The Factors influencing Cost Overrun on Construction Projects in Yemen

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Abstract— Cost overrun in construction projects is a global challenge where developing countries are suffering more than developed countries. Although several factors have been identified as the course of cost overrun, the political situation had never been included. To find the major courses of cost overrun in Yemen, this study adopted literature reviews and surveyed questionnaires. Respondents were project managers from Client, consultant, and contractors. 56 causes of cost overrun from more than 12 countries were categorized into six groups; financial factors, Human resources factors, Construction techniques factors, Environmental factors, Social and Political Factors and Procurement management. The study found that political instability, Poor contract management, Low labor productivity, Delay in progress payments, Risk Management strategies, Poor site management and supervision, Staff training in the skill areas relevant to project, Contractors and Consultant tendering faults, Financing, and payment of completed projects Lack of materials and equipment are highly factors in Yemen. The study contributed an understanding of the impact of the political situation to the construction industry, which also opens an area for future research on how political instability can cause cost overrun.

Index Terms— Construction Project，Cost Overrun，Political instability，Project managers, Yemen.

1 INTRODUCTION

The problem of cost overrun in the construction industry is a global phenomenon (Ameh et al. 2010; Azhar et al.2008; Bhargava et al. 2010; Rahman et al. 2013). In most literature cost overrun is a synonym to cost escalation, cost increase, or budget overrun determined from the difference between the as-built project cost and the contract award amount including contingency amounts (Al-Hazim and Abusalem 2015; Bhargava et al. 2010; Danso and Antwi 2012; Lind and Brunes 2015). A project cost overrun is considered as a common problem in construction projects worldwide for instance 9 of 10 transport infrastructure projects in the global faced the overrun in the range of 20 to100% (Alghonamy 2015; Flyvbjerg et al. 2003).The problem is affecting both developing and developed countries a study in Ghana water supply project found that 33 out of 47 exceeded the budget by 75% (Frimpong et al. 2003). In the UK nearly 30% of client`s complain the problem of cost overrun (Olawale and Sun 2010). In Yemen, cost escalation is more severe than in other developing countries. Ahmad et al. (2013) conducted a study to identify and assess the critical risk factors that are influencing time and cost of construction projects in Yemen. The investigation revealed that 433 projects out of 1069 faced 40.50% cost overrun (Ahmad et al. 2013).

The objective of this paper is to identify the cause of construction overruns on construction projects in Yemen from the list global cost overrun causes. The phenomenon was investigated using Relative Importance Index method where the major causes highlight the main sources of the problem in specific context.

2 LITERATURE REVIEW

Cost control is considered as one of the key success indicator of any construction project among three iron triangle; cost, time and quality (Azhar et al.; Elhag et al. 2005; Enshassi et al. 2009; Hammad et al. 2008; Umar Isma'il et al. 2013). The causes of cost overruns in construction projects are varied, some are not only difficult to predict but also difficult to manage. However, the major cause of cost overrun in many projects is ineffective construction management and poorly established cost control systems (Endut May 2008). This factor depends on individual organizations understanding of project management "Projects that are not managed effectively experience many cost overruns" (Chileshe and Berko 2010).

Azhar et al. (2008) found the top ten cause of cost overrun in Pakistan are; fluctuation in prices of raw materials, unstable cost of manufactured materials, high cost of machineries, lowest bidding procurement procedures, poor project (site) management/ poor cost control, delays between design and procurement phases, incorrect/ inappropriate methods of cost estimation, additional work, improper planning, and unsupportive government policies.

Dissanayaka and Kumaraswamy (1999) found procurement related factors as major cause cost overrun in Hong Kong building projects. Kaming et al. (2010) identified factors, which cause cost overrun in Indonesia, which include material cost and inaccurate material estimating. Endut May (2008) identified the five highest factors which cause cost overrun in Malaysia; changes in building codes was a most critical factor.

Ramabodu and Verster (2010) identified that changes in the scope of work on the site are critical factors, which cause

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cost overruns in South Africa construction. Although, cost overrun can be caused by several reasons a comprehensive analysis of factors associated with the construction cost overrun in post-contract context need to be performed (Doloi 2013). This research project was undertaken to narrow this informational gap with the specific attention to Political Influence

2.1 Effects cost overrun

Cost overruns in construction projects affect both stakeholders and business environment (Amoa-Abban and Allotey 2014). These effects are not limited to the project level, but they can spread to the industry level. The effects of cost overrun in industrial level include; time overrun, disputes, arbitration, total abandonment and litigation (Kikwasi 2012; Sambasivan and Soon 2007).According to Haseeb et al. (2011), the effects of cost overrun can lead to slowing down the growth of the construction sector. The implication of these effects is to slow down other development sectors. Therefore, identifying the causes of cost overrun is the primary stage on mitigating the challenges (Tebeje Zewdu 2015).

2.2 Cost overrun mitigation

Some causes of cost overruns are unavoidable because they cannot be reasonably prevented. However, overruns due to design plan or project management problems are avoidable because they could have reasonably been foreseen and prevented (Azhar et al.2008)Table 1. The conventional strategy is provisional of contingency sum based on heuristic approach, but the persistence of cost overrun problems, this can be achieved through the application of statistical approaches (Aibinu and Jagboro 2002; Enshassi et al. 2009).

Table 1. Previous recommendation to mitigate cost overrun in construction projects

Researchers	Mitigation of cost overrun	Country
(Azhar et al.2008)	Stabilizing cost of materials, Increasing supply of materials and machinery, Involved cost estimation processes, Vigilant project planning, close observance and documentation of cost variation trends in the sector and the country, Adoption of alternative procurement strategies such as design-build contracts and best value procurement.	Pakistan
(Koushki et al. 2005)	The availability of adequate funds, Allocation of sufficient time and money at the design phase, And selection of a competent consultant and a reliable contractor to carry out the work	Kuwait
(Umar Isma'il et al. 2013)	the study recommends contingency provisions should be put in place to mitigate these factors at the project conception stage	Nigeria

3 Research Methodology

This study adopted literature review and a questionnaire survey as the tool of data collection. SPSS software was then used to calculate the relative index of each factor.

3.1 Formulation of preliminary cause of cost overrun

The preliminary factors were identified based on literature review of previous studies in 12 countries Table 2. Focusing on Yemen construction projects experience, 56 potential cost overruns causes were identified groups. Although Ahiaga-Dagbui et al. (2015) condemned this approach because of producing replica causes of cost overrun, it is contended with (Kenley 1998), that construction management research does not make sufficient use of existing research for meta-data or even re-analysis. The finding of this could not only be relevant to Yemen but to all countries which are suffering from political instability

Table 2. Previous studies of the causes of cost overrun in construction projects

Researchers	Major cause of cost overrun	Country
(Iyer and Jha 2005)	Conflict among project participants, Ignorance and lack of knowledge, Presence of poor project specific attributes and nonexistence of cooperation.	India
(Koushki et al. 2005)	Contractor-related problem, Material-related problems, owners' financial constraints	Kuwait
(Memon et al. 2012)	Fluctuation in materials price, Cash flow and financial difficulties faced by contractors, Delay in progress payment by owner, Design changes were most dominant factors causing cost overrun	Malaysia
(Abd El-Karim et al. 2015)	Bribery and corruption, Differing site conditions, Change in currency rate and Tax rate, Owners quality assurance, Scope definitions,	Egypt
(Alhomidan 2013)	Project managerial, consultant, external, construction items, and financial.	Saudi Arabia
(Ahmad et al. 2013)	Increase of Inflation rates, Fluctuations in the material's prices, Political instability, Delay in delivery of materials to site, Foreign currency fluctuations, Delay in subcontractor's work,	Yemen

Researchers	Major cause of cost overrun	Country
(Danso and Antwi 2012)	Poor planning and control, Price fluctuations, Ineffective cost control systems, Lack of coordination at design phase, Design scope changes	Ghana
(Enshassi et al. 2009)	Topographical condition, Political instability and Financial status of the owner	Palestina

3.2 Formulation of group factors

The identified 56 causes for cost overrun from previous studies were categorized into the following six major groups:

1. Financial factors: -Delay in progress payments, Cash flow difficulties by client, Contractor's financial difficulties, Financing and payment of completed projects, Fluctuation of currency exchange rate, Poor Financial management and control, Taxes and Insurance increase
2. Human resources factors: - Improper coordination and Interaction of project Team, Lack of qualified Pro
3. ject Managers, Lack of skilled labor, Low labor productivity, Poor site management and supervision, Project team's experience in development stages, Relationship between labor and management team, Staff training in the skill areas relevant to project
4. Construction techniques factors:- Client-initiated variations, Complexity of design and size of project, Deficiencies in Cost planning and time scheduling, Delays in work approval waiting for information, Design changes during post-contract period, Discrepancies in construction documentation, Fraudulent practices and Corruption, Improper allocations and control of construction resources, Lack of materials and equipment, Low experience of Consultants and contractors, Low speed at decision-making, involving all project teams, Poor Methods of design, evaluation and construction, Risk Management strategies
5. Environmental factors: - Soil and land stability, Environmental pollutions due to project, Geological historical of data of project site, Healthy, and safety during construction, Hydrological historical data of site, Inclement weather, Lack of Environmental analysis, Location and accessibility of the projects, Topography and site condition, Unexpected geological conditions
6. Social and Political Factors: - Change construction laws and regulations, Policy for Importation of technology, equipment, and materials, Political instability, (Political will) support construction projects
7. Procurement management: - Additional works at owner`s request, Contractors and Consultant tendering faults, Deficiencies in Monitoring and evaluation of works during construction, Fluctuation in building materials cost, Form of procurement and contractual arrangements, Inaccurate take off quantities, Incomplete design at the time of tendering, Lack of cost reports during construction stage, Non-adherence to contract conditions, Omissions and errors in the bills of quantities, Poor contract management, Poor procurement programming of materials, Tender period and market condition, unavailability of supplies of labor and materials.

3.3 Respondent groups

The construction industry is a multidisciplinary sector, which involves some professional and stockholders. In this case of study project managers from clients, consultants, and contractors. Literature reviews from 15 randomly selected studies from different 15 countries also adopted the same set Table 3.

Table 3.Respondents groups from previous studies

Researchers	Mitigation of cost overrun	Country
(Iyer and Jha 2005)	Owners, Contractors, and Consultants	India
(Koushki et al. 2005)	Owners	Kuwait
(Memon et al. 2012)	Owners, Contractors, and Consultants	Malaysia
(Abd El-Karim et al. 2015)	Consultants project managers, construction managers, planners, cost estimators, contract administrator, and insurance engineer site engineers.	Egypt
(Alhomidan 2013)	Contractors	Saudi Arabia
(Le-Hoai et al. 2008)	Owners, Contractors, and Consultants	Vietnam
(Ahmad et al. 2013)	Owners, Contractors, and Consultants	Yemen
(Chang 2002)	Owners, Contractors, and Consultants	Taiwan
(Tebeje Zewdu 2015)	Owners, Contractors, and Consultants	Ethiopia
(Kaliba et al. 2009)	Owners, Contractors, and Consultants	Zambia
(Legac et al. 2014)	Literature review	Croatia
(Kim et al. 2008)	Contractors	Korea
(Le-Hoai et al. 2008; Polat et al. 2014)	Owners, Project managers, and site supervisors	Vietnam
(Danso and Antwi 2012)	Consultants/engineers, contractors and clients, and clients	Ghana
(Enshassi et al. 2009)	Project managers, site engineers/office engineers, and organizations' managers	Palestine

3.4 Survey Questionnaire

A structured questionnaire was used prior to a literature review. The questionnaire was designed to capture the current construction industry experiences among project managers from clients, consultants, and contractors sides. The questionnaire was divided into two parts. The first part was to ask projects managers of their work experience. The second part the questionnaire was asked the responded to the most frequent and important factor that leads to cost overrun in construction projects in Yemen.The target was to get 57 potential respondents based on non-statistical approach however only 42 questionnaires were emailed. The respondents were randomly selected based on their backgrounds, professional experiences, and current participation in Yemen construction industry. The non-statistical approach was used because of lack of an updated list of professional project managers in Yemen. Out of 42 questionnaires emailed to the construction projects managers, 22 questionnaires were completely filled and returned Table 4.

The objective of this research is to identify the factors that cause cost overrun across the design consultants, contractors, and client from project manager's perspectives:

1. To identify variables influencing construction cost overruns and to evaluate their relative importance
2. To find out what is most important causes of cost overruns of Yemeni construction projects.
3. To study the perceptions of the construction projects managers.

3.5 Calculation of relative importance of factors

Various methods can be used to rank and subsequently identify the relative critical attributes out of a raw data analysis. According to numerous researchers, the mean and standard deviations are not reliable statistics for assessing overall ranking of the attributes. Sambasivan and Soon (2007) used the relative importance index method to determine the relative importance of the various causes and effects of delays; the same method was adopted in this study. The five-point scale ranged from (0 = strongly disagree), (1= Disagree), (2=Neutral), (3 = Agree), (4=strongly agree) will be adopted and will be transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A * N} \qquad \textit{Equation 1}$$

Where RII= Relative Importance Index

W = is the weighting given to each factor by the respondents (ranging from 0 to 4),

A= is the highest weight (i.e., 4 in this case),

N = is the total number of respondents.

The RII was used to rank (R) the 56 causes of cost overrun. These rankings as perceived by the three groups of respondents (i.e., clients, consultants, and contractors) were used to assess the general and overall rankings to give an overall picture of the causes of cost overrun in Yemen. The same procedure was adopted for ranking the effects. The indices (RII) were then used to determine the rank of each item group.

4 DATA ANALYSIS

The questionnaire response characteristics of the respondents are given in ***Table 4***, where Clients 3 responded equivalent 14%, Contractors 12 equivalent 55% and Consultants 7 equivalent to 32%

Table 4. Sample size

	Target	Sent	Response	Percentage of Respondent
Client	10	7	3	14%
Consultant	20	14	7	32%
Contractors	30	21	12	55%
Total	57	42	22	100%

4.1 Respondent's experience

Table 5 shows that 59 % (13) of the respondents have experience more than 10 years at construction works and 18 % (4) who have experience between 5 to 10 years, 14 % (3) of respondents have experience from 3 to 5 years, and 9 %(2) have experience from one to three years.

Table 5 Respondent's experience

Experience	Client	Consultant	Contractors	Total	Percentage of Respondent
More than 10 Years	1	4	8	13	59%
5-10 Years	1	1	2	4	18%
3-5 Years	1	1	1	3	14%
1-3 Years	0	1	1	2	9%
Total	3	7	12	22	100%

4.2 Financial factors: (F)

Delay in progress payments was ranked as the first factor leads to cost overrun in a financial group with relative important index [RII=0.73] Table 6. As it's been stated that in the contract the client should pay a payment to the contractor according to the progress of work, and the payment it should be monthly or according to the contract. The client should pay contractors claims timely to avoid any cost overrun. the second factor was affecting cost overrun was financing and payment of completed projects with relative important index [RII=0.64]. Unpredictable client cash flow it was highly ranked by the respondents, Cash flow difficulties by the client was ranked as the third factor influencing cost overrun in financial factors group with relative important index [RII=0.55].

Table 6.Financial factors: (F)

Factors	Code	Mean RII	Rank
Delay in progress payments	F1	0.73	1
Cash flow difficulties by client	F2	0.55	3
Contractor's financial difficulties	F3	0.29	7
Financing and payment of complet-	F4	0.64	2

ed projects			
Fluctuation of currency exchange rate	F5	0.53	4
Poor Financial management and control	F6	0.42	5
Taxes and Insurance increase	F7	0.34	6

4.3 Human resources factors: (H)

Low labor productivity was ranked as the first factor affecting cost overrun in human resources factors with relative important index [RII=0.76]. The effects Low labor productivity in time overrun, which consequently cause cost overrun. Adoption of modern construction method like prefabrication can help to improve Productivity Table 7. Poor site management and supervision were ranked as the second factor with relative important index [RII=0.68]. The third factor leads to cost overrun the lack of Staff training in the skill areas relevant to project with relative important index [RII=0.65].

Table 7.Human resources factors: (H)

Factors	Code	Mean RII	Rank
Improper coordination and Interaction of Project Team	H1	0.62	5
Lack of qualified Project Managers	H2	0.63	4
Lack of skilled labor	H3	0.62	6
Low labor productivity	H4	0.76	1
Poor site management and supervision	H5	0.68	2
Project team's experience in development stages	H6	0.56	8
Relationship between labor and management team	H7	0.58	7
Staff training in the skill areas relevant to project	H8	0.65	3

4.4 Construction techniques factors: (C)

Risk Management strategies ranked as the first factor affecting cost overrun in the Factors related to construction techniques with relative important index [RII=0.69]***Table 8***. Risk management application should be applied to all levels of the project to avoid cost overrun, implementing a risk management plan at the beginning of a project can help to remove some of the possible problems that can appear during the project's lifecycle, so managers should apply risks management skill to avoid any cost problems. Lack of materials and equipment was ranked as the second factor affecting cost overrun with relative important index [RII=0.64], Design changes during the post-contract period were ranked as the third factor with relative important index [RII=0.63].

Table 8.Construction techniques factors: (C)

Factors: (C)	Code	Mean RII	Rank
Client-initiated variations	C1	0.56	5
Complexity of design and size of project	C2	0.47	8
Deficiencies in Cost planning and time scheduling	C3	0.46	9
Delays in work approval waiting for information	C4	0.55	7
Design changes during post-contract period	C5	0.63	3
Discrepancies in construction documentations	C6	0.60	4
Fraudulent practices and Corruption	C7	0.38	13
Improper allocations and control of construction resources	C8	0.46	10
Lack of materials and equipment	C9	0.64	2
Low experience of Consultants and contractors	C10	0.39	12
Low speed at decision-making, involving all project teams	C11	0.42	11
Poor Methods of design, evaluation, and construction	C12	0.55	6
Risk Management strategies	C13	0.69	1

4.5 Environmental factors: (E)

Inclement weather was ranked as the first factor affecting cost overrun from the Environmental factors group with relative important index [RII=0.62]Table 9. Lack of Environmental analysis was ranked as the second factor with relative important index [RII=0.57]. Location and accessibility of the projects were ranked as the third factor with relative important index [RII=0.53]

Table 9.Environmental factors: (E)

Factors:(E)	Code	Mean RII	Rank
Soil and land stability	E1	0.52	4
Environmental pollutions due to project	E2	0.37	10
Geological historical of data project site	E3	0.47	6
Healthy and safety during construction	E4	0.42	8
Hydrological historical data site	E5	0.45	7
Inclement weather	E6	0.62	1
Lack of Environmental analysis	E7	0.57	2
Location and accessibility of the projects	E8	0.53	3
Topography and site condition	E9	0.52	5
Unexpected geological conditions	E10	0.40	9

4.6 Social and Political Factors: (S)

According to the Political situation in Yemen, the respondent has ranked Political instability as the first in the Political factors group with relative important index [RII=0.84]. This confirms that the instability of political situation can be a major cause leads to cost overrun. Poor Policy for the importation of technology, equipment, and materials was ranked as the second factor with relative important index [RII=0.55], the (Political will) support construction projects were ranked as the third factor with relative important index [RII=0.42] Table 10.

Table 10.Social and Political Factors: (S)

Social and Political Factors:(S)	Code	Mean RII	Rank
Change construction laws and regulations	S1	0.36	4
Policy for Importation of technology, equipment, and materials	S2	0.55	2
Political instability	S3	0.84	1
Political will to support construction projects	S4	0.42	3

4.7 Procurement management: (P)

Contractors and Consultant tendering faults were ranked as the first factor affecting cost overrun with relative important index [RII=0.77] In some case and according to contract the owner may cancel some items in the bill of quantities. In this case, the contractor gets a loss if items loaded with profits are canceled. Sometimes the front-loading rate is huge, and this will leads to cost overrun, Poor contract management was ranked as the second factor affecting cost overrun with relative important index [RII=0.76], Inaccurate quantity take-off gets as the third factor with relative important index [RII=0.64]***Table 11***.

Table 11.Procurement management: (P)

Procurement management :(P)	Code	Mean RII	Rank
Additional works at owner`s request	P1	0.59	7
Contractors and Consultant tendering faults	P2	0.64	1
Deficiencies in Monitoring and evaluation of works during construction	P3	0.62	4
Fluctuation in building materials cost	P4	0.47	11
Form of procurement and contractual arrangements	P5	0.52	10
Inaccurate take off quantities	P6	0.64	3
Incomplete design at the time of tendering	P7	0.60	6
Lack of cost reports during construction stage	P8	0.46	12
Non-adherence to contract conditions	P9	0.44	13
Omissions and errors in the bills of quantities	P10	0.55	9
Poor contract management	P11	0.76	2
Poor procurement programming of materials	P12	0.57	8
Tender period and market condition	P13	0.61	5
unavailability of supplies of labor and materials	P14	0.42	14

4.8 The top ten-factor affecting cost overrun from construction manager perspective

The ten most important causes of cost overrun (based on all respondents) as shown in the ***Table 12*** were: (1) Political instability [RII=0.84], (2) Poor contract management [RII=0.76], (3) Low labor productivity [RII=0.76], (4) Delay in progress payments [RII=0.73], (5) problems with Risk Management strategies [RII=0.69], (6) Poor site management and supervision [RII=0.68], (7) lack of Staff training in the skill areas relevant to project [RII=0.65], (8) Contractors and Consultant tendering faults [RII=0.64], (9) Financing and payment of completed projects [RII=0.64], and (10) Lack of materials and equipment [RII=0.64].

Table 12. Top ten factor affecting cost overrun

Top ten factors	Code	Relative Importance	Rank
Political instability	S3	0.84	1
Poor contract management	P11	0.76	2
Low labor productivity	H4	0.76	3
Delay in progress payments	F1	0.73	4
Risk Management strategies	C13	0.69	5
Poor site management and supervision	H5	0.68	6
Staff training in the skill areas relevant to project	H8	0.65	7
Contractors and Consultant tendering faults	P2	0.64	8
Financing and payment of completed projects	F4	0.64	9

4.9 Groups cause cost overruns at construction projects

The group causes of cost overrun (based on all respondents) as shown in the Table 13 were: (1) Human resources group [RII=0.64], (2) Procurement management [RII=0.58], (3) Social and Political Factors [RII=0.55], (4) Construction techniques [RII=0.52], (5) Financial factors [RII=0.50], (6) Environmental factors [RII=0.49]

Table 13 Groups cause cost overruns at construction projects

Group	Client	Consultant	Contractors	Mean RII	Rank
Financial factors: (F)	0.32	0.71	0.47	0.50	5
Human resources factors: (H)	0.81	0.35	0.76	0.64	1
Construction techniques factors:(C)	0.55	0.48	0.54	0.52	4
Environmental factors:(E)	0.44	0.55	0.49	0.49	6
Social and Political Factors:(S)	0.35	0.67	0.62	0.55	3

5 Conclusion

A Survey of the factor affecting cost overrun in the construction industry in Yemen from projects managers' perspective has found that Political instability has a high influence on project cost overrun with relative important index [RII=0.84],.In literature, the political situation has not been considered as a

major factor that causes cost overrun in construction projects. However, the case is different in Yemen where it was even ranked in top three in the cause group analysis with [RII=0.55].

Also, the study has identified main ten causes of cost overrun in Yemen are; (1) Political instability, (2) Poor contract management, (3) Low labor productivity, (4) Delay in progress payments, (5) Risk Management strategies, (6) Poor site management and supervision, (7) Staff training in the skill areas relevant to project, (8) Contractors and Consultant tendering faults, (9) Financing and payment of completed projects (10) Lack of materials and equipment.

The study contributed an understanding of the impact of political instability on the construction industry which also opens an area for future research on how a political instability can have the factors which cause construction cost overrun.

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