Prompting Cost Overrun Factors during PCP in Construction Projects

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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 countries. 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 construction. 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 circumstances. 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 Pakistan. 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 stage. This problem can be overcome if appropriate planning and proper management is ensured. Construction Planning can be categorized in three types: pre-construction planning,
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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 by\textsuperscript{4} 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 Turkey\textsuperscript{5}, Indonesia\textsuperscript{6}, Singapore\textsuperscript{6}, South Africa\textsuperscript{7} and other developing countries\textsuperscript{8-11}. 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\textsuperscript{12}. 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.

\[
RII = \frac{\sum (aixi)}{\sum xi}
\]

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

| Types of Organization                  | Frequency | Percentage | Cumulative% |
|----------------------------------------|-----------|------------|-------------|
| 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          | Frequency | Percentage | Cumulative% |
|----------------------------------------|-----------|------------|-------------|
| 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 | Frequency | Percentage | Cumulative% |
|-------------------------------------------------------|-----------|------------|-------------|
| 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      | 100.00      |

| Level of Position | Frequency | Percentage | Cumulative% |
|-------------------|-----------|------------|-------------|
| 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  | 22  | 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   |
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.

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