Severity Analysis Of The Factors Influencing Cost Overrun In Road Projects

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Abstract: Cost overrun appears to be a common occurrence especially in projects that involve high investments. This study investigated the cost performance in construction projects in Sri Lanka in order to identify the causes of cost overrun and their implications. A quantitative survey was performed for the targeted respondents namely employer, contractor and consultant involved in road projects in Sri Lanka. A total of 44 responses were collected from 50 sets of a questionnaire distributed. The respondents were asked to rate the listed causes on the basis of probability of occurrence and severity of the impact. The causes were ranked according to the degree of importance as responded by the target population. The findings of the study revealed that the majority of cost overrun factors with rating 6 out of 10 lie in medium severity impact zone. Results indicated that the major contributors to poor cost performance include external and material issues that have been elaborately discussed in this work. This research contributes towards best practice of cost monitoring.

Keywords: Cost overrun, Cost Monitoring, Road Construction

1. Introduction
A considerable progress has been evident in road construction in Sri Lanka within the past two decades. Most of the road projects have been financed from donor funds. The cost of finance is very high so that the return on investment is relatively low [1]. The growing rate of cost overrun and delays in the delivery of construction projects are the major criticism in the construction industries world over [2]. The construction sector in Sri Lanka holds the highest amount of private sector investment and has been the major driving force behind Sri Lanka’s recovery. The construction activities have great significance in achieving Sri Lanka’s socio-economic development which includes roads, highways, power systems, airports, townships, buildings and houses, urban infrastructure, schools, hospitals, offices, etc [3]. Despite the fact that the construction industry is an integral part of Sri Lanka’s national economy and its significant performance, the industry faces a considerable number of challenges and the construction performance and improvement have been underestimated. There are several factors which are responsible for cost overrun. However, construction projects are said to be successful if the main factors that contribute to cost overrun are identified and examined beforehand. Thus, this research attempts to identify the major causes of cost overrun in Sri Lankan construction industry that can be tackled at appropriate levels for improving the productivity of construction industry.

2. Research Aim
The aim of this research is to identify the factors influencing cost overrun specific to road construction projects in Sri Lanka.

3. Research Objectives
Objectives of the research are to;
1. Identify the basic factors of cost overrun in construction projects
2. Rank the severity of factors influencing cost overrun specific to road projects in Sri Lanka
3. Make recommendations to minimize cost overrun in road projects.

4. Scope and Limitations
The context is post contract cost management in roads sector. The study is limited to Sri Lankan projects. Under road construction, highways, bridges, flyovers and tunnels were not considered due to lack of information. Further, the research is limited to Grade “A” roads which are long distance facilitated with separate lanes, colour lights, electricity and water.

5. Literature Survey
Construction industry is a sector capable of making a direct impact on the social and economic aspects of a country [4]. Construction industry is the backbone of the socio-economic development of a country [5], [6]. A construction project has to be completed within its pre-determined budget, estimated time and at the required standards [7]. A construction project has to be completed within its pre-determined budget, estimated time and at the required standards [7] as its effectiveness depends on time, cost, quality and scope [8]. Many scholars have identified cost as the most crucial aspect of a project which is highly prone to variations [9]. Besides, there can be situations where cost is the only constraint in a project, in which case the other factors will have to be bundled within the variable ‘cost’ [10]. The inability to identify accurately the cost components makes it difficult to set cost limits initially. Unexpected cost encountered in an underestimated project is known as ‘cost overrun’ [11]. Cost overrun can be as high as 183% of the estimated cost [12]. Cost overruns are common [13]. The majority of construction projects in Singapore implemented during the last decade too have experienced cost overrun by more than 50% [14]. Cost overruns occur when changes are made to the planned base line, work scope and schedule [15]. Cost divergence to be a phenomenon rather than a perception [16]. Cost variance is a parameter that can measure the success of a project as cost overruns can have a direct impact on project progress. However, cost overruns are present even in construction projects that have been successfully completed [17]. This makes it essential to have a reliable and dependable mechanism of cost monitoring. Cost overrun can even lead to project termination [18]. Several researchers have identified factors that cause cost overrun in construction
projects; inflation due to economic conditions; availability of materials; project delays as a result of resource shortages and deficiencies in cost estimates [19]. The causes of cost overruns could be again due to low level of accuracy in the initial estimates (due to limited scope, incomplete drawings and unreliable cost information) and low level of competency in controlling risk itself [20]. With risk awareness, a project team will be in a safer position to mitigate the risk factors and closely estimate the project costs. In contrast, it is labour, material, financial constraints and equipment that mainly affect the project cost [21]. Payment delays, unpredictable weather conditions, inflation, low precision of the estimates, complexity of the project, inaccurate site investigation, insufficient experience of the contractors and unfamiliarity with the local regulations are the predominant causes of cost overruns in the Sri Lankan projects [1]. Labour has to be monitored to minimise cost overrun since the labour component has an impact on the cost of the project as confirmed by Cotton et al [22]. Poor management of the design is the primary source of cost variance and even time variance for that matter [23]. Wastage in the construction industry leads to delays, improper management, quality issues, poor constructability, lack of safety and poor transportation [24]. The method of resource handling has a direct influence on the project cost [25]. When there is a failure to define the scope of work of a project properly at the beginning of the project itself, a gradual and incremental change in the original scope of the work can happen over a period of time [26]. When features and functionality are added to a project scope with no control and without addressing their effects on time, costs, and resources a scope creep is said to occur which can silently contribute to cost overruns [27]. This expanded scope may require changes in the method of execution already planned. Besides, when the increase in the total scope is substantial, the contractor’s pricing strategies, technical approaches, and resource allocations can also get ‘flushed away’ with it [28]. When there is no comprehensive change management mechanism, this can escalate into a global claim for the disruptive events as the effects of the changes cannot be isolated or segregated according to the individual changes [29]. Factors causing cost overrun can be categorized as internal and external [30]. Changes in the project schedule, complexities in engineering and construction and other controllable factors are internal factors while local concerns and requirements, market conditions, impact of inflation and other factors that are not directly controllable are external factors. The foregoing warrants a proper cost control mechanism. Labour, material, financial constraints and equipment used mainly affect the project cost [21]. A considerable amount of the project cost has to be spent over the construction materials in road projects, hence material costs should be monitored accurately by reducing the wastage in particular [31]. Moreover, the labor component also impacts on project costs thus labour should also be monitored in order to minimise the cost overrun [22]. Monitoring is used to determine time and cost estimates by comparing planned and actual performance [15]. Cost monitoring has been defined as the comparison between the expected project values and actual project values [32]. Cost monitoring is essential in construction projects because cost considerations are significant to construction projects [17]. Moreover, the project is successful with the integration of the cost, time and quality factors [23]. Project cost is the parameter which decides the project success [17]. The most critical and important task which can maximise the profit is to maintain the well-established cost control system [33]. A very essential thing for cost controlling is the prediction of performance of the project for providing early warning of cost overrun. Then, corrective actions could be taken timely if actual value exceeds the budgeted value [34]. Cost monitoring provides the initial base for the cost controlling system in construction projects because it is a function of cost control [32]. Completing projects within the budget, on time by ensuring the quality is a universal objective [34]. A large number of cost data involves cost monitoring and standard and well established procedure ensures monitoring the process [33]. If the monitoring system can provide clear information, it improves the efficiency in cost controlling system. In a nutshell, objectives of the cost monitoring are to ensure the profit expected, carry out the project within predefined boundary of cost and time, carry out the continuous performance comparison and assist the future work [35]. The primary objective of the cost monitoring is to determine what has been occurred and what would be happened in the project by maintaining time, cost and scope boundaries [15]. Motivation is considered as the key factor to increase productivity [15]. Promoting opportunities, work satisfaction, incentive payments, giving responsibilities, job performances and good interrelationship are few drivers of labour motivation [36]. It was also reiterated that, procurement, weather conditions, new techniques, complexity of the project, site geography and rework are examples affecting labour productivity [36]. Furthermore, examples for organisational policies and leadership are ethical behavior of management, welfare conditions, training and site manager’s competency. Wastage in construction means time delays, improper management, quality costs, poor constructability, lack of safety and poor transportation [24]. The main reason for the cost overrun in road projects is wastage during heavy usage of raw materials [31]. Methods of resources handling is the factor which directly influence the project cost [25]. Even though the material and labour wastage is reduced, cost overrun can be due to heavy usage of plant and machineries. Perhaps, effective usage of construction plant and equipment can significantly impact on performance of the construction. Contractors have been struggling over the potentially substantial increase of the original contract scope in some exceptional cases [28]. Scope creep is also a silent contributor to cost overrun in road projects. Scope creep occurs when changes are allowed to the original project scope that is not controlled in any shape or form. It is also adding features and functionality (project scope) without addressing the effects on time, costs, and resources [28]. Road construction projects are more complex than any other type of construction projects [36]. Accordingly, the main cause for cost overrun in road construction projects is insufficient planning and project management. Construction risk, cost overruns and project delays are sources of risk associated with road projects [37]. Even though the project managers keep record about the labour involvement and material usage, they do not compare the records with the planned schedules [22]. The main reason for cost overrun in road projects is wasteage caused due to excessive usage of raw materials [31]. Factors of cost and time overrun in road projects are inadequate plant and equipment and materials [21]. On the other hand, disruption is also a reason behind cost overrun. In its simplest sense,
disruption is hindrance to actual progress thus reducing the output of construction resources, those being, primarily, labour and plant. Disruption results in loss of productivity that delays the work being carried out and not necessarily the scheduled completion. However it has a direct cost impact [28]. Road construction projects have the uncertainty of quantifying the actual cost for work quantity until the project ends [34]. The main reason for cost overrun in road projects is wastage that occurs when there is a heavy usage of raw materials and thus material costs, in particular, have to be monitored accurately [31]. Contractors face difficulties in certain instances when the original contract scope increased substantially [28]. For instance, the addition of just a few miles in a road project that has only few major items that are significant cost-wise such as excavation into embankment, asphaltling and road ancillaries, can increase the scope of the project by two to three times [39]. The requirement of monitoring the cost in road construction projects is much higher than other construction projects.

6. Research Methodology
A comprehensive sampling strategy was used to achieve the required number of respondents for significant statistical analysis. In order to achieve predictably, representative and strong quantitative data, the questionnaires were disseminated among the contractors, consultants and employers engaged in the road sector. A total of 50 questionnaire sets were sent out to 10 employers, 15 consultants and 25 contractors. Among those responded were 10 employers, 12 consultants and 20 contractors. The collected data were analyzed with the aid of descriptive tools of the statistical software i.e. Statistical Package for Social Science (SPSS 24). The descriptive methods used were mean, median and standard deviations. Before analyzing the data, the Cronbach’s alpha test was used to check reliability statistics of variables where reliability ranges from 0 to 1. The reliability of a scale is strongly dependent on the number of items comprising the scale. If the scale is long enough, even items with poor internal consistency may have a reliable scale [40]. Higher the values of Cronbach’s coefficient alpha, higher will be the degree of internal consistency. Normality test was also performed to check whether the data was normally distributed or not. To test the hypothesis and to determine the agreement of ranks among the respondents’ groups, Kendall coefficient of concordance (W) was used. At the last stage, non-parametric tests were used to check correlation of each group and individual variables.

7. Findings and Discussion
According to concordance test, the value of W for rankings of causes of cost overrun was found to be 0.198. The results are shown in Table 1. As per the result of the analysis, the p values was found to be less than 0.05, hence this verifies that the null hypothesis where “there is no agreement among the sets of rankings groups has to be rejected. Subsequently, the alternative hypothesis; i.e., “there is agreement among the sets of rankings groups” is supported with a confidence level of more than 95%.

<table>
<thead>
<tr>
<th>Causes</th>
<th>Mean</th>
<th>SD</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market vacillations</td>
<td>3.72</td>
<td>1.27</td>
<td>1</td>
</tr>
<tr>
<td>Corruption</td>
<td>3.70</td>
<td>1.34</td>
<td>2</td>
</tr>
<tr>
<td>Scope creep</td>
<td>3.69</td>
<td>1.04</td>
<td>3</td>
</tr>
<tr>
<td>Shortage of materials</td>
<td>3.68</td>
<td>1.20</td>
<td>4</td>
</tr>
<tr>
<td>Delay in sub-contractors work</td>
<td>3.67</td>
<td>1.45</td>
<td>5</td>
</tr>
<tr>
<td>Lack of pre-contract project coordination</td>
<td>3.61</td>
<td>1.13</td>
<td>6</td>
</tr>
<tr>
<td>Lack of skilled labor</td>
<td>3.57</td>
<td>1.31</td>
<td>7</td>
</tr>
<tr>
<td>Specification changes</td>
<td>3.52</td>
<td>1.22</td>
<td>8</td>
</tr>
<tr>
<td>Labour issues</td>
<td>3.49</td>
<td>1.20</td>
<td>9</td>
</tr>
<tr>
<td>Inadequate &amp; insufficient skill of labour</td>
<td>3.41</td>
<td>1.10</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 1: Coefficient of Concordance and significance level of causes of cost overrun

<table>
<thead>
<tr>
<th>Test Statistics</th>
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<tr>
<td>Kendall's W</td>
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<td></td>
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<tr>
<td>p value</td>
<td>0.198</td>
<td>0.0000000029</td>
</tr>
</tbody>
</table>

Top ten causes of cost overrun are listed based on the ranking of their average mean values and presented in Table 2. It is observed that the most frequent causes of cost overrun as per survey were “Market Vacillations” as 1st followed by “Corruption” as 2nd which falls in the range of high as per the assessment scale. Further, it is reported that “Scope creep” is 3rd, “Shortage of construction material required” is ranked 4th, “Delay in subcontractor's work” as 5th which is again with mean values of more than moderate and very close to high. Likewise, “Lack of pre-contract project coordination” is ranked 6th, “Lack of Skilled Labor” at 7th position, “Specification changes” as 8th, “Labour issues” as 9th and “Inadequate & Insufficient skill of labor” is at the 10th position. It is also observed that there is not much difference in the mean values of most variables. The causes and their mean values have calculated, analyzed and are tabulated below. SD is standard deviation.

8. Conclusions and Recommendations
This research attempted to investigate the cost overrun problems particularly for building construction projects in Sri Lanka. The probable reasons of cost overrun in road construction in Sri Lanka were reviewed through the literature assessment and a random sampling of the respondents was made and following conclusions from the study were drawn. With regard to cost overrun variables, the 10 most important factors were identified from each set of ranks. Based on the outcome of results the major reason behind cost overrun was found to be the market vacillations. This is an external cause beyond control of the parties. The
second is the corruption which is a manmade cause of cost overrun within the control if proper mechanisms set out and implemented. It is concluded that the causes of cost overrun fall mostly into the external, contractors, management and material related groups, which are seemingly involved in cost performance of any construction projects. The study also identified the frequency of experience of cost overruns in the construction projects in Sri Lanka and the survey result indicated that 6 out of 10 projects fall into this category. It must be noted that more specific and detailed studies on the causes of cost overrun and its effects are needed. The government and the related sector should be deeply committed to rooting out corruption to end the culture of impunity. This can be achieved through increasing the use of electronic payments and e-procurement.

References


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