Taxonomy Formulation for Factors Affecting Cost Overrun in Sri Lankan Construction

D. C. L. G. Rodrigo and S. N. Malkanthi
Department of Civil and Environmental Engineering
Faculty of Engineering
University of Ruhuna
Hapugala, Galle
SRI LANKA
E-mail: snmalkanthi@cee.ru.ac.lk

Abstract: Cost overrun which is meant as exceeding the final cost of the project than the original estimate of the construction project leads to profit reduction or losses. Hence, identifying the most critical cost overrun factors is essential. This study is aiming to distinguish the factors affecting cost overruns in Sri Lankan construction industry. Mitigating measures for cost overrun have been proposed with the severity of the cost overrun factors. Qualitative analysis was done through questionnaire surveying choosing 76 respondents as 38 from each of contractor and consultant. All respondent’s represented engineers or quantity surveyors who have immense experience in the construction industry. For data analysing purpose, Relative importance index method was used. Two taxonomies were developed separately considering opinions towards cost overrun phenomena by contractors and consultants. In both taxonomies, the most critical category was contractor related cost overrun factors and the least critical category was an external cost overrun factors. Among all 42 cost overrun factors, Poor site management, Poor allocation of labours, lack of coordination between construction parties, Problems with availability of labour, material and equipment and unrealistic schedules have ranked as the most critical cost overrun factors.

Keywords: Cost overrun, taxonomy, relative important index, mitigating measures.

1. INTRODUCTION

The construction industry in any country plays a major role in the economic development among the other major sectors and it contributes to generate employment in the country. Therefore, success or failures in this sector directly affect the national income of the country. Main aspects of a construction project are quality, time, and cost. Successful completion of a project should be within the anticipated budget, fixed time, and expected quality targets. However, it is very rare a project is completed within these limitations. Through the above main factors, the cost can be identified as the driving force of the project since each source which leads a project to a final destination mainly depends on money.

1.1. Significance of the research

As a developing country, Sri Lanka is facing severe problems encountered due to cost overrun. Although the personnel in a project know what factors are affecting cost overrun, they are having a minor idea about the importance level of the factors affecting cost overrun. As the final output of this research, major personnel of a project; client, contractor, consultant can have a clear idea about what are the major factors affecting cost overrun in the construction industry and the least to the most importance of them. This target is achieved by taxonomy formulation by major contributors affecting cost overrun in Sri Lankan construction industry. Through taxonomy, set of data is classified with minor to the major importance level of factors, So, taxonomy depicts the factors that should be mostly focused to avoid cost overrun. Two taxonomies were developed considering different perspectives of contractors and consultants.

Role of a consultant is to provide expert advice to the contractor according to the clients’ needs while contractor actually performs the work by considering expert advice. Both roles are crucial in a construction project. Thus, perspectives of consultant and contractor will give a more impartial result for ranking of cost overrun factors.
In order to overcome cost overrun, mitigation measures are used. Through the literature review and prepared taxonomies, mitigation measures were introduced. So this research will be a guideline for construction projects. At the preliminary stage of the project, relevant circumstances for cost overrun can be identified then they can be avoided or minimized referring mitigation methods.

1.2. Objectives of the research

The aim of this research is preparing a guideline to minimize cost overrun in Sri Lankan construction industry. Following objectives are followed to achieve this goal.

- Identifying major contributors for cost overrun through the literature review.
- Preparing taxonomy for contributors of cost overrun.
- Proposing mitigating measures considering prepared taxonomy and the literature review.

2. LITERATURE REVIEW

The topic “Factors affecting construction cost overrun” has been explored by many types of research all around the world. Many of them have identified the factors in different areas: (a) building projects, (b) road projects, (c) bridge projects etc.

Cost overrun is a common phenomenon that can be seen in the construction industry nowadays. If the final cost of the project exceeds the original estimate, it is called cost overrun. In the developing countries, cost overrun is a prominent issue among cost-related issues. By conducting questionnaire survey on cost study in the United Kingdom, Olawale and Sun (2010) reported that many construction projects still suffer cost overruns. Only 41% of respondent participating in the survey experienced cost overrun less than 10% of their cost projects. This indicates about 59% of respondents experienced cost overrun more than 10%.

Haruna et al. (2016) used quantitative analysis method to find mostly affecting cost overrun factors in Nigeria. He used 16 cost overrun factors and they were evaluated by a questionnaire survey. Most of the respondents were having work experience within the range of 5-10 years. Fraudulent practice, improper planning, contractor’s lack of experience, lack of coordination between designer and contractor and poor site management were identified as critical factors for cost overrun.

Azis et al. (2013) conducted a research to find cost overrun factors in Malaysia. The final result was “contractor's site management” as most severe contributor under “information and communication” category of cost overrun and the least influenced category was financial management.

Polat et al. (2014) focused on factors affecting cost overrun in micro-scaled constructions. He conducted a literature review and 38 factors were identified. These factors were categorized into 7 major groups as Contract-related factors, Time-related factors, Cost-related factors, Quality-related factors, Human resource-related factors, Communications-related factors, and Risk-related factors. Scope for questionnaires was 136 micro-scaled construction companies. The survey results indicated that the design problems (i.e., design changes, constructability problems, delays in design approvals) are the most critical factor.

Subramani et al (2014) results showed that, slow decision making, poor schedule management, increase in material/machine prices, poor contract management, poor design/ delay in providing design, rework due to wrong work, problems in land acquisition, wrong estimation/ estimation method, and long period between design and time of bidding/tendering are the major causes of cost overrun.

Thejale et al. (2015) have come with 45 cost overrun factors through literature reviews and meeting with experts in the field and concluded shortage of materials and shortage of labour as the most critical factors.

Similar studies to find the factors affecting cost overrun have been carried out by many other researchers in various countries.
3. RESEARCH METHODOLOGY

The methodology is the process of achieving the expected objectives of the research. Most influencing sub-factors (49 Nos for time overrun and 42 Nos for cost overrun) were identified under different categories (8 Nos for time overrun and 7 Nos for cost overrun) with the help of previous literature and the preliminary questionnaires were prepared as an approach to the research. Prepared preliminary questionnaires were distributed among field expertise to get valuable comments prior to making of final questionnaires. After making of final questionnaires, the representative sample size was calculated as 38. Therefore, total of 152 responses was achieved as 38 for each perspective for time and cost overrun aspects.

Responses were analyzed by ‘Relative Importance Index (RII)’ method. The relative important index is a commonly used formula for data analysis. When considering the importance level of the time and cost overrun factor according to the respondents’ view, 5-point scale was used and RII was calculated.

\[ RII = \sum a \times \frac{n}{N} \]

Where,
RII = Relative importance index
\( a \) = Constant expression weight
\( n \) = Frequency of response
\( N \) = Total number of response

Here, \( N \) = 38, ‘\( a \)’ and ‘\( n \)’ are variables.

In 5 point scale, the importance level of the relevant factor as follows.
1 = not significant
2 = slightly significant
3 = moderately significant
4 = very significant
5 = extremely significant

Every sub-factor was ranked by RII method and main factors were ranked by using the average value of RII values of sub-factors included in the particular category. By looking at the finalized results, a set of guidelines were prepared.

4. RESULTS AND DISCUSSION

Information gathered through the questionnaire survey was analysed using Relative Importance Index (RII). Results were given under two themes. First, RII for all the individual factors were calculated. Based on the RII value for individual factors, significant cost overrun category was determined. Through this analysis method, most significant cost categories as well as most significant individual cost factors were determined.

4.1. Assessing cost overrun factors

Based on the relative index for individual factors, average RII value for each major cost overrun category was calculated to evaluate the most influencing cost overrun category. Table 1 shows the highest influencing sub-factors under each category from both contractors’ and consultants’ perspective. Table 2 shows the highest influencing factors from both perspectives, irrespective of the category.
Table 1 Highest ranked sub-factors of cost overrun in each main category

<table>
<thead>
<tr>
<th>Category</th>
<th>Perspective</th>
<th>Highest significant factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Related</td>
<td>Contractor</td>
<td>Lack of coordination at design phase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Delay in providing detail drawings</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Defective Design</td>
</tr>
<tr>
<td>Material Related</td>
<td>Contractor</td>
<td>Shortage of Materials</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Inaccurate quantity take-off</td>
</tr>
<tr>
<td>Client Related</td>
<td>Contractor</td>
<td>Delays in issuing information to the contractor during construction stage</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Additional work at owners request</td>
</tr>
<tr>
<td>Site Related</td>
<td>Contractor</td>
<td>Poor site layout</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Unknown geological conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unexpected site condition</td>
</tr>
<tr>
<td>Financial Related</td>
<td>Contractor</td>
<td>Lack of cost planning/monitoring during pre and post contract stages</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>high interest rates by bankers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lack of cost planning/monitoring during pre and post contract stages</td>
</tr>
<tr>
<td>External Related</td>
<td>Contractor</td>
<td>Inappropriate government policies</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Adverse effects of weather</td>
</tr>
<tr>
<td>Contractor Related</td>
<td>Contractor</td>
<td>Problems with availability of labour, material and equipment</td>
</tr>
<tr>
<td></td>
<td>Consultant</td>
<td>Poor site management</td>
</tr>
</tbody>
</table>

Table 2 Individual ranking of sub-factors

<table>
<thead>
<tr>
<th>Rank</th>
<th>Contractor’s Perspective</th>
<th>Consultant’s Perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Problems with availability of labour, material and equipment</td>
<td>Poor site management</td>
</tr>
<tr>
<td>2</td>
<td>Poor site management</td>
<td>previous experience of contractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poor allocation of labours</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lack of coordination between construction parties</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problems with availability of labour, material and equipment</td>
</tr>
<tr>
<td>3</td>
<td>lack of coordination between construction parties</td>
<td></td>
</tr>
</tbody>
</table>
## 4.2. Assessing major cost overrun factor categories

Based on the relative index for individual factors, average RII value for each major cost overrun category was calculated to evaluate the most influencing cost overrun category. Graphs were plotted considering both views of consultant and contractor.

![Figure 1 Major Cost Overrun Categories – Consultant's View](image1)

![Figure 2 Major Cost Overrun Categories – Contractor's View](image2)

According to the Figure 1 and Figure 2, category of contractor related cost overrun factors was selected as most influencing category for cost overrun while the category of external cost overrun factors selected as the least influencing one.
Finally resulted were presented as two taxonomies as shown in Figure 3 which gives a clear idea about the most significant cost overrun categories.

![Figure 3 Formulated Taxonomies](image)

### 4.3. Usage of taxonomies in construction industry

The proposed taxonomies can be used to make guidelines to mitigate cost overruns in construction projects. Following are proposed as important guidelines.

1. Effective site management and supervision with frequent progress meeting
2. Giving focus on capabilities and past performance of contractors
3. Enhancing the relationship among the client, contractor and consultant throughout the project period.
4. Performing a preconstruction planning of project tasks and resources needs
5. Enhancing coordination between administration and workers through frequent progress meetings - Comprehensive contract administration
6. Using actual value and earned value concept for cost monitoring in the project
7. Implementing mitigating measures to overcome contractor related cost overrun of the project.

### 5. CONCLUSIONS

Cost overrun is an essential topic to be researched as it directly influences the success of the project. In this research, 7 main categories of cost overrun factors were evaluated. As the final objective, all the seven factors were ordered according to the severity of them. Hence, two taxonomies were developed considering contractor and consultant. Most influencing category for cost overrun was selected as contractor related factors. Among all 42 cost overrun factors poor site management, poor
allocation of labours, lack of coordination between construction parties, problems with availability of labour, material and equipment and unrealistic schedules were selected as most influencing factors for cost overrun. This research will be a guideline for construction projects. At the preliminary stage of the project, most influencing circumstances for cost overrun can be identified and they can be avoided or minimized referring mitigation methods. As the final result depicts both views of contractor and consultant, impartial solution can be obtained

6. REFERENCES


