Abstract. Construction industry of Pakistan is creating a number of opportunities in employment as well as plays a role model for economy development of the country. This construction industry has a serious issue of cost overrun in all construction projects especially in construction of highway projects. Cost overrun is a serious and critical issue in construction of highway projects which gives negative impact to construction practitioners because it is not only cross the approved budget but also approved time of the project. The main objective of this study is to find out critical factors causing cost overrun in highway projects of Sindh according to contractors’ perspectives. Deep literature review was carried out and a total of 64 factors of cost overrun were identified. To achieve the objective, a questionnaire was designed and distributed among 16 selected respondents who have more than 20 years of experience in construction of highway projects. The results from analysis found that most critical factors of cost overrun in the order of importance include financial and cash flow difficulties faced by contractor, frequent changes in design, changes in price of materials, poor planning by client, change in scope of project, change in specification of materials and delay in taking decisions. This study will assist contractors to narrow down some of the critical factors that would lead to cost overrun, and therefore be prepared with the ways to mitigate these problems in construction of highway projects of Sindh province.

INTRODUCTION

Construction industry not only plays as the main role for growth of economy of a country but also encourages other industries too [1]. The construction industry is facing highly unpredictable and variable causes like availability of resources, financial problems, environment and political conditions, contractual relations and low productivity. Construction industry of developed and developing countries has failed to achieve goals of the project. Successful project must fulfill the prime factors of construction management including cost, time and quality. Unfortunately, it is observed that most construction projects have failed to complete within approved cost and time as well as expected quality [2]. However, it is undeniable nowadays that construction projects are commonly completed within the significant problems of cost overrun [3]. Cost Overrun is not only observed in developing countries but also in developed countries [4].

PREVIOUS STUDIES

Many studies have been carried out to find the critical and causative factors of cost overrun in construction industry. Researcher [5] conducted a study on 258 transportation projects which cover railway projects, bridges,
tunnels and highway projects. These projects were located around 5 continents including developed and developing nations. The results of the study showed that 9 out of 10 transportation projects (90%) faced problem of cost overrun and mean cost overrun for all projects was found 28%. A survey by [6] was carried out to explore construction projects cost performance in private and public projects in Malaysia based on tendering method, procurement method, and type of project and size of project. From the survey, it was found that 55 % of the projects experienced cost overrun problem, and mostly this problem is faced by public projects as compared to private projects.

In Pakistan, different studies have been carried out to identify critical and major factors of cost overrun in construction industry. A research conducted by [7] in which major and critical factors were identified in construction projects of Pakistan. Outcomes of research have indicated that errors in making design and drawing, improper planning for time and cost estimates, payment problem faced by contractor, variations in price of materials, and no proper planning, were among the major factors of cost overrun. Moreover, [8] conducted a study to find out critical factors of cost overrun or budget overrun. Their study found that bidding process in lower price, payment delay to contractor, unavailability of materials, poor cost control, reconstruction at site, and delay in process of approval were the critical factors causing cost or budget increase in construction industry of Pakistan. It was found from another research conducted by [9] that causative factors of cost overrun in Pakistan construction industry comprise underestimate time duration of project, poor management at site by contractors, rapidly changes in design, shortage of labors and cash and financial problems faced by contractors.

As most previous studies were to identify cost overrun factors in construction projects of Pakistan, therefore this research seeks to identify the causative factors of cost overrun from contractor’s perspective in construction of highway projects in Sindh province of Pakistan.

RESEARCH METHODOLOGY

From comprehensive and in depth literature review, it had identified 64 common factors of cost overrun in construction industry. This study employs quantitative method in which the identified factors of cost overrun were organized in questionnaire and distributed among highly experienced respondents working with contractors of highway projects.

Demography of Respondents

Table 1 shows the demography of the selected respondents participating in the questionnaire survey. The Table shows that the maximum experience is 31 years, and the minimum experience is 15 years. On average, the respondents’ working experience with contractors in construction of highway is more than 21 years. This clearly indicates that all respondents are well exposed to the construction of highway projects, and therefore able to provide inputs and feedbacks on the problem of cost overrun faced by contractors in highway construction projects around Sindh Province.

<table>
<thead>
<tr>
<th>No.</th>
<th>Position</th>
<th>Organization</th>
<th>Qualification</th>
<th>Experience (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Construction Engineer</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
<td>31</td>
</tr>
<tr>
<td>2</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>Master of Project Management</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
<td>27</td>
</tr>
<tr>
<td>4</td>
<td>Quantity Surveyor</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
<td>26</td>
</tr>
<tr>
<td>5</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>Masters in Highway Engineering</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
<td>23</td>
</tr>
<tr>
<td>7</td>
<td>Project Engineer</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
<td>22</td>
</tr>
</tbody>
</table>
TABLE 1. Demographics of survey respondents (Continue)

<table>
<thead>
<tr>
<th>No.</th>
<th>Design Engineer</th>
<th>Contractor (Pvt)</th>
<th>Masters in Structural Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>9</td>
<td>Managing Director</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>10</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>11</td>
<td>Quantity Surveyor</td>
<td>Contractor (Pvt)</td>
<td>Masters in Civil Engineering</td>
</tr>
<tr>
<td>12</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>13</td>
<td>Construction Engineer</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>14</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
<tr>
<td>15</td>
<td>Project Manager</td>
<td>Contractor (Pvt)</td>
<td>B.E in Civil Engineering</td>
</tr>
</tbody>
</table>

DATA ANALYSIS

Questionnaire survey for this research was designed based on Likert’s scale. Likert scale is simply a declaration which the respondent is questioned to evaluate according to any kind of objective or subjective criteria; commonly the level of agreement or disagreement is measured.

The questionnaire was designed on Likert’s scale of five ordinal actions from one (1) to five (5) according to the level of contribution. Each scale indicates the resulting score as follows:

(1) = Not significant
(2) = Slightly significant
(3) = Moderately significant;
(4) = Significant; and
(5) = Highly significant

Each of the respondents was asked to rate each factor on five point Likert scale. Respondents with more than 15 years of experience and holding at least Bachelor’s Degree in Civil Engineering were selected for consistency of collected data. For statistical analysis, the Statistical software package (SPSS) Version 20 and Microsoft excel were used. Reliability of the collected data was analyzed through SPSS Version 20. It was found that the value of Cronbach’s alpha was 0.813, which clearly shows the collected data are generally acceptable and reliable with higher consistency. Data was evaluated by using formula of average index (AI) as expressed in Equation (1) as follows:

\[ AI = \frac{\sum (1X_1+2X_2+3X_3+4X_4+5X_5)}{\sum (X_1+X_2+X_3+X_4+X_5)} \]

Where,

N= Total number of respondents for “1, 2, 3, 4, 5…”
X_1= shows number of respondents for “Not significant”
X_2= shows number of respondents for “Slightly significant”
X_3= shows number of respondents for “Moderately significant”
X_4= shows number of respondents for “Significant”
X_5= shows number of respondents for “Highly significant”.

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RESULTS AND DISCUSSION

After completing the data analysis, the factors whose average index’s values of more than 3.6 were selected as critical causative factors [9]. Table 2 shows the critical causative factors of cost overrun in highway construction projects of Sindh Province arranged descending according to its criticality.

<table>
<thead>
<tr>
<th>Factors</th>
<th>AI Value</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial and cash flow difficulties faced by contractor</td>
<td>4.421</td>
<td>1</td>
</tr>
<tr>
<td>Frequent changes in design</td>
<td>4.312</td>
<td>2</td>
</tr>
<tr>
<td>Changes in price of materials</td>
<td>4.210</td>
<td>3</td>
</tr>
<tr>
<td>Poor planning by client</td>
<td>4.055</td>
<td>4</td>
</tr>
<tr>
<td>Change in scope of project</td>
<td>3.925</td>
<td>5</td>
</tr>
<tr>
<td>Change in specification of materials</td>
<td>3.871</td>
<td>6</td>
</tr>
<tr>
<td>Delay in taking decisions</td>
<td>3.776</td>
<td>7</td>
</tr>
<tr>
<td>Poor site management</td>
<td>3.613</td>
<td>8</td>
</tr>
</tbody>
</table>

Based on their respective average index’s score, it can be seen from Table 2 that financial and cash flow difficulties faced by contractor (4.421), frequent design changes (4.312), changes in price of materials (4.210), poor planning by client (4.055), change in scope of project (3.925), changes in specification of material (3.871), delay in taking decisions (3.776), and poor site management (3.613) are the critical causative factors of cost overrun in highway projects from the perspective of contractors. Arranged in the order of its hierarchy, the descriptions for each of the critical causative factors are as the followings:

(i) Financial and Cash Flow Difficulties Faced by Contractor

Financial and cash flow difficulties faced by contractor is the top most causative factor of cost overrun in construction of highway projects in Sindh Province. It is a true fact that a contractor plays important role from initial to completion of the project, and therefore sufficient funds is required to ensure the smoothness of every single work activity. Financial and cash flow difficulties faced by contractor may lead to slow down and stop of the construction activities at site which results in the cost overrun [10].

(ii) Frequent Changes in Design

Frequent design changes in the execution of the construction projects creates problem of cost overrun. Contractors started work at site as per given design provided by consultants and client. This problem of frequent changes in design is generally caused by unforeseen ground conditions by consultant. Frequent design changes disturb the flow of construction activities at site. Mostly the design of the project is not finalised up to tender of the project and sudden and frequent design changes could lead to cost overrun in the project [11].

(iii) Changes in Price of Materials

Changes in price of materials are one of the causative factors of cost overrun in construction of highway projects in Sindh Province. When the price of materials is fixed at the time of tender and price of materials changes from execution to completion of project, the changes of price of material also causes cost overrun in projects. Price of
materials are kept on increasing as observed in the last few decades and this is a critical factor of cost overrun in construction industry [12].

(iv) Poor Planning by Client

Every project must be completed within approved time, standards and budget. Unfortunately, due to of poor planning by client like shortage of resources of the project, time duration of the project and sudden changes in key posts causes of cost overrun in highway projects. Poor planning of the project causes cost overrun because every project has its own budget and that project should be completed within the approved and agreed cost [13].

(v) Change in scope of project

Scope of the project can be defined as entire deliverable that is expected at the completion of the project. If any changes in scope is made, the entire plan of the project will be changed. Change in scope occurs because of errors in initial objective of the project. Change in the agreed scope of project definitely causes cost and time overrun [14].

(vi) Change in specification of materials

Specifications of materials are provided to contractors at the time of tender and contractor gave order for supply of those materials at site. Changes in the specification of materials may result in the delay of project progress. Ultimately this would lead to project’s cost overrun [15]

(vii) Delay in Taking Decisions

Client/owner and consultant and contractors are decision makers of the project. If their decisions of the project are not taken on proper time, slowdown of activities which delays the project’s progress would occur, and this may result in the cost overrun of the project [16]. Apparently, the delay in taking decision about approval of drawings, delay in approval of materials, and delay approval of specification have led to the issue of cost overrun in construction of highway projects.

(viii) Poor site Management

Poor site management factor occurs when the construction activities and daily routine works are not properly managed by site engineers and staff. Poor site management shows the incompetency of contractor’s staff at the site [17]. Sometimes project managers are suddenly transferred to any other project, and this issue of poor site management occurs which lead to cost overrun in construction of highway project.

CONCLUSION

This research identified the cost overrun factors from contractor’s perspective in highway projects of Sindh Province. A total of 64 factors were identified from previous studies. After statistical analysis, the factors with average index value of more than 3.6 were selected major critical causative factors of cost overrun. The results have shown that financial and cash flow difficulties faced by contractor (4.421), frequent changes in design (4.312), changes in price of materials (4.210), poor planning by client (4.055), change in scope of project (3.925), change in specification of materials (3.871), delay in taking decisions (3.776) and poor site management (3.613) are the major critical causative factors of cost overrun in highway construction projects in Sindh Province. Meanwhile, a future study can be carried out to explore the mitigating measures for major causative factors of cost overrun in highways projects.

REFERENCES