractors/suppliers in a great variety of project activities". They added that a lack of planning for managing project contractors has resulted in projects constantly being behind schedule, leading to many budget issues (Vafaiee et.al., 2010). Concentrating on procurement management problems, these writers stated that most of the procurement oriented problems arise from inappropriately supplying goods and services required for project performance. Further to the comments made by O'Brien, who argues that a delay is usually a costly issue, they added that a delay normally leads to contractor

inconvenience and loss of revenue. Vafaiee (2010) noticed that none of the gas projects in Iran have been completed within schedule, with an average delay of 60% and an average cost overrun of 20% (Vafaiee et.al., 2010).

Vafaiee et.al (2010) conveyed a questionnaire asking clients, consultants, contractors, management contractors and suppliers of gas projects to indicate their perception of the magnitude of thirty identified procurement-oriented problems. Referring to the results of the questionnaire, these authors observed financial problems as having the highest significance and contractor problems being perceived as having lowest significance in the procurement process of gas projects. Results showed that some problems such as political constraints and insufficient supportive legislation which forces local banks to financially assist the gas industry, as well asexcessive domestic inflation rates are strongly connected to government policies; therefore, the solution for these problems is beyond the stakeholders' range of action.

Dehghan et.al. (2007) stated that project success is directly related to the definition and implementation of a sound integrated management system. On the other hand, they recognized that cost management is based on the idea that costs are not produced spontaneously but rather as a result of managers' decisions, which are impacted by limited resources (Dehghan et.al., 2007). The authors also stated that, given the multiplicity of contractors acting within the Iranian construction industry, there is intense competition for awarding contracts through the lowest bid method. The use of this method may lead contractors to include higher risk allowances in their bids. Therefore, contractors should firstly understand and acknowledge the costs and associated risks with sound accuracy and then control them during the construction phase in order to anticipate and mitigate cost overruns (Dehghan et.al.,2007). As these writers described, cost control methods in Iran are not used accurately. At the lowest levels of work breakdown structure (WBS), the unit cost of resources and work is calculated on the basisof inaccurate estimations such that the total cost derived from the estimation phase is full of risks and uncertainties.

This article reports a survey that aimed at inquiring, recording and documenting the invaluable experiences of experts and connoisseurs from Gas-Oil construction projects in Iran. Key differences between this research and others researches which are concerned with cost and time issues within the Iranian construction industry is the specific focus on the gas-oil industry, on project management issues and the use of an academic approaches when pursuing research goals.

3.0 Data Collection

In order to evaluate and analyze the causes of cost overrun in the Gas-Oil construction industry of Iran a questionnaire was developed with a three-step approach. Firstly, previous researches on time and cost overrun were used for reference in the pilot study. Secondly, a pilot was arranged with two construction project managers acting in the Iranian Gas-Oil industry. They clarified some of the issues that were more important from their point of view, concluding the identification of a total number of 51 factors that affect projects costs. To ensure greatest relevance and association with the Iranian construction industry, a pilot test was performed by way of a series of face-to-face interviews. Thirdly, three experts from construction projects in the Iranian Gas-Oil industry were involved in the critical review of the questionnaire design and structure. During the interviews, one of the authors together with an expert would cross-check and discusses each individual factor from the list of 51. The experts suggested the adding of some more factors to the list and eliminating some of the issues that were not important or effective for cost increase. One of these experts suggested the classification approach, which was eventually adopted. By the end of this stage, the questionnaire was ready to be used. A total number of 44 factors were included and organized in the following five *g*roups:

- Owner-related
- Consultant-related
- Contractor-related
- Project-related
- Material and labour

It is clear from Appendix A that some of the factors are categorized into two different groups. This is because there might be some exceptions in the origins of those factors. But the above groupings were not included in the questionnaire in order to prevent any bias or unwanted effect on the respondents' opinions.

The questionnaire was shared with personnel from the three principal construction parties (owner, consultant and contractor), who were asked to determine the ranks of both frequency of occurrence and severity of each factor listed in Appendix A. A five point scale of 0 to 4 is adopted for evaluating the effect of each factor. These numerical values are assigned to the respondents' rating. In relation to the frequency of occurrence the following scale was used:

0= never; 1= rarely; 2=sometimes; 3=often; 4= always. In relation to severity of factor the following scale was used: 0=no; 1= little; 2= moderate; 3= very; 4= extremely for severity.

Table 2: Number of questionnaires distributed and response rates

Respondent	*Distributed*	*Received*	*Response Rate*
Owners	40	16	40.00%
Consultants	80	37	46.25%
Contractors	60	25	41.67%

Based on the respondents' rank, the mean values were calculated to show which causes had more effect on project performance. Whilst their project positions naturally differed, acting as project starter, planner or executor, respectively; the results were combined at the end, to show which factors or causes had more influence over Gas-Oil construction projects, globally.

4.0 Data Analysis

The responses to the questionnaires were processed by calculating their index value as a measure for identifying the factors that mostly contribute towards project cost overrun. The index was also used to determine the various factors that demand the highest attention from the three perspectives under analysis, that of the owners, contractors and consultants. These factors would therefore be considered as identifiable problems to be solved.

Three types of indexes were considered:

- *Frequency index*: this index describes the occurrence frequency of a factor responsible for cost overruns. It is computed through the following formula:

$$F.I = \frac{\sum_0^4 ai\ ni}{N} \qquad (1)$$

Where:

a_i= constant expressing the weight assigned to each response (ranges from

0 for no occurrence to 4 for always);

n_i= frequency of each response

N= total number of responses.

- *Severity index:* this index expresses the severity of a factor causing cost overruns. It is computed through the following formula:

$$S.I = \frac{\sum_0^4 ai\ ni}{N} \quad (2)$$

Where:

a_i= constant expressing the weight assigned to each response (ranges from 0 for no severity to 4 for extremely severe)

n_i and N as above.

- *Importance index:* this index expresses the overview of a factor based on both its frequency and severity. It is computed through the following formula:

$$IMP.I = F.I \times S.I \quad (3)$$

- *Spearman's Rank Correlation:* this coefficient is used to show whether there is an agreement or disagreement among each pair of project parties. The formula for the Spearman correlation is as below (Keller, 2008):

$$\rho = 1 - \frac{6\sum di^2}{n(n^2 - 1)} \quad (4)$$

Where:

ρ is the Spearman's rank correlation;

d_i is the difference between the ranks of each observation for the two variables and n is the number of ranked items.

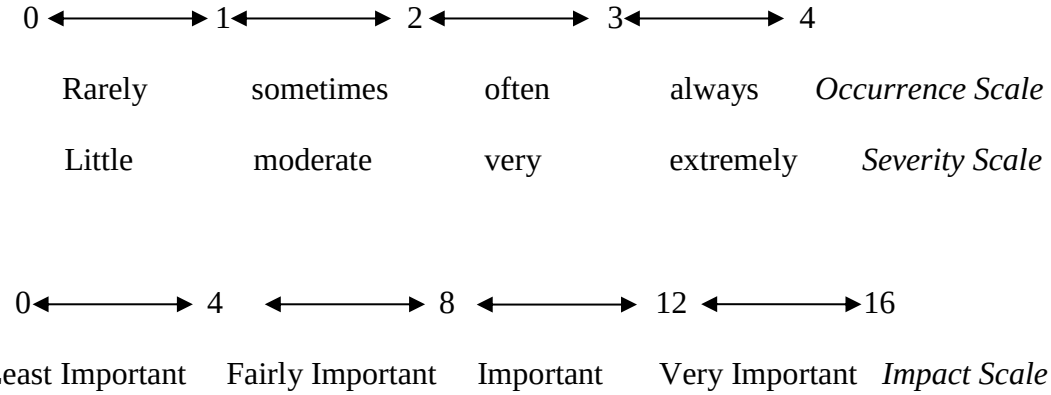
The Spearman's rank correlation can vary from -1 to 1. The results can be interpreted as:

Close to -1 - Negative correlation.

Close to 0 - No linear correlation.

Close to 1 - Positive correlation.

The mean values of the responses and calculated answers obtained from the owners, contractors and consultants were classified from the lowest to the highest level, for the three indexes presented above. Index scales are graphically shown below:



Appendix B shows the severity, frequency and impact indices for the 44 causes and their rankings, as obtained from the survey. It can be seen from these three tables that there is almost no difference in the overall ranking orders associated with occurrence and severity. This means that the more frequently a factor occurs, the greater the severity of its impact on the project budget. The deviation of the occurrence ranking order from the severity ranking order in each respondent group is small and can be neglected. Moreover, the first ten causes in the overall rankings evidence good agreement among the three parties inquired. However, a closer consensus can be seen between the consultants and overall.

5.0 Spearman's Rank Correlation

The Spearman's coefficient of rank correlation demonstrates whether there is an agreement or disagreement among each pair of parties. Table 3 illustrates the results of the Spearman coefficient calculation. The conclusion that can be inferred from these results is that there is a very good agreement among the three parties in ranking these causes regardless of the frequency, severity or importance index. The highest degree of agreement is between the owner-contractor pair, scoring 0.910 for severity, 0.848 for frequency and 0.940 for importance. Given the good agreement between the parties in their ranking of the factors causing cost overrun, all of the data could be used as a whole for further analysis.

Table 3: Spearman's Rank Correlation Results

	Severity Index	*Frequency Index*	*Importance Index*
	Spearman rank correlation coefficient	Spearman rank correlation coefficient	Spearman rank correlation coefficient

Owners-Contractors	0.910	0.848	0.940
Contractors-Consultants	0.846	0.878	0.937
Owners-Consultants	0.867	0.848	0.940

6.0 Suggested Solutions

The results show that there are several important factors underlying the causes of cost overruns in the Gas-Oil construction industry of Iran. The five most important factors, agreed by the project owners, consultants and contractors are: inaccurate cost estimations; improper planning; frequent design changes or mistakes in design; inadequate labour/skill availability; inflation costs for machinery, labour, raw material and transportation prices.

Based on the answers to the questionnaire and on the result analysis performed in the above section, the authors suggest the following set of solutions for cost overrun mitigation of construction projects in the Iranian Gas-Oil industry (see Table 4). These solutions are mainly suggested by the participants in the survey and some are suggested by the authors or come from previous surveys, as depicted in the table.

Table 4: Suggested solutions for the top ten problems identified

Suggested Solutions	Problem
a. Select qualified cost/time estimators *b*. Regular training for cost estimators through meetings or related courses (Asrilhant et.al, 2004) *c*. Use of models for relationships among project construction time, project cumulative sales, and cost (Chen, 2011)	16th problem: Inaccurate cost estimation
a. Minimize project idle time b. Making scope, risk, team and communication perform well at the initiation and planning phase of the project (Chen et.al., 2013)	17th problem: Improper Planning
a. Selecting reputable and experienced consultants *b*. Frequent cross check of design documents	18th problem: Frequent design changes/ errors in design
Set long term plans for training Iranian workers to learn welding, sealing and equipment installation techniques	1st problem: Inadequate labor/skill availability
a. Expedite orders of long delivery items as to reduce the impact of international growth in their price (Vafaiee, Saleh Owlia, & Vahdat, 2010) *b*. Prevent any delay in project schedule by accurate planning	2nd problem: Inflation of machinery, labor, raw material and transportation prices

c. Use expert opinion and advise for estimating inflation rates	
Analyzing gas-oil industry's risk factors comprehensively to make more realistic initial project budget (Dey et.al, 1996), (Ogunlana et.al , 1993)	3rd problem: Prices fluctuation of raw construction materials
Consult with contract law experts before signing any contract	10th problem: Inappropriate contract policies
Consultants to select professional cost estimators to attain more accurate estimating	15thproblem: Inadequate cost estimating approach
Designers and general contractors to cooperate in the project team to expedite project completion (Shahalizadeh & Farhadyar, 2006)	20th problem: Lack of coordination between the design team and the general contractor
a. Select reputable and experienced contractors using the latest and most suitable construction methods *b*. Train contractors to increase their technical knowledge through regular courses	37th problem: Obsolete or inadequate construction methods
Investigate construction site conditions and activities to prevent delays and reworks (Shahalizadeh & Farhadyar, 2006)	38th problem: Inadequate preconstruction study
a. Find competitive contractors by project owner *b*. Employ experienced and qualified technical staff *c*. Train fresh staff to increase their technical knowledge	40th problem: Errors during construction
Care on the selection of technology and the licensing agency at the project outset not to include countries politically in conflict with Iran (Vafaiee, Saleh Owlia, & Vahdat, 2010)	42nd problem: Inappropriate government policies

7.0 Conclusion

This paper has attempted to investigate the main factors impacting the cost of Gas-Oil related construction projects in Iran as a sample of construction cost issues in developing countries. The factors were identified through interviews with gas-oil project managers as well as drawing on factors previously identified by researchers in the construction industry of various countries. The factors identified were then organized in the form of a questionnaire and distributed between respondents as well as active individuals working within construction projects for the gas-oil industry of Iran including project owners, consultants and contractors.

The analysis of the data collected revealed that the predominant issues, which were both most frequent and most severe, were generated from the consultants, threatening project budgets. This was followed by external factors, such as inflation issues and price fluctuations of raw materials as well as governmental obstacles, which are incontrollable. Some suggested solutions to mitigate the effect of these factors are however noted in Section 6.0.

The authors acknowledge that the results obtained from the ranking of each factor, differed entirely from the initial expectations. After the 2012 sanctions on Iranian external trade, it became popular to believe that the predominant problems in the construction industry were based on these limitations and on the unpredictable increase of the major currency exchange rates. However, the results of the survey have shown that although these factors can be important up to a certain level, they are ranked lower than the preventable factors like project mismanagement and various issues related to project parties.

The findings of the paper could help the construction managers to gain better understanding about the problems influencing budget of large-scale construction projects. By taking care of these potential factors in their future projects, construction managers can take control of cost escalation in these projects no just in Iran, but in other developing countries.

Finally, it is worth mentioning that the research project, on which this article is based, has achieved all of its objectives and was used for the proposal of solutions for managing factors causing cost overruns, as summarized in section 6.0.

8.0 Limitations and Future Research

Guidelines for future research on the same topic are listed below:

a. A future survey should be performed to determine the effect on time and cost overruns brought about by the necessity of too many formal procedures prior to a project start, such as tender procedures, contract negotiation and governmental bureaucracy.

b. A further study should be performed for determining the causes of time and cost overruns due to the loss of worker/labour productivity, problems associated with material supply, idle facilities and equipments, unexpected flaws and other related factors.

c. The results of this research could be used to establish a framework, mathematical model or artificial intelligence model for identifying, reducing and mitigating cost overrun issues in construction projects for the Iranian Gas-Oil industry.

d. The selected participants in the inquiry should be addressed personally, in both the delivery of the questionnaires and when collecting the answers. Additionally, having undertaken the survey for this article, it is clear that some respondents prefer interviews to filling out questionnaires. The experience gained with this approach has assisted in recognizing the following main advantages: Less time is needed waiting for the answers to the questionnaires as well as the collection of additional information during the interviews. This allowed for the composition of Table 3 above. The disadvantages are, the higher survey costs due to transportation and time spent during interviews, which limited the number of inquiries and its geographical range in a large country as Iran.

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Appendix A

Table A.1. Cost overrun factors and categories

No.	Factor	Group
1	Inadequate labor/skill availability	Labor/Material
2	Inflation of machinery, labor, raw material and transportation prices	External
3	Fluctuation of raw construction material prices	External
4	Waiting for materials/ Material procurement	Labor/Material
5	High interest rates charged by bankers on contractor loans	External
6	Unstable cost of manufactured materials	External
7	Inadequate production of raw materials in the country	Labor/Material
8	Inadequate duration of contract period	Consultant
9	Inappropriate contractual procedure	Consultant
10	Inappropriate contract policies	Consultant
11	Inadequate quality /ambiguity of contract documents	Consultant
12	Lowest bidding procurement method	Consultant
13	Bureaucracy in bidding/tendering method	Consultant
14	Lack of construction cost data	External
15	Inadequate cost estimating approach	Consultant
16	Inaccurate cost estimating	Consultant
17	Improper planning	Consultant
18	Frequent design changes/ design errors	Consultant
19	Long period between design and time of bidding/tendering	Consultant
20	Lack of coordination between the design team and the general contractor	Consultant/Cntractor
21	Scope changes occasioned by inadequate pre-contract study	Consultant
22	Scope changes arising from redesign and extensive variation	Consultant
23	Poor financial control on site	Contractor
24	Poor relationship between management and labor	Project/Contractor
25	Breakdown of construction plant and equipment	External/Contractor
26	Unforeseen site conditions	External
27	Stealing and waste on site	External/Contractor
28	Social effects like disputes on site	External/Contractor
29	Adverse effect of weather/ Bad weather	External
30	Inadequate site investigation	Consultant
31	Additional work	Project
32	Fraudulent practices, kickbacks, corruption	Project/Contractor
33	Incompetent subcontractors	Contractor
34	Lack of coordination between general contractor and subcontractors	Contractor
35	Litigation	Owner/Contractor
36	Work suspensions owing to conflicts	Project
37	Obsolete or inadequate construction methods	Contractor

38	Inadequate preconstruction study	Contractor
39	Numerous construction activities going on at the same time	Owner/ Consultant
40	Errors during construction	Contractor
41	Domination of construction industry by foreign firms and aids	External
42	Inappropriate government policies	External
43	Obstacles from government	External
44	Financing and payment method for completed work	Owner

Appendix B

Table B.1. Responses from owners, contractors and consultants.

Factors' severity index, mean values and ranking of the top ten overall factors

Factor No.	Overall		Owner		Consultant		Contractor	
	S.I	Rank	S.I	Rank	S.I	Rank	S.I	Rank
8	3.139	1	3.077	2	3.273	2	3.067	2
11	3.135	2	3.000	3	3.273	2	3.133	1
38	3.134	3	3.154	1	3.182	3	3.067	2
42	3.100	4	3.077	2	3.091	4	3.133	1
20	3.086	5	3.077	2	3.182	3	3.000	3
1	3.083	6	3.000	3	3.182	3	3.067	2
18	3.078	7	3.077	2	3.091	4	3.067	2
9	3.078	8	3.077	2	3.091	4	3.067	2
37	3.056	9	3.077	2	3.091	4	3.000	3
10	3.044	10	3.000	3	3.000	5	3.133	1

Table B.2. Responses from owners, contractors and consultants.

Factors' severity index, mean values and ranking of the top ten overall factors

Factor No.	Overall		Owner		Consultant		Contractor	
	F.I	Rank	F.I	Rank	F.I	Rank	F.I	Rank
16	3.162	1	3.154	1	3.000	4	3.333	1
17	3.123	2	3.077	2	3.091	2	3.200	2
18	3.061	3	3.000	3	3.182	1	3.000	3
8	2.927	4	3.000	3	3.182	1	2.600	5
20	2.831	5	2.692	5	3.000	4	2.800	4
1	2.811	6	2.615	6	2.818	5	3.000	3
15	2.769	7	2.615	6	3.091	2	2.600	5
3	2.750	8	2.615	6	2.636	6	3.000	3
2	2.709	9	2.692	5	2.636	6	2.800	4
40	2.602	10	2.769	4	2.636	6	2.400	7

Table B.3. Responses from owners, contractors and consultants.

Factors' impact index, mean values and rankings of the top ten overall factors

Factor No.	Overall		Owner		Consultant		Contractor	
	IMP.I	Rank	IMP.I	Rank	IMP.I	Rank	IMP.I	Rank
16	9.632	1	9.673	1	9.000	5	10.22	1
18	9.412	2	9.201	3	9.835	2	9.20	3
8	9.196	3	9.201	3	10.413	1	7.97	6
17	9.087	4	9.231	2	8.430	7	9.60	2
1	8.729	5	8.020	5	8.967	6	9.20	3
20	8.674	6	8.076	4	9.545	4	8.40	5
2	8.208	7	8.076	4	8.149	8	8.40	5
15	7.936	8	7.147	10	9.554	3	7.11	8
3	7.843	9	7.497	7	7.430	11	8.60	4
42	7.491	10	7.231	8	7.306	10	7.94	7