

Mitigation Measures for Significant Factors Instigating Cost Overrun in Highway Projects

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Abstract

Construction industry has created numerous employment opportunities and playing a role model in economic growth of Pakistan. This industry is facing serious and critical problem of cost overrun especially in highway sector in country Pakistan particularly in Sindh Province. The purpose of this study is to identify mitigation measures for significant factors of cost overrun in highway projects of Sindh Province. In this study, mixed-mode research approach has been used. Quantitatively, a structured questionnaire based on 64 common factors of cost overrun from in-depth literature review was developed and distributed to 30 selected respondents among the client, contractor and consultant having more than 15 years of experience in handling highway projects in Sindh Province. The collected data was statistically analyzed using SPSS where 8 most significant factors of cost overrun were identified. Qualitatively, the identified eight most significant factors were then incorporated in open ended questionnaire and distributed to 30 selected experts for them to write possible mitigation measures for each of the significant factors. The data was then analyzed through content analysis technique to rank the mitigation measures according to their substantiality. The results of this study would be helpful for construction practitioners to be used as reference in taking up appropriate measures in controlling cost overrun in highways projects in Pakistan.

Keywords: Mitigation Measures; Cost Overrun; Highway Projects; Significant Factors; Pakistan.

1. Introduction

Worldwide construction industry is facing problem of cost management which causes cost overrun in huge amount. This problem of poor cost management leads to project cost overrun in both under developed and developed countries [1]. For example, as one of the developed country, the United Kingdom is also facing problem of cost overrun where 75% of the construction employees have claimed that construction projects were struggling with problem of cost overrun [2]. According to Flyvbjerg et al. (2004), cost overrun is a big challenge in construction projects whereby the cost of the projects can exceed more than 180% of initially approved estimated budget of the project [3]. Within the context of this paper, successful construction project can be defined as the one that is completed within its actual approved cost [4]. Whereas, construction industry is regarded as a dynamic industry which is continuously facing problem with its budget. Although different strategies and improvements have been implemented in an effort to minimize the issue, cost overrun is still a critical problem in most construction industries all over the world [5].

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Construction industry is one of the important industries in Pakistan as it plays a significant role in the growth of the nation's economy. Similar to other countries, construction industry in Pakistan is also facing many challenges especially cost overrun problem in construction projects. Several studies have been carried out to investigate delay and cost overrun issues in different types of construction projects in Pakistan [6-8]; however, only few studies have been conducted on highway sectors [9]. GoP (2016) stated that cost overrun in highway projects affects the GDP (Gross Domestic Product) of the country and also on economy of the country [10]. Sohu et al. (2018) indicated that government of Pakistan is now trying best for good quality of highway projects which should be completed on cost and time [11]. According to Manthar et al. (2017), cost overrun is big issue in Sindh province and mitigation measures of cost overrun should be identified [12]. Apparently, there is still a big gap to examine the causative factors cost overrun and determine appropriate mitigation measures for the significant factors instigating cost overrun in Highway projects in Pakistan.

Due to the lack of study on the causative factors of cost overrun in Pakistan's Highway projects as highlighted earlier; thus, this study is aimed at determining suitable measures to mitigate the significant factors causing cost overrun in Highway construction projects. In order to achieve the aim, this study embarks on the following objectives:

- 1) To identify the most significant factors of cost overrun in highway projects of Sindh.
- 2) To determine mitigation measures for significant factors of cost overrun in highway projects of Sindh

2. Literature Review

2.1. Cost Overrun

Cost overrun is a genuine issue in all types of construction projects. A study carried out in Palestine in which different factors of cost overrun were identified from literature review and questionnaires was designed in which all factors were incorporated in five groups [13]. Designed questionnaire was distributed among 31 selected respondents to identify the main factors of cost overrun. Results of study showed that the following were found as major factors of cost overrun:

- 1) Change in currency exchange
- 2) Poor contract management
- 3) Material cost and
- 4) Level of competition

Another research conducted by Enshassi et al. (2009) in Gaza to identify the main causes of cost overrun [14]. A questionnaire was designed in which identified factors of cost overrun were merged and questionnaire was distributed among 110 selected respondents to identify main factors of cost overrun. Findings of this research identified the following as critical factors of cost overrun in construction projects;

- 1) Fluctuation of materials price
- 2) Delay of supply of materials
- 3) Delay of equipment's by contractor
- 4) Inflation.

Similarly, Kasimu (2012) conducted a survey through quantitative approach to find causes of cost overrun in United Kingdom. Total 10 factors of cost overrun (changes in design, improper time evaluation of project, conflicts between parties, inflation, lack of experience, late payment of completed works, and complex nature of work, poor contract management and inexperienced contractor) were identified as major causes of cost overrun [15]. Furthermore, Ullah et al. (2017) carried out a study in which major factors of cost overrun were identified through distribution of questionnaire survey as [16];

- 1) Change in market values
- 2) Less experience in the contract work
- 3) Mistakes in estimation of time duration of project
- 4) Political approach in the project.

In another research conducted by Abusafiya and Suliman (2017), which was reported that, sudden changes in design, delay in schedule, labour productivity and inaccurate estimation of cost were causative factors of cost overrun in construction projects of Bahrain [17]. Moreover, another research has been done by Ismail et al. (2014) which interviews were conducted among experts and the factors of cost overrun identified were [18];

- 1) Poor management and supervision at site

- 2) Incompetent and inexperienced sub-contractor
- 3) Schedule delay
- 4) Improper design information and delay in process of payment to sub-contractor.

According to Waithera and Susan (2017) studies, the main and major causes of cost overrun in construction of road projects in Kenya are project schedule, poor project management, project scope, government policies, resources and contract management [19]. A questionnaire survey was conducted by Abu El-Maaty et al. (2017) to know the main causes of cost overrun in road project were technical staff at contractor, inadequate planning and preparation of project planning and execution [20].

2.2. Mitigation Measures

A research carried by Ade et al. (2013) to identify mitigation measures of cost overrun factors in Malaysian construction industry. Mitigation measures for cost overrun factors were [21];

- (i) Strategic planning of project for project management related factors
- (ii) proper planning should be adopted for design and documentation related factors
- (iii) appointment of experienced sub-contractors for contractor's site management
- (iv) Development of human resources in the construction industry for labor related factor
- (v) Regular co-ordination between parties for communication related factor of cost overrun.

Another study carried by Awolesi et al. (2015) in which mitigation measures of cost overrun for small contractors were identified by conducting semi structured interviews. Findings of study were [22];

- (i) Proper supervision and management
- (ii) Appointment of experienced sub-contractors
- (iii) Use of proper method of construction
- (iv) Coordination between parties
- (v) Coordination between parties and clear communication and information between parties.

3. Research Methodology

This study employs mixed mode approach where quantitative technique was carried out in the first part and then followed by qualitative technique. A comprehensive literature review was carried out to identify factors of cost overrun. The result of literature review helped in identification of 64 common factors of cost overrun. These identified factors helped in a development of a survey questionnaire to identify significant factors of cost overrun in highway projects of Sindh. The developed questionnaire was distributed among very qualified and experienced 30 respondents of client, consultant and contractors of highway projects as shown in Figure 1. A five-point Likert scale have been adopted (e.g. 1 = Not agree 2 = slightly not agree, 3 = Agree, 4 = slightly agree, 5 = strongly agree) for the evaluation of each factor. Each respondent was requested to rate each factor according to their knowledge. For analysis in Statistical Package for the Social Sciences (SPSS) version 20 and Microsoft excel was used. Reliability test of gathered data was checked, and value of Cronbach's alpha was 0.871, which shows that collected data is reliable and having higher consistency.

In second part, qualitative approach was used to identify the mitigation measures for significant factors of cost overrun a, in this regard an open-ended questionnaire was developed in which identified significant factors were organized and respondents were requested to write possible mitigation measures for each significant factor. Open-ended questionnaires were distributed among same 30 respondents of highway projects who were involved in first part demography of respondents are shown in Table 1. Collected data of open-ended questionnaire was analyzed by content analysis method. Content analysis is a research method in which thorough inspection of human conversation, either "systematic, objective, quantitative analysis of human characteristics" is conducted. For the analysis of qualitative data, some of the techniques of meta-summary were applied e.g. extraction, grouping, and the calculation of frequency [23].

Table 1. Demography of respondents

No.	Position	Company/ Organization	Educational Qualification	Experience in highway
1.	General Manager	Client	Bachelor's in civil engineering	32 years
2.	Construction Engineer	Contractor (Pvt)	Bachelor's in civil engineering	31 years
3.	Project Director	Client	Master of Civil Engineering	29 years
4.	Project Manager	Contractor (Pvt)	Master of Project Management	29 years
5.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	27 years
6.	Chief Resident Engineer	Consultant (Pvt)	Bachelor's in civil engineering	27 years
7.	Quantity Surveyor	Contractor (Pvt)	Bachelor's in civil engineering	26 years
8.	Resident Engineer	Consultant (Pvt)	Bachelor's in civil engineering	26 years
9.	Project Manager	Contractor (Pvt)	Masters in Highway Engineering	24 years
10.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	23 years
11.	Resident Engineer	Consultant (Pvt)	Master of Civil Engineering	22 years
12.	Project Engineer	Contractor (Pvt)	Bachelor's in civil engineering	22 years
13.	Design Engineer	Contractor (Pvt)	Masters in Structural Engineering	22 years
14.	Project Director	Client	Bachelor's in civil engineering	21 years
15.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	21 years
16.	Managing Director	Contractor (Pvt)	Bachelor's in civil engineering	20 years
17.	Project Director	Client	Master of Civil Engineering	20 years
18.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	20 years
19.	Resident Engineer	Consultant (Pvt)	Master of Structural Engineering	20 years
20.	Quantity Surveyor	Contractor (Pvt)	Master of Civil Engineering	19 years
21.	Resident Engineer	Consultant (Pvt)	Master of Construction Management	18 years
22.	Deputy Director	Client	Bachelor's in civil engineering	18 years
23.	Resident Engineer	Consultant (Pvt)	Bachelor's in civil engineering	18 years
24.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	17 years
25.	Construction Engineer	Contractor (Pvt)	Bachelor's in civil engineering	17 years
26.	Quantity Surveyor	Consultant (Pvt)	Master of Civil Engineering	16 years
27.	Assistant Director	Client	Master of Civil Engineering	16 years
28.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	16 years
29.	Project Manager	Contractor (Pvt)	Bachelor's in civil engineering	15 years
30.	Assistant Resident Engineer	Consultant (Pvt)	Bachelor's in civil engineering	15 years

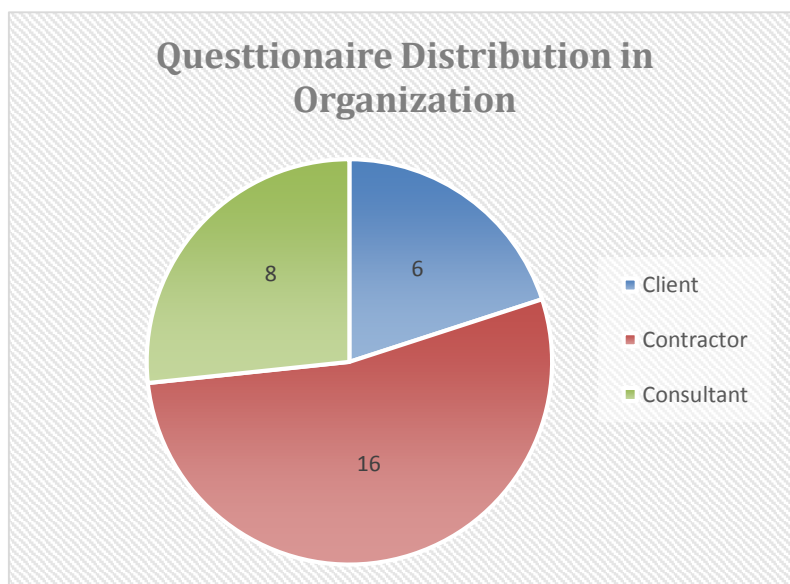


Figure 1. Questionnaire Distribution in Organization

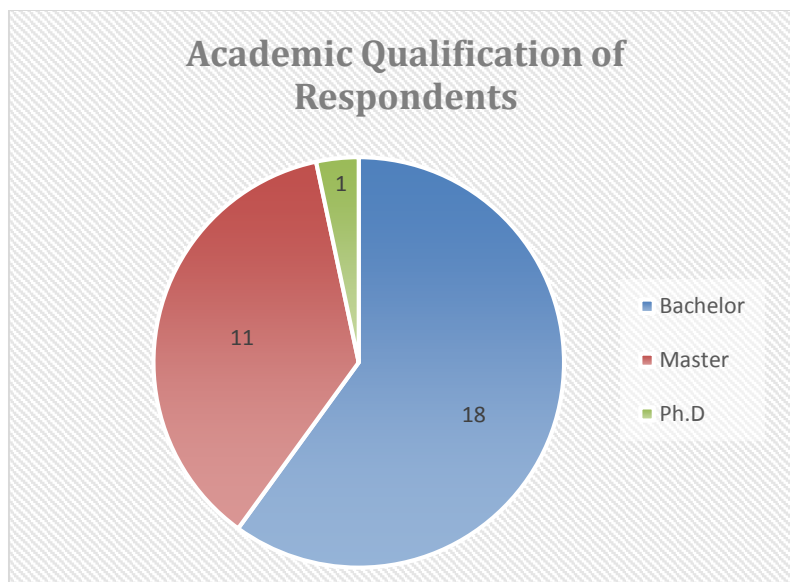


Figure 2. Academic Qualification of Respondents

The Demography of respondents are illustrated in Table 1, which shows the academic qualification, experience, organization and position of the respondents. Maximum experience of the respondents is 32 years and the minimum experience is 15 years. Total years of experience of selected respondents are 647 with an average of 21 years of experience in dealing with highway projects. All the selected respondents are currently working in highway projects with executive and managerial posts in different organizations. Education qualifications of respondents have degree of Bachelor’s in civil engineering and Master of Civil Engineering, Structural Engineering and Construction management as shown in Figure 2. This indicates that selected respondents were reliable and capable to explore the issue of cost overrun in highway projects around Sindh.

3. Results and Discussion

After analysis of collected data, the factors’ mean value was calculated which resulted above 4.6. The selected significant factors of cost overrun can be seen in Table 2.

Table 2. Significant factors of cost overrun

Factors	Mean Value	Rank
Delay in process of payment by Client	4.900	1
Inadequate planning	4.668	2
Owner/Client interference	4.667	3
Poor contract management	4.651	4
Delay in decision making	4.644	5
Laws and regulations frame work	4.633	6
Change in scope of project	4.621	7
Financial difficulties faced by Owner/Client	4.618	8

After determining significant factors of cost overrun in highways projects, another round of questionnaire distribution was carried out with the same selected respondents and they were requested to provide responses for the open-ended questions in the survey questionnaire. The researcher analysed and interpreted collected qualitative data by using content analysis technique [18]. The results in terms of mitigation measures as per suggested by expert respondents for each significant factor are listed in Table 3.

These eight (8) significant factors along with their relevant mitigation measures can be seen in Table 3. These factors are along with their relevant mitigation measures listed according to the highest response rate. For example, one of the factor namely “Delay in process of payment by client” has been responded in terms of five (5) mitigation measures. From these five mitigation measures, unavailability of “Sufficient allocation of each project” measure has been reported by 96.7% of the respondents. In similar the way, other factors like “Inadequate planning” answered by six (6) mitigation measures and 90% experts mentioned that the absence of strategic planning from client side is a major reason. For the

factor “Client interference” 93.3% experts responded that the favouritism from client side for the appointment of contractor should be avoided. Factor “Poor contract management” has been responded by 93.3% of the experts that this is due to poor understanding of contract document. For rest of the factors the responses are listed in similar sorted manner highest to lowest response rate. 93.3% experts revealed that insufficient information or details could be the reason in delay in decision making. For “Laws and regulations of frame work” factor 96.6% experts suggested that client should adopt general policies. The factors “Change in scope of project” and “Financial difficulties faced by client” 93.3% respondents answered poor assessment or investigation and insufficient funds for individual project respectively.

Table 3. Results from experts on the mitigation measures

Factors	Mitigation Measures	Percentage	Factors	Mitigation Measures	Percentage
1. Delay in process of payment by Client	1. Sufficient allocation of each project	96.7	2. Inadequate planning	1. Before starting of project client should make strategic planning	90
	2. Changes in regulatory authority should be avoided	90		2. before tendering planning committee should visit project site	80
	3. Forex restrict ration should be avoided	83.3		3. Planning section should hire competent staff	73.3
	4. Political influence should be avoided by client	73.3		4. Project cost should be estimated properly	63.3
	5. Client should expedite process of payment to contractor	56.7		5. Effective planning should be adopted	56.7
				6. Time duration of project should be estimated properly	36.7
3. Client interference	1. Client should avoid appointing favoured contractor	93.3	4. Poor contract management	1. In bidding process contract document should be well understood	93.3
	2. Delay in approvals should be avoided	83.3		2. Contracts should be awarded on merit basis.	86.7
	3. Changes in key posts of project should be avoided	76.7		3. Well experienced consultant should be hired	80
	4. Client should avoid political influence	66.7		4. Contract document should be well detailed	73.3
	5. Policies should not be revised on basis of favouritism	60		5. Competent staff should be appointed for making comprehensive contract document	60
5. Delay in decision making	1. Sufficient amount of details should be provided to take proper decisions	90	6. Laws and regulations of frame work	1. Client should adopt general policies	96.6
	2. Qulaified and competent team should be appointed	83.3		2. Laws and policies should be clear so that contractor can understand easily.	90
	3. Nepotism and favouritism should be avoided	73.3		3. Law and regular policies should be revised every year	86.6
	4. Communication gap should be removed between parties to take decisions	66.67		4. Law and framework of different departments also be understood before starting of project	80
	5. Frequent meetings should be arranged by client	63.3			
7. Change in scope of project	1. Proper assessment / investigations should be done.	93.3	8. Financial difficulties faced by Client	1. Sufficient funds should be kept for each project.	93.3
	2. Climatic conditions and changes of site should be foreseen.	86.6		2. Donor/Investor should start project on availability of funds.	86.6
	3. Availability of different resources should be investigated.	83.3		3. Funds of project should not be transferred to any other project.	76.6
				4. Government should allocate funds on time to client.	70
4. Political approach should be avoided.	80			5. Client should issue funds as per work done by contractor.	66.7

5. Conclusion

This study has identified the significant factors of cost overrun and further mitigation measures for the determined significant factors of cost overrun in highway projects in Sindh province of Pakistan. Mixed mode research method was used for identification of significant factors of cost overrun and mitigation of these significant factors from well qualified and experienced respondents of highway projects. In initial stage the 8 significant factors of cost overrun were identified by using mean value. Top 8 significant factors were delay in process of payment by Client, inadequate planning, Client interference, poor contract management, and delay in decision making, law and regulations of frame work, change in scope of project, financial difficulties faced by client. Possible mitigation measures of each significant cost overrun factors were determined from professional experts of highway projects by using semi structure questionnaire. Collected data from semi structure questionnaire was calculated by using content analysis. These mitigation measures can be used to control the significant factors of cost overrun.

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