Toward a Typology: cost overrun causes framework in infrastructure projects

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Abstract

The cost overrun of infrastructure projects potentially poses significant financial risks to the investment parties involved. Substantial cost overrun has been identified in infrastructure-project data from across 20 nations in five continents. Studies, in fact, show that the average cost overrun of infrastructure projects presents substantial fiscal risk (Flybjerg & COWI, 2004; Odeck, 2004; Flybjerg et. al., 2009). Yet, over the last several decades, the magnitude of cost overrun of infrastructure projects has failed to improve, suggesting that no significant learning has occurred in mitigating its detrimental effects.

The possible causes of cost overruns are numerous. They are dependent upon the unique characteristics and context of individual projects. According to Flyvbjerg et al. (2004), the two main causes of cost overruns are: optimism bias and strategic misrepresentations. Other studies have identified a spectrum of various causes for cost overruns. These include: technical factors such as lack of experience; the project size, design error, overall price fluctuations, inaccurate estimations, and scope changes (Love et al., 2011; Memon et al., 2011). The spectrum of possible causes makes the planning and management of projects especially challenging.

The objective of this research is to propose a conceptual framework to classify the causes and corresponding approaches to the management of cost overruns along pre-defined dimensions. The typology is developed according to the following steps: firstly, the empirical literature on infrastructure project cost overrun causes is reviewed and catalogued; secondly, based on the review a typology of cost overrun causes has been developed to provide a theoretical framework which organises and describes, parsimoniously, the pattern of relationships between types of causes, overrun and corresponding management approaches - thus simplifying the seemingly complex pattern of relationships. The typology study organises the main causes in four types (financial uncertainty, novelty, complexity, and time pressure) and develops a conceptual framework that identifies and explains patterns of relationships among causes, overrun and the corresponding management approaches within each category. Such a typology can be used to aid the assessment of

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cost overrun causes for large infrastructure projects and to effectively mitigate risks of significant overruns. Finally, we propose a plan to validate the typology empirically.

Keywords: Causes of Cost Overrun, Cost Overrun, Infrastructure Project, and Typology.

1. Introduction

Cost overruns in infrastructure projects are common around the world. High profile examples include: the Big Dig project in Boston which had a cost overrun of 500%; the Wembley Stadium that experienced a 50% cost overrun; and the Scottish Parliament Building that was over three years late and experienced more than 900% cost overrun (Love et al., 2011). In Australia, the Western Australian Perth Arena had an original contract value of AUD 168 million, but a cost overrun of more than three times this amount (Love et al., 2011). According to Flyvbjerg et al. (2005; 2009) the average cost overrun for infrastructure large-scale projects could range from 20.4% to 44.7%; and nine out of 10 projects have cost overruns worldwide. Cost overrun is found across 20 nations and five continents covered by this study. Over the past 70 years, there have been no systematic improvements in cost overrun of infrastructure projects (Bruzelius et al., 2002).

Various causes of cost overruns have been identified. Studies have shown that technical factors lead to cost overruns, including lack of experience, project size, mistakes in design, overall price fluctuations, inaccurate estimations, etc. (Memon et al., 2011). Love et al., (2011) conducted a study on the causes of cost overruns via case studies on a hospital and a school**.** They found that technical factors (such as design errors) are the major causes leading to cost overruns.

According to Flyvbjerg et al. (2004), however, there are two basic reasons why projects experience cost overruns. Firstly, optimism bias encapsulates the systematic propensity of decision makers to be over-optimistic about outcomes of planned actions. Secondly, strategic misrepresentations are the misleading actions used in politicisations and economics, and by planners, to ensure projects proceed (Flyvbjerg, 2006). Traditional estimation practices have been shown to be particularly vulnerable to these detrimental effects, resulting in poor estimation accuracy in previous studies (Flyvbjerg et al., 2002).

It is apparent that there are a large number of causes of overruns and many share similar patterns of impact on overrun costs. Therefore, it will be functionally useful and conceptually meaningful to develop a typology of causes based on their impact on the overruns of infrastructure projects. Based on the review of empirical literature on the cost overrun of infrastructure projects, a typology of causes has been developed to aid the assessment of cost overrun causes for large infrastructure projects.

Below, background literature is reviewed and the research method is described. Then, based on the causes identified in the literature review, a typology of causes of cost overrun has been empirically developed. The proposed plan of validating the framework is explained. Finally, conclusions are drawn.

2. Theoretical Background

Cost is one of the main considerations throughout a project's lifecycle and can be regarded as a significant parameter of a project and the driving force of project achievement. Despite its proven significance, it is not rare to observe a construction project failing to achieve its objectives within the specified, or even the approximate, estimated cost. Cost overruns vary significantly in scale from project to project. Yet, cost overrun is common to infrastructure projects (Azhar et al., 2008). Understanding the causes of cost overruns is critical to the success of infrastructure projects. Past studies have found significant, yet common cost overrun of infrastructure projects.

Pickrell (1990) carried out a study for the US Department of Transportation covering US rail transit projects with a total value of US$24.5 billion. The total capital cost overrun for eight of the projects was calculated to be 61% ranging from -10 to +106%. Another study by the Auditor General of Sweden (1994), covering 15 road and rail projects, revealed that the average cost overrun of eight road projects was 86%. The range for road projects was from -2 to +182%, while the average cost overrun for the seven rail projects was 17%, ranging from -14 to +74%. Another study by Fouracre et al. (1990), carried out for the UK Transport and Road Research Laboratory (TRRL), covered 21 metro systems in developing countries. The outcomes of the study showed that six metro projects had cost overruns above 50%. Two of these projects range up to 500%. Three had cost overruns in the range of up to 100%, and the remaining four ranged up to 50%.

Skamris and Flyvbjerg (1996, 1997) conducted a study in Denmark, in which they compared the accuracy of cost estimates on large-scale infrastructure projects. The study considered cost estimates of seven tunnels and bridges before the decision was made to build. The major conclusion from this study is that cost overrun of 50–100% is common for larger transportation infrastructures, and that overruns above 100% are not unusual.

Studies on causes of overrun have identified a wide spectrum of causes. Frimpong et al. (2003) identified 26 factors that cause cost overruns in the construction of ground water projects. They found that, according to the contractors and consultants, monthly payment difficulties were the most important cost-overrun factor. Owners, however, ranked poor contractor-management as the most important factor. Although there were some differences in viewpoints among the three groups surveyed, there was a high degree of agreement among them with respect to their ranking of the factors. The overall ranking results indicated that the three groups felt the major issues which can cause extreme groundwater project-cost overruns in developing countries are: monthly payment difficulties; poor contractor management; poor technical performances; material procurement; and escalation of material prices.

In Kuwait, a study was done by Kouski et al. (2005) in which cost increases in the construction project was examined. The study found the three most important causes of cost overruns are contractor elide, material related problems and owners' financial constraints. Other studies have identified four of the most important factors that cause cost overruns as:

design changes; inadequate planning; unpredictable weather conditions; and fluctuations in the cost of building materials (Kaming et al., 1997; Chimwaso, 2000).

Flyvbjerg et al. (2002) carried out a study on the cost overrun of road projects. Based on a sample of 258 infrastructure transportation projects valued at US$90 billion, they found that cost estimates used to justify the go-ahead of these projects are systematically misleading. They concluded that the underestimations observed cannot be explained by error, but are best explained by strategic interpretation - which is tantamount to deceitfulness (Flyvbjerg et al., 2002). They thus warn legislators, administrators and those who value honest numbers not to trust cost estimates and benefit-cost analysis produced by project promoters (Flyvbjerg et al., 2002).

Around the globe, many other researchers have been attracted to cost overrun. Asian and African countries have attracted particular attention. In Southeast Asia these researchers are: Kaming et al. (1997) in Indonesia; Ogunlana et al. (1996) in Thailand, Sambasivan; and in Malaysia, Soon (2007). Chan and Kumaraswamy (1995), Chan and Kumaraswamy (1997) and Lo et al. (2006) studied cost overrun in Hong Kong, and Acharya et al. (2006) studied it from a Korean perspective. Chang (2002) conducted surveys in the US. In Middle Eastern countries where petroleum and natural gas exports have played an important role in the economy, researchers are: Faridi and El- Sayegh (2006) in UAE, Koushkiet al. (2005) in Kuwait.

In Africa, Frimpong et al. (2003) conducted studies in Ghana, as did Mansfield et al. (1994), and Aibinu and Odeyinka (2006) in Nigeria. In Vietnam, large-scale projects were studied by Long et al. (2004a) to identify project success factors, and by Long et al. (2004b) to identify ordinary and general issues. Regarding these issues, the Vietnamese government declared the infrastructure project cost-overrun issues as the biggest “headache” (Le-Hoai et al., 2008, p.368) in recent times, especially with government-related funded-projects (Ministry of Planning and Investment in Vietnam, 2003, as cited in Le-Hoai et al., 2008).

Skamris et al. (1996) concluded that in most previous studies, technical factors such as changes in design and technological innovation can be explained as causes of cost overruns. However, there remains a considerable portion of divergence that cannot be clarified by technological causes alone (Odeck, 2004). In fact, Wachs (1990) pointed out that the probable cause of cost overruns in infrastructure projects is due to the inaccuracy of cost forecasts.

On the other hand, Flyvbjerg et al. (2004) argues about the main causes of the cost overruns. They postulate that these causes affect projects throughout their life cycle, and are due to misinformation in policy and the management of the project. Why projects experience cost overruns is firstly due to optimism bias that encapsulates the systematic propensity of decision makers to be overoptimistic about outcomes of planned action. Secondly, they relate to the strategic misrepresentation (deceitfulness) that misleads actions used in politicisations and economics, and by planners to ensure the projects proceed (Flyvbjerg 2006).

Doty and Glick (1994) typologies could constitute theory. Shenhar and Davir (1996) claimed that typologies are complex theories that can be subjected to rigorous empirical testing if typologies are properly developed and fully specified. According to Doty and Glick, "typologies do not provide decision rules for classifying organisations. Instead, typologies identify multiple ideal types, each of which represents a unique combination of the organizational attributes that are believed to determine the relevant outcome(s)" (1994, p. 232). Construction of a conceptual framework through a typology approach, as outlined by Doty and Glick, are required to meet the following criteria: "(a) constructs must be identified, (b) relationships among these constructs must be specified, and (c) these relationships must be testable" (1994, p. 233).

In this paper a new typology for cost overrun causes is proposed. First, causes of cost overrun in infrastructure projects have been identified from the literature review. Then, the causes have been grouped into types based on how they impact overrun. The limitation of understanding cost overrun causes creates differences in mitigating the causes effectively. Therefore, it is important to develop a conceptual framework to reduce the complexity of causes, and to facilitate effective understanding in management of such causes. By mapping studies to identify frequent causes of cost overrun through the literature review of data, we have identified a set of "ideal types". Furthermore, the typology will be useful in predicting the dependent variables, when fully developed.

3. Conceptual framework of cost overrun

Through a comprehensive literature review, most of the causes that have frequently occurred are listed in the table below and measured, based on frequency. This has resulted in the identification of more than 90 causes of cost overrun, which are presented in table 1A in the appendix. Then, we developed a rough-cut typology by grouping factors sharing similar patterns of how it impacts on cost overrun (by identifying relationships between cause and overruns), fitting the factors identified to the rough-cut typology for further refinement. The causes have then been grouped into to four types based on how the causes impact on overrun.

Table 1: A typology of cost overrun causes

Causes of cost overrun	Frequency	Relationship to overrun	Ideal types	Description of each ideal type
Increase in material prices, Inflation, Difficulties in obtaining construction materials at official current prices, Increase in wages, Labour cost increased due to environment restriction, Monthly payment difficulties from agencies, Cash flow during construction, Financial difficulties of owner, Financial difficulties of contractor, Slow payment of completed works, Fluctuation in money exchange rate, High interest rate charged by bankers on loans, Cash flow and financial difficulties faced by contractors, Shortage of materials, Deficiencies in cost estimates prepared by	32%	Increases the volatility of input costs and thus the chances of overrun. Induces tendency for under estimation of costs.	Financial Uncertainty	This type represents factors impacting on the volatility of input costs for the project (Odeck, 2004)

Causes of cost overrun	Frequency	Relationship to overrun	Ideal types	Description of each ideal type
public agencies, Optimism bias, Fraudulent practices, Practice of assigning contract to lowest bidder, Inaccurate estimates.				
Lack of experience of project location, Lack of experience of project type, Inadequate contractor experience, Unexpected subsoil conditions, Poor technical performance, Impractical and complicated design, Inadequate modern equipment (Technology), Unpredictable weather conditions, Unexpected geological conditions, Unforeseen site conditions, Site constraint, Rock and soil suitability, Earth conditions, Deficiencies in the social structure, Social and culture impact, Problem with neighbours, Heritage material discovering experience in contract, and Inaccurate quantity take-off.	20%	Increases the uncertainty of tasks and outcome, thus making planning and estimating difficult.	Novelty	How new the project and the project solution is to the industry (Shenhar & Dvir, 2007)
Deficiencies in the infrastructure, Labour problems, Insurance problems, Problems related to work security, Problems related to workers' health, Additional works, Contractor's poor site management and supervision, Shortage of site workers, Lack of communication among parties, Mistakes during construction, Relationship between management and labour, Slow information flow between parties, Inaccurate site investigation, Rework, Changes in material specification and type, Design error, Project size, Incomplete drawings, Inadequate specifications, Lack of skilled labour, Equipment availability and failure, Number of works being done at same time, Lack of constructability, Scope Change of the project, Insufficient equipment, Labour disputes and strikes, Owner interference, Obstacles from government, Laws and regulatory framework, and Delay of preparation and approval of drawings. Disputes on site, Political complexities.	38%	Increases the complexity of coordination of parties and tasks, thus making it harder to meet preset targets.	Complexity	Project complexity can be defined as consisting of many varied interrelated parts' and can be operationalized in terms of differentiation (the number of varied elements, e.g. tasks, specialists, components) and interdependency (the degree of interrelatedness between these elements) (Baccarini, 1996)
Unrealistic contract duration and requirements imposed, Incorrect planning and scheduling by contractors, Delay in material procurement, Poor design and delays in design, Late delivery of materials and equipment, Delay in decision making, Reasons that yield construction delays, Inadequate planning and scheduling, Delay in payment to supplier/ subcontractors and Insufficient time for estimate.	10%	Forcing project team to take short-cuts, crashing, concurrent tasks/projects which are known to cause delays and overrun	Time pressure	This represents the urgency of the project, namely how much time there is to complete the job (Shenhar & Dvir, 2007)

The four types identified in Table 1 are the ideal types of each group, which are; 'financial uncertainty', 'complexity', 'novelty', and 'time pressure'. Each type will be ranked based on each variable. Figure 1 shows the framework of cost overrun and the scale of each type.

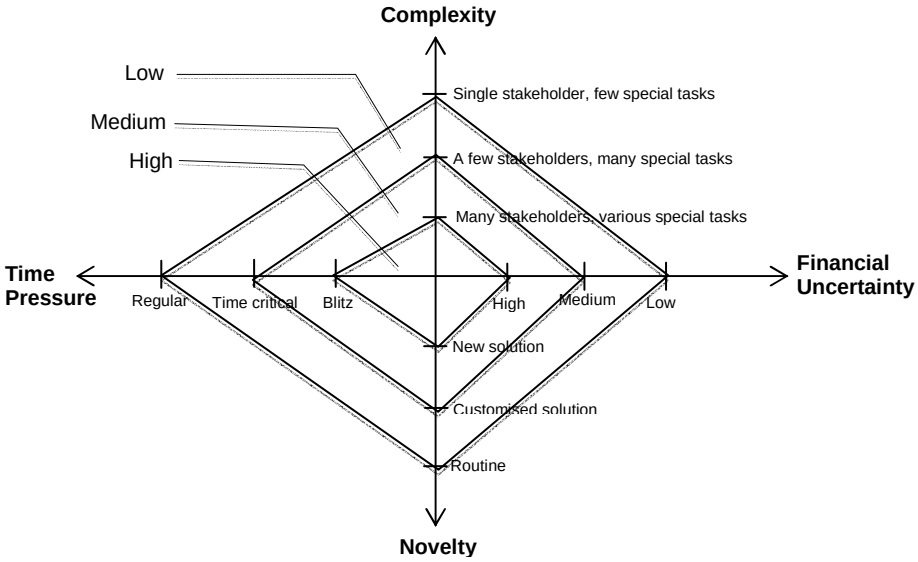

Figure 1: cost overrun framework

4. Research design

The research design of this paper is divided into three stages; empirical literature review, construction of a theoretical framework by using typology, and empirical validation. The typology has been developed via the following steps:

First, the empirical literature on infrastructure project cost overrun causes has been reviewed and catalogued. 26 studies on infrastructure projects have been selected (transportation, health, education, power and water). The selection is based on countries and citation of the publications. The literature covers developing and developed countries. The period of the literature reviewed is between 1990 and 2011.

Second, based on the review, a typology of cost overrun causes has been developed to provide a theoretical framework that organises and describes the relationships between types of causes, overrun and corresponding management approaches. Thus, the seemingly complex pattern of relationships has been simplified. The typology study organises the main causes in four types: financial uncertainty, novelty, complexity, and time pressure. It develops a conceptual framework that identifies and explains patterns of relationship among causes, overrun and the corresponding management approaches within each category. Such a typology can be used to aid the assessment of causes of cost overrun for large infrastructure projects and to effectively mitigate risks of significant overruns.

Finally, we have proposed a plan to validate the typology empirically. A survey has been used to validate the conceptual framework of cost overrun. The reason to conduct the survey in Saudi Arabia is twofold. First, the construction boom which started in 2005 is expected to go through a period of accelerated growth over the next few years, with a value of projects estimated at US $629 billion (Al-alrabia, 2012). The other reason is due to the lack of research on cost overrun in infrastructure projects in Saudi Arabia.

The survey questionnaire has been designed and distributed to experienced project managers and executive managers. The questionnaire poses specific questions to the respondents' that have most recently completed infrastructure projects (e.g. education, health, transportation, water, power and IT) with a contract value over 50 million Saudi Riyals (US $14 million), excluding operation and maintenance variables. The questionnaire consists of three sections: general information about the participant's experience; causes of cost overrun; and the frequency and severity of each of these causes, including the extent of cost overrun, respectively.

The first section contains questions about participants and their organisation, work experience, academic qualifications, the number of projects constructed within 20 years. In the second section, the participants are asked to scale the frequency of 40 cost overrun causes using this scale: (Never (N)=1, Occasionally (OC)=2, Sometime (S)= 3, Often (O), =4, Always (A)= 5). Furthermore, they are asked to scale the severity of the same causes within the following scale: (No significant (NS)=1, Some effect (SE)=2, Moderate (M)=3, Significant (S)=4, Extremely significant (ES)=5). They are also asked about their most recent involvement in a project regarding the overall major causes of cost overrun. The last section of the questionnaire elicits general comment in reference to the study.

Currently, we have received approximately 85 responses to the online questionnaire. The average experience of participants is 15 years with the average age of respondents being 45 years old. Water and transportation projects overall experienced cost overrun of 40%-60%. The overall causes were reported to be poor design, unclear project scope (owner), lack of experience of the contractor and consultants, poor planning and programming, and corruption between the contractor and subcontractor.

Subsequent to these findings, we will empirically examine a data set from the survey being conducted in Saudi Arabia to validate our framework. We will use factor analysis for the validation, due to the fact that we have developed a measure of cost overrun causes for the survey (explained above in this section). According to Thompson (2004) there are two discrete classes of factor analysis: exploratory factor analysis (EFA); and confirmatory factor analysis (CFA) to empirically validate the typology framework.

EFA is a statistical method used to uncover the underlying structure of a relatively large set of variables. EFA is a technique within factor analysis whose overarching goal is to identify the underlying relationships between measured variables (Finch and West, 1997). It is commonly used when developing a scale and serves to identify a set of latent constructs underlying a set of measured variables (Kline, 2010). It is not required to have any specific hypotheses about how many factors will emerge, and what items or variables these factors will comprise (Suhr, 2006).

CFA, on the other hand, is a special form of factor analysis. It is used to test whether measures of a construct are consistent with the understanding of the nature of that construct. As such, the objective of CFA is to test whether the data fits a hypothesized measurement framework. This hypothesized framework is based on analytic research

(Thompson, 2004; Schmitt, 2011). When developing a scale, it should use EFA before moving on to CFA (Thompson, 2004).

As a result, first, we will use EFA technique to inductively generate an alternative conceptual framework of the level grouping of cost overrun framework causes. Subsequently, we will test the ability of each of the competing frameworks to account for the underlying structure of the data, using CFA technique.

5. Conclusion

The purpose of this paper was to develop a conceptual framework to aid the assessment of cost overrun causes for large infrastructure projects, to identify the major types and to measure the relationship between causes and overrun. We were also interested in seeing how various causes would impact on cost overrun. Since there are many studies identifying various causes, we synthesized the empirical literature on infrastructure project cost overrun causes and analysed the frequency of cost overrun causes. The potential contribution of this study is in identifying an empirically derived typology of cost overrun causes, comprising financial uncertainty, novelty, complexity, and time pressure. Within each type, there exist similar patterns of relationships between causes and overrun, whilst the patterns between types are different.

Based on developing a conceptual framework from the literature review, the design seeks to empirically validate the typology framework. Therefore, this paper proposes a plan to validate the typology empirically via a survey that has been conducted in Saudi Arabia. We have used the questionnaire data for the analysis. The design is comprised of three steps. The first step is to construct the conceptual framework through typology theory. The next step is to validate the framework using two techniques of factor analysis which are: exploratory factor analysis (EFA); and confirmatory factor analysis (CFA).

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Appendix A

Table 1A: Mapping previous study

Causes of cost overruns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Σ
Increase in material prices.	1		1	1				1				1			1				1			1		1		1	10
Inflation.					1		1	1		1		1					1			1							7
Difficulties in obtaining construction materials at official current prices.		1				1															1						3
Increase in wages.	1		1						1																		3
Price fluctuations.		1			1			1											1			1					5
Materials cost increased by inflation.			1			1					1						1							1			5
Labour cost increased due to environment restriction.	1																				1						2
Monthly payment difficulties form agencies.			1						1														1				3
Cash flow during construction		1					1																				2
Financial difficulties of owner.						1														1							2
Financial difficulties of contractor.						1		1													1						3
Slow payment of completed works.	1							1																1			3
Market Conditions.		1					1				1						1					1					5
Fluctuation in money exchange rate.			1		1			1																			3
Delay payment to supplier/ subcontractors.			1							1													1				3
Deficiencies in cost estimates prepared by public agencies.			1																	1							2
Deficiencies in the infrastructure.		1			1			1																			3
Labour problems.	1						1																				2
Insurance problems.		1							1										1					1			4
Problems related to work security.	1					1	1															1					4
Problems related to workers' health.			1					1																			2
Additional works.			1					1													1		1				4
Inaccurate quantity take-off.	1								1																		2
Lack of experience of project location.				1				1					1	1		1		1								1	7
Lack of experience of project type.				1				1					1								1						4
Contractor's poor site management and supervision.						1			1			1										1					4
Inadequate contractor experience.			1																								1
Shortage of site workers.			1					1	1												1						4
Lack of communication among parties.	1				1															1							3
Unrealistic contract duration and requirements imposed.								1			1								1					1			4
Mistakes during construction.			1					1												1		1					4
Relationship between management and labour.	1							1																			2
Slow information flow between parties.		1							1										1				1				4
Inaccurate site investigation.			1					1													1						3
Lack of coordination between parties.																				1							1
Rework.		1							1											1							3
Unexpected subsoil conditions.																						1					1
Deficiencies in cost estimates prepared.	1					1			1											1							4
Poor technical performance.	1				1																	1		1			4
Design changes.						1			1																		2
Incorrect planning and scheduling by contractors.		1								1								1									3
Delay in material procurement.							1																1				2
Poor design and delays in design.			1			1													1								3
Late delivery of materials and equipment.	1							1												1				1			4

Causes of cost overruns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Σ
Changes in material specification and type.								1														1					2
Design error.		1																									1
Project size.	1	1		1		1		1	1	1			1		1	1		1		1		1	1			1	15
High interest rate charged by bankers on loans.			1					1														1					3
Incomplete drawings.			1				1																1				3
Inadequate specifications.	1							1													1			1			4
Lack of skilled labour.			1																								1
Waste on site.		1							1											1		1					4
Equipment availability and failure.	1																										1
Delay in decision making.								1																		1	2
Poor financial control on site.		1							1												1	1					4
Number of works being done at same time.							1																				1
Lack of constructability.								1														1					2
Impractical and complicated design.																				1							1
Change in the scope of the project.	1					1					1	1										1					5
Insufficient equipment.	1	1			1		1	1	1										1		1			1	1		10
Inadequate modern equipment (Technology)						1			1																		2
Optimism bias.				1									1	1	1												4
Fraudulent practices.		1						1													1						3
Disputes on site.	1							1																			2
Labour disputes and strike.								1													1						2
Owner interference.		1																									1
Lack of experience of local regulation.								1																			1
Obstacles from government.								1																			1
Political complexities.		1					1													1							3
Practice of assigning contract to lowest bidder.					1															1			1				3
Strategic misrepresentation.													1	1	1												3
Laws and regulatory framework.						1		1																			2
Unpredictable weather conditions.	1	1			1	1		1	1			1							1		1	1	1				11
Unexpected geological conditions								1																			1
Unforeseen site conditions.							1																				1
Site constraint.		1																									1
Rock and soil suitability.								1											1								2
Earth conditions.								1																			1
Deficiencies in the social structure.	1					1			1										1				1		1		6
Social and culture impact.	1																										1
Problem with neighbours.					1		1														1						3
Heritage material discovering.			1																								1
Reasons that yield construction delays.								1															1			1	3
Inaccurate estimates.					1			1															1			1	4
Delays		1				1		1			1				1	1						1		1		1	9
Escalation of material prices.			1																	1			1			1	4
Low bid.	1		1																	1				1			4
Poor management assistance.								1																			1
Cash flow and financial difficulties faced by contractors.			1				1		1														1				4
Delay preparation and approval of drawings.	1																			1			1				3
Inadequate planning and scheduling.								1													1						2
Insufficient time for estimate.	1							1																			2
Experience in contract.						1														1			1				3
Shortage of materials	1		1			1		1												1					1		6

(1)Arditi et al., (1985); (2)Mansield et al., (1994); (3)Kaming et al., (1997); (4)Flyvbjerg et al., (2002); (5) Frimpong et al., (2003); (6) Le-Hoai et al., (2008); (7)Memon et al, (2010); (8)Memon et al., (2011); (9)Mahmid & Bruland (2011); (10)Love et al., (2011); (11)UMTA (1990); (12)Office of program Policy Analysis and Government Accountability (1996); (13)Flyvbjerg, Holm, & Buhl (2003); (14)Priemus, Flyvbjerg & Wee (2008); (15)Flyvbjerg, Holm, and Buhl (2004); (16)Odeck (2004); (17)Roxas Jr. & Chalermpon (2008); (18)Singh (2009); (19)Long et al (2004); (20)Ameh et al (2010); (21)Kaliba (2009); (22)Omoregie (2006); (23)Creedy et al (2010); (24)Achuenu and Kolawole (1998); (25)Morris (1990); (26)Danata et al (2006).