

## Contributing Cost Variation Factors in Highway Projects

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### Abstract

Cost overrun is known as when the final cost of any project surpasses the sectioned cost of the project at the floating of tender. Cost overrun or cost variation overrun is the main problem in the construction of highway projects in Sindh Province of Pakistan. To attain the main objective of the research a literature review was conducted and 64 general factors of cost overrun were found in construction industry. A questionnaire was developed and distributed among 28 well experienced experts having maximum experience in construction of building projects. Gathered data was analyzed by method of average index. Results shows that main and causative factors of cost variation were financial and cash issues faced by owner, slow information between parties, change in price of material, delay of design, poor site management, payment and financial issues problem faced by the contractor and delay in decision making. This research can help petitioners of highway projects to overcome these main and causative factors of cost.

*Keywords:* Cost Variation; Contributing Factors; Highway Projects; Pakistan.

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### 1. Introduction

The construction industry is known as main industry among all industries which plays an important and vital role in growing the economy of the country. It also contributes positively to the development of Gross Domestic Product (GDP) as well as in employment of labor forces. The construction industry has improved life standard by delivering infrastructures like hospitals, buildings, schools and other facilities. Hence, it is quite difficult to complete the project within approved cost, time and standard quality. Of these, cost overrun is found as a major issue because it affects the economy of any country [1, 2]. According to [3] Chen et al. (2016), investigated cost overrun in 418 design and build projects, the results showed that more than 50% of the projects had cost overrun. Cost overrun creates the issue of litigation, cash flow issues, mistrust and arbitration in construction projects [4]. According to [5] that most projects are affected by the cost overrun and out of 10 projects, 9 projects have faced cost overrun. This cost overrun issue is found as dominant in construction in all developing countries where this cost overrun almost exceed more than 100% of the estimated [6]. Factors which causing cost overrun vary from country to country because of the changes in political, economic, environmental and social conditions [7]. The current literature review shows regarding the importance of cost variation and its impact on construction projects. Many research has been conducted out to find out cost variation factors in construction projects but not a single study has been carried out to identify main factors of cost variation in highway

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schemes of Pakistan. Hence, the main aim of the study is to find out the causative and critical cost variation factors of highway projects in the region of Sindh.

## 2. Literature review

A study carried out by Zafar et al. [8] to determine the main factors of cost overrun by a quantitative approach through stakeholders of construction projects of Pakistan. The findings revealed that major factors of cost overrun were a shortage of experienced contractors, project site location, security problems, low productivity and mistakes in the estimation of cost for the project. Another study carried by Abusafiya and Suliman [9] regarding cost overrun causative factors in Bahrain construction projects. A questionnaire was designed and dispersed among experts and engineers to find out causative cost overrun factors. Results of the study showed that causative cost overrun factors were frequent changes in design, schedule delay, faults during the construction process, inadequate supervision and site management, mistakes in time and cost estimates, delay in making and approval of different design and drawings and poor design. According to Le-Hoai et al. [10] that serious cost overrun factors were sudden changes made by the client in the specification of materials, design changes during construction, delay progress in payment by the client, variation in cost of materials, rework at site due to mistakes. Similarly, a study carried out by Ali M. et al. [11] to find identify the significant cost overrun factors in Vietnam construction projects. Results showed that poor site management at site, poor supervision, financial issues faced by the client, many changes in design and financial problems faced by the contractor were found as a significant cost overrun factors. While [12] identified top seven critical cost overrun factors in road projects were owner interruption in the project, payment issues by contractor, slow decision process, delay of payment from government to client, scope changes and appointment of new contractors. Meanwhile, a study carried by Al-Emad et al. [13] in construction projects of Pakistan through the quantitative approach and identified the major factors of cost overrun in construction projects. Results were changes of material price, insufficient control procedure at a construction site, unavailability of technical and skilled staff, delays in approval of work and lack of materials at the site were known as influencing cost overrun factors. Comprehensive and in-depth literature was carried and it helps to identify 64 general factors of cost overrun worldwide. These 64 common factors of cost overrun were further investigated to identify the causative cost overrun factors in highway projects of Sindh province.

## 3. Research Methodology and of Data Collection Procedure

In first stage, based upon literature review general factors which causes cost overrun in construction projects globally. Secondly, a questionnaire was designed which incorporated 64 factors where were identified. Designed questionnaire was distributed personally among twenty-eight highly experienced respondents which were randomly selected from each client, consultant and contractor. The selected respondents were requested to rank the significance level of each factor which contributing cost overrun. A Likert scale having five points of 1 to 5 was used to measure the degree of significance of each factor where; 1=NI= Not important, 2=SI= slightly important, 3=MI= moderately important, 4=I= important, 5=SI= strongly important. In last, gathered data was analyzed by using following formula of average index as shown in Equation (1):

$$AI = \frac{\sum(1X_1 + 2X_2 + X_3 + 4X_4 + 5X_5)}{\sum(X_1 + X_2 + X_3 + X_4 + X_5)} \quad (1)$$

Where;

- X1 = No of defendants for "Not Important"
- X2 = No of defendants for "Slightly important"
- X3 = No of defendants for "Moderately important"
- X4 = No of defendants for "Important"
- X5 = No of defendants for "Strongly Significant"

Evaluation ranges to check significant level as adopted by [14]. The level of importance was implemented in this research as mentioned follows:

- 5.00 ≥ A.I ≥ 4.500 "Highly Significant"
- 4.50 ≥ A.I ≥ 3.50 "Important"
- 3.50 ≥ A.I ≥ 2.50 "Moderately important"
- 2.50 ≥ A.I ≥ 1.50 "Small Important"
- 1.50 ≥ A.I ≥ 0.50 "Not Important"

Research flow chart of this research is mentioned as below Figure 1;

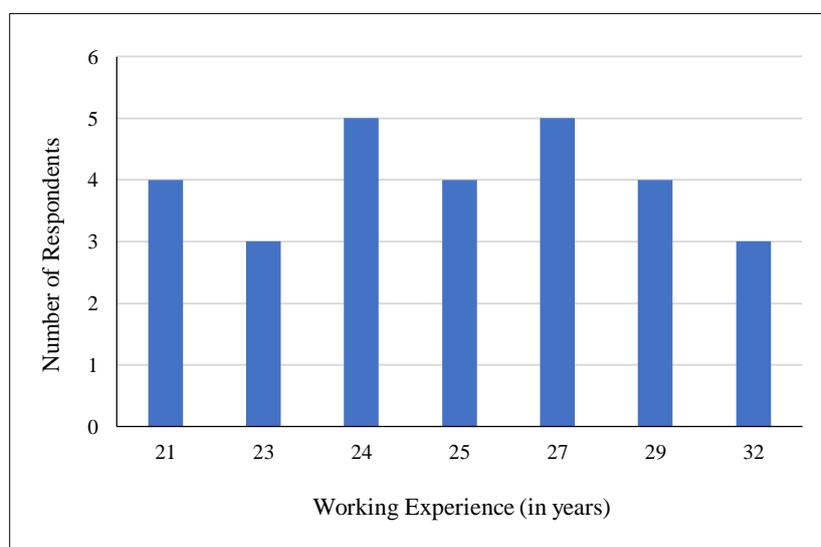


**Figure 1. Research Flow Chart**

The reliability test was also calculated by using software SPSS Version 22. According to [15] that Cronbach’s alpha value is more 0.7 is acceptable and Cronbach alpha value is less than 0.3 and it cannot be accepted. After analysis of data, the Cronbach’s alpha value was found 0.841, which shows that data is acceptable.

### 4. Results and Discussions

The selected respondents involved in questionnaire survey had involved in handling highway projects for many years. Working experience of selected respondents is shown in Figure 2.



**Figure 2. Experience of Respondents**

Figure 2 confirms that selected respondents having maximum experience in dealing construction of highway projects in Sindh region of Pakistan. Table 1. shows cost overrun factors according to their severity.

**Table 1. Causative cost overrun factors**

| # | Factor                                   | Score |   |   |    |    | AI value | Significant |
|---|--|-------|---|---|----|----|----------|-------------|
|   |  | 1     | 2 | 3 | 4  | 5  |          |             |
| 1 | financial and cash issues faced by owner | 0     | 1 | 5 | 10 | 12 | 4.18     | Causative   |
| 2 | Slow information between parties         | 1     | 3 | 3 | 6  | 15 | 4.11     | Causative   |
| 3 | Change in material price                 | 0     | 3 | 3 | 11 | 11 | 4.07     | Causative   |
| 4 | Delay in design                          | 0     | 2 | 6 | 10 | 10 | 4.00     | Causative   |
| 5 | Poor site management                     | 1     | 2 | 5 | 9  | 11 | 3.96     | Causative   |
| 6 | Payment problem faced by contractor      | 2     | 1 | 5 | 9  | 11 | 3.93     | Causative   |
| 7 | Delay in decision making                 | 1     | 1 | 8 | 8  | 10 | 3.89     | Causative   |
| 8 | Natural disaster                         | 0     | 2 | 9 | 8  | 9  | 3.86     | Causative   |

After concluding the process of data analysis, factors whose score (calculated from the average index) greater than 3.6 were designated as causative factors [15]. Table 1. represents that 8 causative factors are found as a critical and contributing factor in highway projects of Sindh region which are arranged in descending according to its severity. Result obtained as can be seen in Table 1 about each contributing factor. Factors such as financial difficulties faced by

client, slow information between parties, change in price of material, delay of design, poor site management, cash and payment issues and problems faced by contractor, delay in decision making and natural disaster were found as the major contributing factors of cost overrun that based on the value of average index obtained as 4.18, 4.11, 4.07, 4.00, 3.96, 3.93, 3.89 and 3.86 respectively.

#### **4.1. Financial Issues Faced by Client**

Financial issues faced by the client was found as a most contributing cost variation factor with AI value of 4.18. Client faced financial issues due to a shortage of funds from the government. Construction activities remained suspended if the client delays the payment process to contractor then subsequently which leads to projects to the cost overrun [16].

#### **4.2. Slow Information between Parties**

Communication between parties who are involved in construction projects must be very strong for successful completion of the project. But unfortunately, it has been observed that due to slow information between parties many construction projects have faced the crucial problem of cost variation [9].

#### **4.3. Change in Price of Material**

Change and fluctuation in materials price was found as one of the contributing and critical factor of cost variation in the construction of highway projects. Price and rates of materials are decided in the initial phase of planning of each construction project. Prices and rates of materials changes from the initial stage of the project up to its completion. This variation and changes in price and rates of material lead towards cost overrun in construction projects [17].

#### **4.4. Delay in Design**

Appointment of inexperienced staff in consultant which is unable to finalize the design of project on time leads a project to cost overrun. Due to delay in design, many construction activities remained suspended and which causes cost variation [18].

#### **4.5. Poor Site Management**

Poor site management at site factor arises when construction activities at the site are not well managed and organized by staff and site engineers. Poor site management expressions the staff appointed by the contractor is incompetent at the site [10].

#### **4.6. Payment Problem Faced by Contractor**

Payment and cash problems faced by the contractor was also one of contributing cost variation factor in building projects. It is fact that contractor contributes his important role from initial stage to final stage of the project. Construction activities remain suspended due to payment problem faced by the contractor which leads a project to cost overrun [19].

#### **4.7. Delay in Decision Making**

Whenever the decision of construction activities are not decided on proper timing which may affect the overall performance of the project. Consultant, contractor and client are the main players of all projects. Delay in taking a decision by these main players causes the cost overrun in construction projects [20]. Delay in decision making for approval of materials, consent of drawings, as well as approval of specification of different items, leads towards of cost variation in the construction of highway projects.

#### **4.8. Natural Disaster**

Natural disaster like heavy flood, heavy rains are known as a contributing cost variation factor in the construction of highway projects. Floods and rains affect the performance of projects to complete the approved cost of the project. Natural disaster which is one of major factor which contributes to cost overrun [21].

### **5. Comparison with Previous Research**

The contributing cost variation factors found through the conducting survey among the selected respondents involved in highway projects in Sindh are compared with the identified factors in previous studies of factors in other countries. Table 2 shows a comparison between top eight contributing factors from the conducted survey and from the previous studies.

**Table 2. Comparison of factors**

| Survey Results                          | Rank | Previous Research                | Rank |
|---|------|----------------------------------|------|
| Financial issues faced by the client    | 1    | Weather Effect                   | 1    |
| Slow information between parties        | 2    | Poor planning                    | 2    |
| Change in material price                | 3    | Shortage of material at the site | 3    |
| Delay in design                         | 4    | Shortage of labour               | 4    |
| Poor site management                    | 5    | Delay in decision making         | 5    |
| Payment problem faced by the contractor | 6    | Late delivery of equipment       | 6    |
| Delay in decision making                | 7    | Fluctuation in material price    | 7    |
| Natural disaster                        | 8    | Design changes                   | 8    |

The comparison between a survey of this study and previous study is moderately similar. Findings show that delay in design and design changes are the most similar contributing factors of cost variation. Similarly, factor of natural disaster is in this study and in the previous study is found similar. It is fact that heavy rains, floods and earthquake affects the construction activities at site [22]. Likewise, change in the price of material is also found in this research as well in previous research. Changes in the cost of different items of the project lead the project for the problem of cost variation. However, poor planning, shortage of material at the site, shortage of labour and late delivery of equipment were found as contributing factors in previous studies.

## 6. Conclusion

A project is known as successful when it is completed within the approved budget. However, issue of cost variation is still facing construction industry worldwide. Previous research helped to recognize the 64 common factors of cost variation in the construction industry. A questionnaire was designed on based of identified common factors and a questionnaire was distributed among 28 well-experienced respondents of the client, consultant and contractors involved in highway projects to explore the contributing cost variation factors in the construction of highway projects in the region of Sindh province. Collected data were analyzed by average index value and findings were that Financial issues faced by the client, Slow information between parties, Change in material price, Poor site management, Payment problem faced by the contractor, Delay in decision making and Natural disaster were identified as a contributing cost variation factors in highway projects of Sindh province. Findings of this research also showed that the contributing cost variation factors identified by selected by experts are quite similar to the previous studies.

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