Components of Cost Overrun in China Construction Projects

Shaiful Amri Mansur¹, Rosli Mohamad Zin² and Liu Linbo³
¹ Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Malaysia, Senior Lecturer, shaifuamri@utm.my
² Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Malaysia, Associate Professor, roslizin@utm.my
³ Faculty of Civil Engineering, Universiti Teknologi Malaysia, 81310 Skudai, Malaysia, Masters Student, guailinbo@gmail.com

ABSTRACT

This paper concerns an investigation into the causes of cost overrun in the construction industry of China. Cost overrun is common in all the countries of the world. For example, China has been experiencing severe cost overrun problem in the construction industry. The aim of the paper is to evaluate the major factors giving impact on cost components including labour, material, equipment and subcontractor. General factors that caused cost overrun in construction projects were obtained from literature review. The first questionnaire was designed to identify severity of factors for each cost component. The second questionnaire was designed to obtain the average proportions of cost components and cost of each top-ten factors for each cost component. The survey findings indicated that low productivity of labour, escalation of material prices, high cost of machineries and cash flow, and poor financial management are possible causes related to cost overrun in construction project of China as compared to other factors.

Keywords: Cost management, Cost overrun factors, Construction projects, China

1. INTRODUCTION

1.1. Background of Study

With the development of the national economy of China, construction industry plays a very important role in the whole economy. So et al. [1] concluded that the normal growth of the construction industry can drive the growth of the nation macro-economic and vice versa, through analysing the relationship between GDP of Hong Kong construction industry. Chui and Bai [2] revealed that the construction industry is very important to the growth of the national economy because it has an impact on nearly every aspect of the economy. However, with the development of construction industry, the projects are becoming more complex and highly monitored by client. Therefore, construction industry is facing a higher risk of cost overrun.

Cost overrun provides the construction industry a bigger challenge because of tight monetary relationship with national economy. Therefore, improving construction cost efficiency would certainly contribute to cost savings for a country [3]. Cost management is important to avoid cost overrun, which benefits the construction industry, and then benefits the national economy. Okpala and Aniekwu [4] stated that construction implementation is the final phase of the construction processes which include project conception, project design, and project construction. It creates the physical form that satisfies the conception and permits the realization of the design. Therefore, project construction operation is a critical phase to avoid cost overrun through controlling the cost. This paper focus on the causes of cost overrun during project construction phase.

In construction phase, budgeted cost is a major component of the project cost management and it reflects product value. Budgeted cost plays an important role for properly arranging basic construction plan, strengthening project cost management and ensuring the best efficiency of
construction funds. The problem of cost overrun, not only reducing the construction project investment returns, but also leading to the state of infrastructure investment become seriously out of control. Cost overrun has become a challenge in the construction industry worldwide, because it was leading projects to various claims. Hence, improving cost management is very important. In order to achieve the project objective completing within the budget, the construction industry should adopt innovative management techniques, team building and value engineering [3].

1.2. Problem Statement

It is widely accepted that a project is considered successful if it can be completed within the budget, on time, and in accordance with specifications and stakeholder satisfaction [5]. Therefore, achieving a total project cost that is within the budget is one of the most targeted criteria of a successful project. Most companies have various strategies to manage construction cost, in order to reduce the risk of cost overrun.

For the past several decades, because of size, complexity and high demand by client, construction project objectives of quality, cost and time are difficult to achieve. Previous studies show that most projects were completed exceeding their stipulated budget [6]. Cost overrun may create significant financial risk to both contractors and owners. In spite of the risks involved, the history of the construction industry is full of projects that were completed with significant cost overrun. Although contractors are using guidelines for monitoring and controlling construction cost, they are still facing cost overrun problem. Commonly, contractors would use their profit to cover cost overburdens, but cost overburden can offset their profits easily. Therefore, it is very important to identify project cost overrun major components in order to manage and reduce its impact.

This study evaluates major components that cause cost overrun in construction projects of China, in order to reduce the impact of cost overrun and take proper actions to minimize the associated risks. This research can be used as a guide for contractors to plan for problems associated with cost overrun. In addition, this paper presents the significant differences among different project cost components in China.

1.3. Aim and Objectives

The aim of the study is to evaluate the cost component that cause cost overrun in the construction industry of China. The objectives of this study are:

1. To identify the general factors that can cause cost overrun in construction project.
2. To analyse significant differences among different components of cost in construction industry of China.
3. To evaluate the importance of the factors that cause cost overrun in construction project of China.

1.4. Scope of Study

A few considerations have been taken while carrying out this study. The study covers poor cost performance in construction project in terms of cost overrun in China. The data collection referred to experienced contractors in construction project. The type of project includes residential, industrial, and building constructions. The study covers direct cost components, namely, labour, material, equipment, and subcontractor. As data gathering mechanism, two questionnaire surveys were performed in this study. Questionnaires were delivered respectively to 100 respondents who are residing in Guiyang and Ningbo areas in China.
2. Literature Review

2.1 Definition of Cost Overrun

Love et al. [7] stated that the definition of actual construction cost is the accounted cost at the time of completion of the project. Cost overrun happens when unanticipated increases in a budgeted cost happened because of some factors such as high machinery maintenance cost. Cost overrun has long been identified as the principal factors leading to the high cost of construction [4][8]. In other words, cost overrun is the final construction project accounted cost that is higher than the cost estimation prepared and released during initial planning, preliminary engineering, detailed engineering, procurement, or even at the start of construction.

2.2 Cost Performance Indicator

A cost performance indicator is an indicator for measuring the efficiency of actual construction work cost compared to planned cost. It is used to measure the performance of contractors during the execution of a project [9]. For example, cost performance can be measured through a Cost Performance Index (CPI) computed as [10]:

\[ CPI = \frac{BCWP}{ACWP} \]  

where,

\[ BCWP = \text{Budgeted Cost of Work Performed} \]
\[ ACWP = \text{Actual Cost of Work Performed} \]

From the equation: if CPI = 0, it means, the cost was as planned (at the budget value); if CPI > 1, it means, the project was below its budget; if CPI < 1, it means, the project exceeded its budget. Therefore, if CPI < 1, cost overrun has happened in the project. It is important to identify the causes that lead to the cost overrun, in order to take action and control the cost.

2.3 Factors of Cost Overrun

Contractors normally concern about the project cost running beyond control. Cost will affect contractors profit, which is one of the major criteria of success. In recent years, lots of professional articles have been written about construction cost issues worldwide. Numerous causes of project cost overrun were identified, such as escalation of material prices, labour cost, equipment cost, contractor lack of experience, and poor project site management and supervision [11].

For different countries, major factors that cause construction cost overrun may differ from those found in previous studies. Past researchers have also studied these factors from various perspectives. For this study, twenty-five factors were identified from literature review and used as the primary data in the questionnaire.

2.4 Percentages of Cost Components from Other Countries

Construction project costs consist of mainly direct costs and indirect costs. This study focus on the direct cost, that normally include labour, material, equipment and subcontractor cost. Findings from other countries were use with primary data to do the comparison between China and other countries. Previous studies showed that the proportion of labour cost was between 30 – 50% in
Kuwait [12], material cost was 37.7% in Gaza Strip [3], equipment cost was between 35 – 50% in the United Kingdom [13], and subcontractor cost was 18.9% in the United Kingdom [14].

3 RESEARCH METHODOLOGY

Previous literature provided the basis for the questionnaire survey used. In order to avoid extreme results from respondent residing in very small towns or very big cities, it is better to choose moderate cities to reduce biases. Guiyang and Ningbo were selected to be the cities that the questionnaires were distributed, because both of these are moderate cities (Figure 1). In order to achieve the aforementioned aim and objectives, the study was broken down into four main phases.

Phase 1: Identifying general cost overrun factors from previous studies. Forty-three general cost overrun factors were identified through literature review, which are believed to affect project cost performance. They were listed under four groups that is labour, material, equipment and subcontractor.

Phase 2: Distributing Questionnaire I to the contractor respondents in Guiyang and Ningbo of China. A questionnaire survey was used to elicit the attitude of contractors towards the factors affecting cost performance of construction projects in China. The respondents were asked to indicate, the level of importance of each one of the identified forty-three factors based on their local experience in the four groups (labour, material, equipment and subcontractor), based on a five-point Likert scale (i.e. totally disagree, disagree, indifference, agree, totally agree). Through analysing the data from the returned respondents of Questionnaire I, the top-ten (most important) cost overrun factors of each group are identified and used in Questionnaire II.

Phase 3: Distributing Questionnaire II to contractors in Guiyang and Ningbo of China. There are two parts in Questionnaire II: Part A: the contractors were asked about proportions of cost components based on their experience, Part B: the contractors were asked about the percentage of top-ten relative important factors of each cost components.

Phase 4: Comparing different cost components and evaluating relative important cost overrun factors for each cost component.

![Figure 1: The Locations Of Questionnaire Distributed in China](image)

The Relative Importance Index method (RII) was used to determine contractors perceptions towards the identified cost overrun factors. The RII is used to rank different causes of cost overrun.
The RII value has a range between 0 to 1 (0 not inclusive), where the higher the value of RII, the more important is the cause of cost overrun. The RII was computed as follows [11][15][16][17]:

$$\text{RII} = \frac{\sum W}{A \times N}$$  \hspace{1cm} (2)

where,

- $W$ = weighting given to each factor by the respondents and ranging from 1 to 5;
- $A$ = highest weight in rating (i.e. 5 in this case);
- $N$ = total number of respondents

In order to determine the average percentage of each direct cost components and top-ten relative importance factors of each cost component including labour, material, equipment, and subcontractor, the following mean value formula was used [18]:

$$X = \frac{\sum X_m}{N}$$  \hspace{1cm} (3)

where,

- $X$ = average percentage of direct cost component given by respondents;
- $X_m$ = percentage of direct cost component given by respondents;
- $m = 1, 2, 3\ldots N$;
- $N$ = total number of respondents

4. RESULTS AND DISCUSSION

Based on the first questionnaire, the summary of RII and rank for factors affecting the cost performance of construction projects are shown in Table 1. The most important factors that cause cost overrun in construction projects of China were obtained by analysing Questionnaire I. For further demonstrating that the top-ten factors of each group are actually more important than other factors, Questionnaire II was used to get the average proportions of each cost component and cost of each top-ten cost overrun factor from each group. Table 1 illustrates the top-ten factors affecting the cost performance of construction projects and each proportion of them according to the perception of contractors to the four cost components.

| Group 1: Labour-related Factors    | RII  | Rank | Percentage |
|-----------------------------------|------|------|------------|
| Low productivity of labour        | 0.938| 1    | 2.68       |
| Improper planning                 | 0.925| 2    | 9.48       |
| Lack of skilled labour            | 0.900| 3    | 1.12       |
| Shortages of labour               | 0.888| 4    | 1.08       |
| Information and Communication     | 0.875| 5    | 0.90       |
| Lack of experienced and qualified staff | 0.850| 6    | 0.82       |
| Inadequate contractor experience | 0.838 | 7 | 0.81 |
| Poor site management and supervision | 0.813 | 8 | 0.73 |
| Labour cost | 0.788 | 9 | 0.68 |
| Project management and contract administration | 0.750 | 10 | 0.61 |
| **Group 2: Material-related Factors** | | | |
| Escalation of material prices | 0.938 | 1 | 2.26 |
| Material quality issues | 0.925 | 2 | 15.20 |
| Poor site management and supervision | 0.900 | 3 | 1.52 |
| Shortage of materials | 0.888 | 4 | 1.35 |
| Project materials monopoly by some suppliers | 0.875 | 5 | 1.28 |
| High level of quality requirement | 0.850 | 6 | 0.88 |
| Delay in delivery of materials on site | 0.825 | 7 | 0.82 |
| Rework due to error in construction | 0.813 | 8 | 0.76 |
| Improper planning | 0.800 | 9 | 0.69 |
| Lack of experience and qualification staff | 0.788 | 10 | 0.58 |
| **Group 3: Equipment-related Factors** | | | |
| High cost of machineries | 0.925 | 1 | 10.60 |
| Rework due to error in construction | 0.913 | 2 | 2.28 |
| Lack of experience and qualification staff | 0.888 | 3 | 1.83 |
| Equipment breakdown | 0.875 | 4 | 1.45 |
| Poor site management and supervision | 0.838 | 5 | 1.16 |
| Equipment and tools shortage | 0.825 | 6 | 0.89 |
| Project schedule changes | 0.800 | 7 | 0.86 |
| Mistakes in design | 0.750 | 8 | 0.79 |
| Delay in completion | 0.725 | 9 | 0.71 |
| Unforeseen condition | 0.713 | 10 | 0.68 |
| **Group 4: Sub-contractor-related Factors** | | | |
| Cash flow and financial difficulties | 0.925 | 1 | 0.74 |
| Poor financial management of subcontractor | 0.913 | 2 | 0.70 |
| Information and communication | 0.900 | 3 | 0.65 |
| Poor site management and supervision | 0.875 | 4 | 0.60 |
| Improper planning | 0.863 | 5 | 0.52 |
| Project management and contract administration | 0.850 | 6 | 0.48 |
| Rework due to error in construction | 0.825 | 7 | 0.45 |
Lack of skilled Labour          0.800  8  3.45
Inadequate subcontractor experience          0.788  9  0.36
Lack of experience and qualification staff          0.775  10  0.19

The average percentages of labour, material, equipment, and subcontractor costs to the total construction component costs are 22.5%, 30.5%, 24.8%, and 10.2%, respectively. Comparing to other countries, labour cost in China (22.5%) is lower than in Kuwait; material cost in China (30.5%) is lower than in Gaza Strip; equipment cost in China (24.8%) is lower than in the U.K.; and subcontractor cost in China (10.2%) is also lower than in the U.K. There are two situations that can be inferred here: firstly, if the size of the projects were smaller in China than the other countries, the lower components cost in China is totally predictable; secondly, if the size of projects were equivalent or bigger in China and other countries, the reason for lower components cost maybe because of better cost management in China than the selected other countries.

The average percentage of material cost is 30.5% of total construction cost, which is the highest cost. The factors listed in Table 1 have been ranked according to most important factor by contractors. Because of extraordinary social factors in China, there are great difficulties to get materials, especially because project materials are monopolized by specific suppliers. Any delay in the supply of materials to the site is usually treated as poor management by the contractor. On the other hand, failure of supplying materials actually causes the contractor to lose valuable time which may lead to delay and increase risk of cost overrun.

Table 1 also indicates the high importance of equipment to finish the project on time. Shortage of equipment cause many problems such as dependant on labour instead of equipment, high repair cost, lack of required productivity and difficulty of execution. Labour resource management is also an important aspect that requires serious consideration during project development.

The lowest proportion is subcontractor cost, which accounts for only 10.2% of the total cost. This might be the result of adopting traditional procurement method by most projects in China, because of the "cheaper is better" mentality among the general contractors. This creates the tendency to seek out the lowest cost of subcontractors in the given market and compromises the quality of construction. It can lead to serious disputes involving quality of final product, in addition to unnecessary increase in cost, which may lead to cost overrun.

5. CONCLUSIONS

In conclusion, there were forty-three general factors identified from previous studies as the plausible causes of cost overrun in construction projects. They were group as labour-related, material-related, equipment-related and subcontractor-related factors. There were significant differences among the different components of cost in the construction industry of China.

The study showed that material cost is the highest component, which is followed by equipment, labour and subcontractor cost, respectively. They range from 10% to 30% of the total cost. The study also found that the average top-ten cost items for labour, material, equipment and subcontractor are between 79% to 86% of each component cost. This demonstrated the top-ten cost items for each cost component are indeed the main contributors to cost overrun in construction project of China as compared to other factors.
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