

Prompting Cost Overrun Factors during PCP in Construction Projects

Muhammad Akram Akhund^{1*}, Ali Raza Khoso², Jam Shahzaib Khan³, Hafiz Usama Imad⁴
and Khan Muhammad Memon⁵

¹Department of Civil Engineering, Mehran U.E.T, Jamshoro, Sindh, Pakistan; akhund42@gmail.com

²Department of Civil Engineering, Mehran UET, Jamshoro, Sindh, Pakistan; engr.aliraza23@gmail.com

³Department of Civil Engineering, QUCEST, Larkano, Sindh, Pakistan; Jam_shahzaib@hotmail.com

⁴Department of Civil Engineering, ISRA University, Hyderabad, Sindh, Pakistan; usama.imad@isra.edu.pk

⁵Department of Civil Engineering, NED University Karachi, Pakistan; engr.khanmm@gmail.com

Abstract

A construction project involving Public capital normally goes through serious problems and challenges of cost overrun. This issue if addressed at pre-construction planning phase can reduce various problems of budget overrun. **Objectives:** The aim of this research study is to explore the most critical factors of cost overrun in construction projects of Pakistan during Pre-Construction Planning (PCP) phase. **Methods/Statistical Analysis:** A structured questionnaire was designed for data collection. A total of 110 questionnaires were distributed among construction firms located in Pakistan which were analyzed statistically to determine significant factors. Statistical Package for the Social Sciences (SPSS) version 24.0 was used to find out the critical factor of cost overrun in construction project of Pakistan during PCP phase through relative importance index method. **Findings:** The research concludes that top most critical factor of cost overrun during PCP phase of construction projects are, wrong or improper design, inaccurate estimation, variation in scope of work, poor resource management and change of orders. **Application/Improvements:** This research is a step towards reduction of cost overrun issues in construction projects.

Keywords: Cost overrun, Construction Project, Importance Index (RII), Pakistan, Pre-Construction Planning (PCP) Relative

1. Introduction

Construction is among one of the most emerging businesses in the world specially developing countries¹. It acts as driving force for several other sectors for the boost of economy thus requires an immense investment. Every major sector like education, transportation, mining, logistics, insurance, consultation, and management is inscribed with construction². Management and quality assurance of this sector is thus of key importance. Slight delays in these projects may impacts in significant economic loss. Unfortunately, these delays are very ubiquitous in this industry particularly in developing countries. Potentially profitable projects are converted in money loosing schemes because of these delays, which is undesirable for contractor as well as for the owner.

This has resulted in worse project performance and distrust among parties. These delays are basically extension in any part of the project which is not in original plan and become necessary to execute due to unexpected circumstances³. Likewise many countries, construction industry of Pakistan is facing a lot of challenges, related to the delays and cost overrun. Cost overrun is the one of the prime causes in the decline of the construction industry of Pakistan⁴. This issue is a crucial problem for other developing countries like Pakistan too and also a menace for the construction practitioners. Cost overrun is generally defined as the difference between the executed cost on a project and estimated cost of the project at bidding stage⁵. This problem can be overcome if appropriate planning and proper management is ensured. Construction Planning can be categorized in three types: pre-construction planning,

construction planning and post construction planning. The former one is the type significantly contribute towards the cost management and minimizing cost overrun problem at earlier stage. A research study by⁶ related to cost overrun discovered that construction stakeholders plays an essential part during planning in the pre-construction phase and this overrun can be minimized if a project is properly planned.

Planning in construction industry of developing countries has very unsatisfactory status for managing cost overrun problem. This issue is considered subjectively by ignoring proper planning at preparing bid document. Commonly delays happens in the project due to ignorance and negligence during planning stage of projects. In past several examples shows failure of projects, like in Turkey⁷, Indonesia⁸, Singapore⁹, South Africa¹⁰ and other developing countries¹¹⁻¹³. These projects could not be completed within allocated budget thus ranked in the list of failed projects. From Indonesian construction industry it has been claimed that only 20% projects are completed within stipulated cost. Only 35% projects have been completed within evaluated budget in South Africa which is still quite low. This problem can be reduced by applying PCP planning procedures. It is evidenced from Singaporean construction organizations that the industries, which have applied PCP techniques, have reduced 15% of the construction cost than others^{4,7}. This research focuses on overcoming this critical issue of cost overrun in construction projects of Pakistan. For resolving this problem authors identified the cost overrun factors in PCP phase with the help of experienced practitioners from construction industry of Pakistan.

2. Research Methodology

For achieving the aim of research, the work has been divided into two stages. In first stage, the cost overrun factors were determined with the help of in-depth literature review. Previously tested and used factors from earlier published studies were used to ensure clear and comprehensible factors. A total fifty-five (55) critical factors were found through literature.

Quantitative surveys are designed to acquire information from individuals regarding resemblance of identified factors with Pakistan's Construction industry. To develop operational factors from the semi-structured interviews, each factor was presented to experienced practitioners to find out cost overrun factors related to the PCP stage in construction projects of Pakistan. Data was collected using Survey. The data collection was

based on the full population of project managers and relevant officials. Their educational backgrounds include architects, engineers and building surveyors. The chosen population has both pros and cons, but was chosen since publicly funded construction projects represent some of the most complex construction projects in Pakistan which implies that a further generalization to less complex public funded construction projects is possible. Further, the publicly employed project managers are the only trade group which follows a public construction project from the beginning to the end. After having finalized factors relevant to Pakistan Construction industry from phase 1, a secondary questionnaire was set up. In the second phase, the identified factors were presented to the stakeholders for determining the critical factors of cost overrun in PCP stage. To measure the impact of each factor on cost, these elements were measured on an ordinal five point Likert scale (where 1 very low, 2 low, 3 medium, 4 high, 5 very high impact).

Gathered data was sorted and the analysis was conducted using Statistical Package for the Social Sciences (SPSS). Frequency of response, rank given by respondents, weightage of the factors, and other relevant data was used for finding average mean, standard deviation and average index. Relative Importance Index (RII) statistical technique (having formula mentioned as equation (1)) was used to analyze the collected data and rank factors with an index range of 0.0-1.0. To check the reliability of the dataset, the Cronbach alpha test was conducted. The data of both structured and unstructured questionnaires sets was assessed by following RII equation.

$$RII = \frac{\sum(a_{ixi})}{\sum x_i} \quad \text{Eq 1}$$

3. Results and Discussion

Out of fifty-five (55) cost overrun factors extracted from existing literature, thirty seven (37) factors of cost overrun are shortlisted for PCP in construction projects of Pakistan by experienced construction practitioners. Table 1 illustrates the factors and their sources from where they are extracted. In the second phase, 110 structured questionnaires were distributed for data collection among different construction project stakeholders. The response rate of completely filled and valid questionnaire for analysis is 75.45%. Initially the Cronbach Alpha value was found to be 0.64, which is questionable.

Table 1. Causative factor of cost overrun for construction industry of Pakistan

NO	Cost Overrun Factors	References
PCPF-1	Exchange rate /fluctuation of prices	(9,11,13,18)
PCPF-2	Material and labor wastage escalation (inflation)	(11,13,18)
PCPF-3	Financial instability in markets	(11,15,18)
PCPF-4	Poor scope definition	(11,20)
PCPF-5	Improper selection of subsequent consultants	(11,13,18)
PCPF-6	Unclear perception of requirement of resources	(11,19)
PCPF-7	Construction methods	(14)
PCPF-8	Poor resource management	(10,19)
PCPF-9	Lack of database in estimating activity duration and resources	(18-20)
PCPF-10	Wrong or improper (poor/inappropriate) design	(11,14,19)
PCPF-11	Insufficient training of designers	(9,19)
PCPF-12	Poor use of advanced engineering design software	(10)
PCPF-13	Mistakes and delays in producing design documents	(9,11)
PCPF-14	Insufficient or ill-integrated basic project data and survey	(21)
PCPF-15	Change in drawings & specifications	(11,14,19)
PCPF-16	Inaccurate site investigation	(11,14)
PCPF-17	Uncooperative owners	(14,21)
PCPF-18	Unreasonable project time frame	(14,19)
PCPF-19	Inadequate definition of substantial completion	(14)
PCPF-20	Improper project feasibility study	(11)
PCPF-21	Increase in scope of work	(14,20)
PCPF-22	Political situation	(10-11)
PCPF-23	Physical obstructions (religious places)	(11)
PCPF-24	Conflict, war, revolution, and riots	(10-11)
PCPF-25	Monopoly	(11)
PCPF-26	Bribes (kickbacks) & personal interest (prejudices) "corruption"	(10-11)
PCPF-27	Fraudulent practices	(9,11)
PCPF-28	Excessive bureaucracy in project owned operation	(10,17)
PCPF-29	Changes in laws and government regulations	(11,13)
PCPF-30	Permits (urban planning bureau & order of engineers) and access facilities	(10,18,20)
PCPF-31	Change orders	(11,21)
PCPF-32	Environmental concerns and restrictions	(10,17,21)
PCPF-33	Judgment and experience of the involved people in estimating time and resources	(17,19,21)
PCPF-34	Wrong estimation	(11,17,18,20)
PCPF-35	Inadequate cost benefit considerations and progress review while planning	(11,21)
PCPF-36	Poor professional construction management	(11,17,18)
PCPF-37	Inadequate control procedures	(11,18)

After eliminating 14 doubtful questionnaires, the Cronbach Alpha value was found to be 0.88, which is an acceptable value. Table 2 encapsulates the numbers of distributed, collected, reliable and invalid questionnaires. In this research study, experienced construction practitioners at various backgrounds and of different projects of Pakistan were involved as respondents. For example; consultants, clients, contractor as professional background and commercial, roads, residential, social amenities and bridges projects as types of projects. An Expanding

experience range of respondents is considered for data collection to have a mixed type response. Respondents set was consisting of 24.10% construction experts have working experience less than five years, 41% of having rich experience of 6-10 years. However, 16.90% and 18.10% of construction experts have working experience of 11 to 15 years and more than 15 years respectively. Other classification and cataloging of respondents with respect to nature, profession, position, and type of project in which they are involved is tabulated in Table 3.

Table 2. Summary of collected questionnaires sets

No. of questionnaire sets distributed among construction practitioners	110
No. of questionnaire sets received from construction practitioners	97
No. of questionnaire sets valid for analysis	83
No. of questionnaire set invalid for analysis	14
No. of questionnaires not received	13

Table 3. Demographic data of respondents

	Frequency	Percentage	Cumulative%
Types of Organization			
Consultant	36	43.40	43.40
Constructor	29	34.90	78.30
Client	15	18.10	96.40
Other	3	3.60	100.00
Types of Construction Projects			
Commercial	17	20.50	20.50
Roads	20	24.10	44.00
Residential	15	18.10	62.70
Social Amenities	5	6.00	68.70
Bridges	23	27.70	96.40
Others	3	3.60	100.00
Total Working Experience of Construction Practitioners			
0-5 Years	20	24.10	24.10
6-10 Years	34	41.00	65.10
11-15 Years	14	16.90	81.90
More than 15 Years	15	18.10	100.0
Level of Position			
Chief Executive Officer (CEO)	6	7.23	7.23
Superintendent engineer	13	15.66	22.89
Contract Engineer	11	13.53	36.42
Construction project manager	29	34.94	71.36
Executive engineer	9	10.84	82.20
Resident engineer	11	13.25	95.45
Director	4	4.82	100.00

Relative Importance Index (RII) is calculated by assigning weightage to the respondents depending on their position and experience. The response in shape of value on Likert scale, frequency of response and average value is used to calculate RII. The collected data was arranged by using RII method. Table 4, shows the analyzed results of cost overrun factors at the stage of PCP with ranking in ascending order. The results of this research presents that, wrong or improper (poor/inappropriate) design, wrong estimation, increase in scope of work, poor

resource management, change orders, exchange rate/ fluctuation of prices, construction methods and material and labor wage escalation (inflation) with their mean RII weightage value of 0.84, 0.83, 0.82, 0.82, 0.80, 0.80, 0.79 and 0.79 respectively, are the most critical affecting factors of cost overrun during PCP in the construction projects of Pakistan. These factors are in accordance to the other studies in the region. Other developing countries have identified certain cost overrun factors for their respective countries.

Table 4. Pre-construction planning cost overrun factors

PCP Factors	ES	VS	MS	SS	NS	RII	Rank
Wrong or improper (poor/inappropriate) design	36	34	7	4	2	0.84	1
Wrong estimation	31	32	20	0	0	0.83	2
Increase in scope of work	32	31	16	4	0	0.82	3
Poor resource management	32	31	16	4	0	0.82	3
Change orders	31	25	22	5	0	0.80	4
Exchange rate /fluctuation of prices	31	25	22	5	0	0.80	4
Construction methods	29	31	16	5	2	0.79	5
Material and labor wage escalation (inflation)	28	33	13	7	2	0.79	5
Financial instability in markets	26	37	12	3	5	0.78	6
Poor professional construction management	24	33	12	14	0	0.76	7
Insufficient training of designers	24	33	12	14	0	0.76	7
Change in drawings & specifications	18	39	16	9	1	0.75	8
Bribes (kickbacks) & personal interest (prejudices) "corruption"	16	36	22	9	0	0.74	9
Inadequate control procedures	24	16	34	6	3	0.73	10
Inaccurate site investigation	18	22	35	8	0	0.72	11
Improper project feasibility study	18	22	35	8	0	0.72	11
Insufficient or ill-integrated basic project data and survey	17	36	10	17	3	0.71	12
Inadequate cost benefit considerations and progress review while planning	21	28	16	11	7	0.71	12
Excessive bureaucracy in project owned operation	18	18	33	14	0	0.70	13
Lack of database in estimating activity duration and resources	17	24	33	3	6	0.70	13
Physical obstructions (religious places)	16	21	29	17	0	0.69	14
Poor scope definition	22	19	21	11	10	0.68	15
Unclear perception of demand	24	16	18	14	11	0.67	16
Fraudulent practices	23	17	19	15	9	0.67	16
Mistakes and delays in producing design documents	21	18	22	13	9	0.67	16
Permits (urban planning bureau & order of engineers) and access facilities	21	19	9	31	3	0.66	17
Judgment and experience of the involved people in estimating time and resources	22	17	8	32	4	0.65	18
Poor use of advanced engineering design software	22	17	8	32	4	0.65	18
Unreasonable project time frame	14	19	30	11	9	0.64	19
Environmental concerns and restrictions	15	15	30	12	11	0.63	20

PCP Factors	ES	VS	MS	SS	NS	RII	Rank
Uncooperative owners	16	18	16	20	13	0.61	21
Changes in laws and government regulations	17	15	20	16	15	0.61	21
Improper selection of subsequent consultants	16	15	22	14	16	0.60	22
Conflict, war, revolution, and riots	14	17	26	4	22	0.59	23
Inadequate definition of substantial completion	16	19	11	19	18	0.59	23
Political situation	15	18	17	14	19	0.59	23
Monopoly	15	17	15	14	22	0.57	24

These factors vary from place to place and country to country. While most common reasons of cost overrun in Indonesia are fluctuation in material cost prices, complexity of construction projects and inaccurate material estimating. Adversely disturbing the cost performance, conflict among the main project stakeholders, inappropriate bidding time interval, and aggressive competition at tender stage, and lack of project knowledge, climatic conditions and delay in decision making¹⁰⁻¹³. Similarly, some significant factors of cost overrun in building construction projects From Ethiopia are poor planning, poor coordination among construction practitioners, inflation in the cost of construction material, changes order by the owner and surplus quantity of construction material during execution¹⁴⁻¹⁷.

Similarly, Egyptian Construction industry have highlighted, additional work, wrong method of cost estimation, use of old bidding procurements, involvement of government personal in bidding or tendering, funding problems, poor ground conditions and inflation and fluctuation in raw material cost prices as the most influential factors responsible for cost overrun⁸⁻¹¹. In the same way, mistakes, errors and omissions in consultant suggested material, rework due to the poor construction and inaccurate budget estimation are the highlighted factors from Denmark¹⁸⁻²¹.

4. Conclusion and Future Recommendation

Cost overrun in construction projects of Pakistan is still a challengeable problem especially in Public projects. This issue can be resolved by focusing on pre-construction planning phase of project life cycle. This research work investigated the key causes responsible for cost overrun during PCP phase from in depth literature review and from the views of expert from construction industry of

Pakistan. The research suggests that, wrong or improper (poor/inappropriate) design, wrong estimation, increase in scope of work, poor resource management, change orders, exchange rate /fluctuation of prices ,construction methods ,material and labor wage escalation (inflation), financial instability in markets and poor professional construction management are top critical causes of cost overrun during PCP phase.

This work only focused on critical causes of cost overrun in PCP phase in construction industry of Pakistan; however the study can be further extended to provide causative measure. The study can be compared with other research in developing countries and more favorable results in terms of comparison can be obtained.

5. Acknowledgment

The authors wish to acknowledge efforts of our colleagues, teachers, supporting staff and other fellows for providing support during data collection, their timely guidance and support to complete this work.

6. References

1. Sweis G, Sweis R, Abu Hammad A, Shboul A. Delays in construction projects: The case of Jordan. *International Journal of Project Management*. 2008; 26(6):665–74. <https://doi.org/10.1016/j.ijproman.2007.09.009>
2. Assaf SA, Al-Hejji S. Causes of delay in large construction projects. *International Journal of Project Management*. 2006; 24(4):349–57. <https://doi.org/10.1016/j.ijproman.2005.11.010>
3. Bramble BB, Callahan MT. *Construction delay claims*. Aspen Publishers; 2010. p. 1–1032.
4. Cost overrun factors in construction industry of Pakistan. Available from: https://www.researchgate.net/publication/277987526_Cost_Overrun_Factors_In_Construction_Industry_of_Pakistan

5. Mahamid I. Contractors' perception of risk factors affecting cost overrun in building projects in Palestine. *The IES Journal Part A: Civil and Structural Engineering*. 2014; 7(1):38–50. <https://doi.org/10.1080/19373260.2013.854180>
6. Divakar K, Subramanian K. Critical success factors in the real-time monitoring of construction projects. *Research Journal of Applied Sciences, Engineering and Technology*. 2009; 1(2):35–9.
7. Duran O. Current risk management applications in Turkish construction industry. MSc diss. Gaziantep University; 2006.
8. Kaming PF, Olomolaiye PO, Holt GD, Harris FC. Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics*. 1997; 15(1):83–94. <https://doi.org/10.1080/014461997373132>
9. Hwang BG, Low LK. Construction project change management in Singapore: Status, importance and impact. *International Journal of Project Management*. 2012; 30(7):817–26. <https://doi.org/10.1016/j.ijproman.2011.11.001>
10. Nega F. Causes and effects of cost overrun on public building construction projects in Ethiopia. Addis Ababa University; 2008. p. 80–1.
11. CII best practices front end planning and alignment. Available from: https://cdn.ymaws.com/www.projectmanagement.org.za/resource/resmgr/Knowledge_Series_June_2015/PMSA_Knowledge_Series_-_CII_.pdf
12. Arditi D, Akan GT, Gurdamar S. Cost overruns in public projects. *International Journal of Project Management*. 1985; 3(4):218–24. [https://doi.org/10.1016/0263-7863\(85\)90053-5](https://doi.org/10.1016/0263-7863(85)90053-5)
13. Iyer KC, Jha KN. Factors affecting cost performance: Evidence from Indian construction projects. *International Journal of Project Management*. 2005; 23(4):283–95. <https://doi.org/10.1016/j.ijproman.2004.10.003>
14. Factors affecting schedule delay, cost overrun, and quality level in public construction projects. Available from: <https://ascelibrary.org/doi/10.1061/%28ASCE%29ME.1943-5479.0000391>
15. Al-Hazim N. Delay and cost overrun in road construction projects in Jordan. *International Journal of Engineering and Technology*. 2015; 4(2):288–93. <https://doi.org/10.14419/ijet.v4i2.4409>
16. Al-Hazim N, Salem ZA, Ahmad H. Delay and cost overrun in infrastructure projects in Jordan. *Procedia Engineering*. 2017; 182:18–24. <https://doi.org/10.1016/j.proeng.2017.03.105>
17. Frimpong Y, Oluwoye J, Crawford L. Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study. *International Journal of Project Management*. 2003; 21(5):321–6. [https://doi.org/10.1016/S0263-7863\(02\)00055-8](https://doi.org/10.1016/S0263-7863(02)00055-8)
18. Abbas A, Din ZU, Farooqui R. Achieving greater project success and profitability through pre-construction planning: A case-based study. *Procedia Engineering*. 2016; 145:804–11. <https://doi.org/10.1016/j.proeng.2016.04.105>
19. Final Report for NCHRP Report 574: Guidance for cost estimation and management for highway projects during planning, programming, and preconstruction. Available from: <http://www.trb.org/Publications/Blurbs/158465.aspx>
20. Koushki PA, Al-Rashid K, Kartam N. Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*. 2005; 23(3):285–94. <https://doi.org/10.1080/0144619042000326710>
21. Accuracy of estimating techniques for predicting residential construction costs—a case study of an Auckland residential construction company. Available from: <https://unitec.researchbank.ac.nz/handle/10652/1794>