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Planning & Mitigation Methods to Reduce the Project Delays in Sri Lankan Civil Engineering Construction Industries

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Abstract: A construction project is commonly acknowledged as a successful project when the aim of the project is achieved in terms of predetermined objectives of completing the project on time, within budget and to the required quality standard. Delay in the completion of a construction project can be a major problem for contractors, consultants as well as for clients. These delays lead to costly disputes and adverse relationships amongst project participants. Projects can be delayed due to large number of reasons. The reasons are related to various types of uncertainties associated with activities during the construction process or during the planning and design stages. Project delays in general are due to delays caused by the client, delays caused by the contractors/consultants and delays due to equipment/materials & environmental factors. The objective of this research was to identify the major causes of construction project delays in the construction industries in Sri Lanka and find out how planning and mitigation methods would minimize their impacts. This study was carried out through questionnaire surveys and interviews conducted within the construction industry professionals in Sri Lanka. It is expected that this study would identify project planning deficiencies in the construction industry and propose recommendations to rectify identified issues and thereby reduce project delays which would contribute towards sustainable construction.

Keywords: Construction Delays, Construction Planning, Project Delays, Project Planning

1. Introduction

A construction project is a high risk activity which must be managed effectively in all stages.

A project represents a unique set of activities that need to be completed to produce a unique product. The success of a product is judged by meeting the criteria of cost, time, quality, safety.

One of the most important problems that may occur in a construction project is delays and the significance of these delays vary considerably from project to project. Any disruption to a project's objectives will certainly contribute to project delays with its specified adverse effects on project objectives.

The causes for construction project delays are client related causes, contractor related causes, consultant related causes, material related causes, labour related causes, and equipment related causes and external causes. The effects of construction delays are acceleration of work, schedule change, delayed project completion, increased cost, liquidated damages etc.

Planning is the heart of construction project management. The planner must weigh the cost and the reliability of different options, at the same time ensuring technical feasibility. Construction planning is more difficult in same ways since the construction process is dynamic as the site and the physical facility change over time as construction proceed.

2. Literature Review

Several researchers have studied about the causes of the construction project delays in different countries. The findings of such studies have been reviewed for this research.

Frimpong et al (2001) had carried out the research on finding out delay causes in ground water construction projects in 2001 in Ghana as a case study. The objective was to study and evaluate the factors that contribute to delay and cost overrun in ground water constructions.

There were 26 factors affecting construction delays identified from the previous observations their relative importance index were determined.

Monthly payment difficulties from agencies, poor contractor management, planning and scheduling deficiencies, material procurement and poor technical performance were identified as major causes of delays. Identifying appropriate funding levels of the projects at planning stage, introducing training programmes to improve managerial skills of the contractors and introducing effective material procurement systems were suggested as mitigation activities.

Chan and Kumaraswamy (1997) did a survey to assess the relative importance of 20 potential delay factors in Hong Kong construction projects and five key factors were found, such as poor risk management and supervision, unforeseen site conditions, slow decision making, client-initiated variations, and work variations. However, Al-Momani (2000) in a research on construction delays in 130 public projects in Jordan found that weather, site conditions, late deliveries, economic conditions and increase in quantity are the critical factors which cause construction delays in Jordan construction industry.

Assaf *et al.* (1995) identified 56 main causes of delay in large building construction projects in Saudi Arabia and calculated their relative importance. Based on the contractors surveyed the most important delay factors were preparation and approval of shop drawings, delays in contractor's progress, payment by owners and design changes.

3. Objective and Scope

3.1 Objective of the study

i. Study the causes of construction project delays
ii. Identify methods to minimize construction project delays
iii. Propose proper project planning methods to avoid construction project delays

3.2 Scope of the study

The scope of the study was limited to Sri Lankan civil engineering projects such as Building, Roads/Highway, Irrigation, Water supply etc.

4. Methodology

To understand the current status of project delays and planning solutions in construction industry, the data collection was carried out through a questionnaire survey and a series of interviews. Preliminary survey was carried out through interviews and discussions to finalize the questionnaire.

The questionnaire survey included 107 nos. Sri Lankan construction projects. The questionnaire was divided into three main parts. Part one includes the details of the respondents and organizations in order to get the information about the respondent's details and organization as well. Part two included factors that cause construction project delays in Sri Lankan construction industry. This part is comprised of seven categories such as client, contractor, consultant, materials, equipment, labour and external factors.

Causes of delays by Client

- Delay in progress payments
- Delay to furnish and deliver the site
- Change orders by owner during construction
- Delay in revising and approving design
- Delay in approving shop drawing and sample
- Poor communication and coordination
- Slowness in decision making process
- Conflicts between joint-ownership of the project
- Suspension of work by client

Causes of delays by Contractor

- Difficulties in financing project
- Conflicts in sub-contractors schedule
- Rework due to errors during construction
- Conflicts between contractor and other parties
- Poor communication and coordination
- Ineffective planning and scheduling of project
- Implementation of improper construction
- Delays in sub-contractors work
- Inadequate contractor's work
- Frequent change of sub-contractors
- Poor qualification of the contractor's technical staff
- Delays in site mobilization

Causes of delays by Consultant

- Poor communication and coordination
- Delay in approving major changes in the scope of work
- Inadequate experience of consultant
- Mistakes and discrepancies in design documents
- Delays in producing design documents
- Unclear and inadequate details in drawings
- Insufficient data collection and survey before design
- Non-use of advanced engineering design software

Causes of delays by Material

- Shortage of construction materials in market
- Changes in material types during construction
- Delay in material delivery
- Damage of sorted material while they are urgently needed
- Delay in manufacturing special building materials
- Late procurement of materials

Causes of delays by Labour

- Shortage of labours
- Work permit of labours
- Low productivity level of labours
- Personal conflicts among labours

Causes of delays by Equipment

- Equipment breakdowns
- Shortage of equipment
- Low level of equipment operator's skill
- Low productivity and efficiency of equipment
- Lack of high-technology mechanical equipment

External causes of delays

- Effects of subsurface and ground conditions
- Delay in obtaining permits from municipality
- Weather effect on construction activities
- Traffic control and restriction at job site
- Accident during construction
- Changes in government regulations and laws
- Delay in providing services from utilities
- Delay in performing final inspection and certification

Part three included identified mitigation methods to reduce the impact of project delays.

- Proper project planning and scheduling
- Effective strategic planning
- Site management and supervision
- Collaborative working in construction
- Frequent coordination between the parties involved
- Frequent progress meeting
- Accurate initial cost estimates

The questions were based on the Liker's scale of five ordinal measures from 1 to 5 (very low effect to very high effect) according to level of contributing.

- Relative Importance Index (RII) was calculated.

$$RII = \frac{\sum w_i x_i}{\sum x_i}$$

Where:
i - Response category index
w_i - Weight assigned to i^{th} response (1, 2, 3, 4, 5 respectively)
x_i - Frequency of the i^{th} response given as percentage of the total responses for each factor

- The factors were ranked in each category based on the Relative Importance Index (RII)

5. Analysis and Results

5.1 Factors that contribute to construction project delays

All the causes of delays were ranked based on their Relative Importance Index as shown below.

Table 4.1: Ranking of Causes of Delay in Sri Lankan Construction Projects

Causes of delay	RII	Rank
Conflicts in sub-contractor's schedule during execution of project	3.27	1
Delay in progress payments	3.27	1

Weather effect on construction activities	3.22	3
Difficulties in financing project	3.21	4
Shortage of labour	3.20	5
Frequent change of sub-contractors	3.18	6
Low productivity level of labour	3.14	7
Delays in sub-contractor’s work	3.13	8
Rework due to errors during construction	3.13	8
Effects of subsurface and ground conditions.	3.08	10
Poor communication and coordination	3.08	10
Delay in material delivery	3.07	12
Delay in approving major changes in the scope of work	3.03	13
Personal conflicts among labour	3.02	14
Ineffective planning and scheduling of project	3.01	15
Change orders by owner during construction	3.01	15
Insufficient data collection and surveying before design	3.00	17
Slowness in the decision making process	3.00	17
Suspension of work by owner	2.98	19
Lack of high-technology	2.97	20
Inadequate contractor's work	2.94	21
Traffic control and restriction at job site	2.94	21
Delay to furnish and deliver the site	2.93	23
Shortage of equipment	2.92	24
Delays in producing design documents	2.92	24
Non use of advanced engineering design software	2.92	24
Equipment breakdowns	2.91	27
Delay in obtaining permits from municipality	2.91	27
Poor communication and coordination	2.91	27
Improper construction methods implement	2.90	30
Delay in approving shop drawing and sample materials	2.90	30
Late procurement of materials	2.89	32
Delay in manufacturing special building materials	2.88	33
Conflicts between contractor and other parties	2.87	34
Unclear and inadequate details in drawings	2.83	35
Delay in revising and approving design documents	2.83	35
Shortage of construction materials in market	2.82	37
Low productivity and efficiency of equipment	2.81	38
Work permit of labours	2.79	39
Poor communication and coordination	2.78	40
Changes in material types during construction	2.77	41
Poor qualification of the contractor's technical staff	2.75	42
Delay in providing services from utilities	2.73	43
Damage of sorted material while they are needed urgently	2.73	43
Mistakes and discrepancies in design documents	2.73	43
Delay in performing final inspection and certification	2.72	46
Inadequate experience of consultant	2.71	47
Low level of equipment-operator's skill	2.71	47
Changes in government regulations and laws	2.64	49
Conflicts between joint-ownership of the project	2.59	50
Delays in site mobilization	2.59	50
Accident during construction	2.40	52

5.2 Factors affecting construction project delays

Delay affecting factors were ranked based on their Relative Importance Index shown below.

Table 2: Ranking of delay affecting factors

Related Factors	RII	Rank
Labour	3.04	1
Contractor	2.99	2
Client	2.92	3
Consultant	2.90	4
Equipment	2.86	5
Material	2.86	6
External	2.83	7

5.3 Mitigation methods to reduce delays in Sri Lankan construction projects

Methods of minimizing delays are ranked based on their Relative Importance Index shown below.

Table 3: Ranking of mitigation methods to reduce delays in Sri Lankan construction projects

Minimizing methods	**RII**	**Rank**
Proper project planning and scheduling	3.97	1
Effective strategic planning	3.93	2
Collaborative working in construction	3.77	3
Site management and supervision	3.75	4
Frequent coordination between the parties involved	3.71	5
Accurate initial cost estimates	3.70	6
Frequent progress meetings	3.68	7

6. Conclusion

Delay in Sri Lankan construction projects is mostly originated by labour, followed by contractor and client, while external related causes are less important. Client and contractor specified that labour related causes as sources of delay. Conflicts in sub-contractors schedule, delay in progress payments, weather effects on construction activities, difficulties in financing project, shortage of labour, frequent change of subcontractors, low productivity level of labour, delays in sub-contractor's work, rework due to errors during construction and effects of subsurface and ground conditions are the top 10 major causes of delay in Sri Lankan construction projects. Proper project planning and scheduling and Effective strategic planning are the major mitigation methods to reduce construction project delays in Sri Lanka.

7. Recommendation

Continuous monitoring, financial controlling, labour management, revising schedule, material/ Equipment controlling and usage of planning softwares are the planning activities proposed to minimize and control delays in Sri Lankan construction projects.

The clients should pay special attention to minimize changes in order during construction so as to avoid delays, pay progress payment to the contractors on time as it weakens the contractor's ability to finance the work and speed up reviewing and approving of design documents. Consultants should focus on avoid delays in reviewing and approving design documents, build up the knowledge and skills of technical staff and improve coordination between parties. The contractors should give more attention to improve the knowledge and skills of technical staff and manage the financial resources and plan cash flow by utilizing progress payment.

More research on construction delays should be done in order to develop guidelines and planning activities.

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