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Cost of Time Delay and Financial Implication of Its Project Recovery in Construction Projects

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Abstract: An unexpected delay in a construction project will extend the overall duration of project activities and entails an increase in project costs. Once a project is troubled, a concerted effort is made to recover the project objectives as much as possible. The main purpose of this study is to identify the cost of delays and the implication of project recovery schedule on overall completion costs. A questionnaire review was performed to determine the key sources of delay from client, employee, and consultant views. Along with top ten most frequent factors of delay, the survey also focused on the mitigation recovery methods adopted on site by all the involved parties. Methods of project recovery shall be extended to the essential factors found which can speed up the development of delayed project. The end result is two-dimensional focusing on project recovery cost as well as types of mitigation adopted namely management and on-site approach.

Keywords **- Delay, Cost Overrun, Cost of Delay, Project Recovery.**

I. INTRODUCTION

With the foresight of achieving the primary objective of timely completion, construction projects are considered and visualized. Project delay is exceeded time either after the contract date or after the date on which the participating participants have agreed to deliver the project. (Kumar, 2016). Delays in terms of time, expense, quality and safety have an adverse effect on project performance. (Kumar, 2016) Building delay measures are not limited strictly to the construction industry but affect the overall economy.

The opportunity to execute a job is typically the key for the client and the contractor alike. This made it necessary for negotiating partners to evaluate project disruptions in order to make the correct choices on potential time and/or cost payout claims. (Braimah, 2013) Many public projects are extensions of a previous project, and inaccuracies in calculating project cost and construction period will result in inappropriate scheduling or phasing of similar projects within projects, thus delaying much needed improvements. (Pramen P. Shrestha, 2013)

According to the latest report for December 2018 released by the Ministry of Statistics and Program Implementation, out of 384 delayed projects, 113 projects have a total delay of 1 to 12 months, 61 are delayed by 13 to 24 months, 101 represent a delay of 25 to 60 months and 109 projects indicate 61 months and above. As stated by various project implementation agencies, the brief explanations for the time overruns are delays in land acquisition, forest clearing and equipment supply. In addition, there are other factors such as fund restrictions, geological shocks, geo-mining conditions, slow progress in civil works, labour shortages, insufficient contractor mobilization, Maoist issues, court cases, contractual issues, ROU / ROW (right of use / right of way) issues, law and order situation etc. This is a statistical concern which shows that construction projects are essentially laggards in the country's overall growth. Time and cost overruns were a major problem that affected the numerous projects in the sector.

II. FACTORS OF DELAY

Project delays are often the product of a mismanaged event / s and can be seen as a risk to the projects that can be managed or reduced. Such mismanagement is caused due to a number of reasons. A thorough literature study was done to identify these factors. A survey was conducted with a total of 30 correspondents. These stake holders were directly connected to the case project which was a renowned government of public sector. According to the survey top ten factors of delay were identified as - owner – initiated variation/ change orders, owner interference, delays of payments, weather, climate & rain effects on construction activities, poor site conditions (location, ground, etc.), poor communication and coordination between construction parties, delay in decision making, skilled labour shortage, unethical behaviors used by contractors to achieve the highest possible level of profit, slow permits by government agencies

III. Cost of Delay

Cost of delay (CoD) is a primary measure, reflecting the economic effect of a project implementation delay. It is a way of communicating the impact of time on the outcomes we hope to achieve. More formally, it is the partial derivative about time of the overall expected value. (Dolfing, 2019). Therefore, the cost of delay (CoD) should be calculated by taking into account the cumulative effect of the tangible and intangible costs of these programs. Tangible benefits comprise of revenue generating potential and earnings from property development. On the other hand, intangible benefit includes social, environmental, and other indirect benefits. The costs thus set will serve as the basis for mobilizing external capital and taking policy decisions in the best interests of net profits.

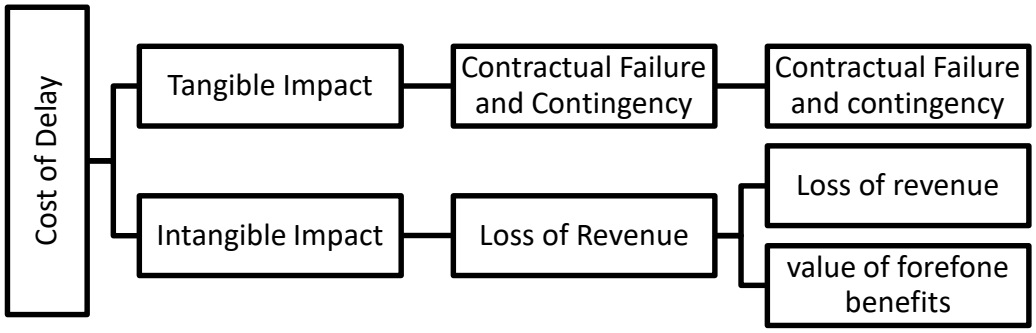

Figure 1 Economic implications of cost of delay

IV. Calculation of Cost of Delay

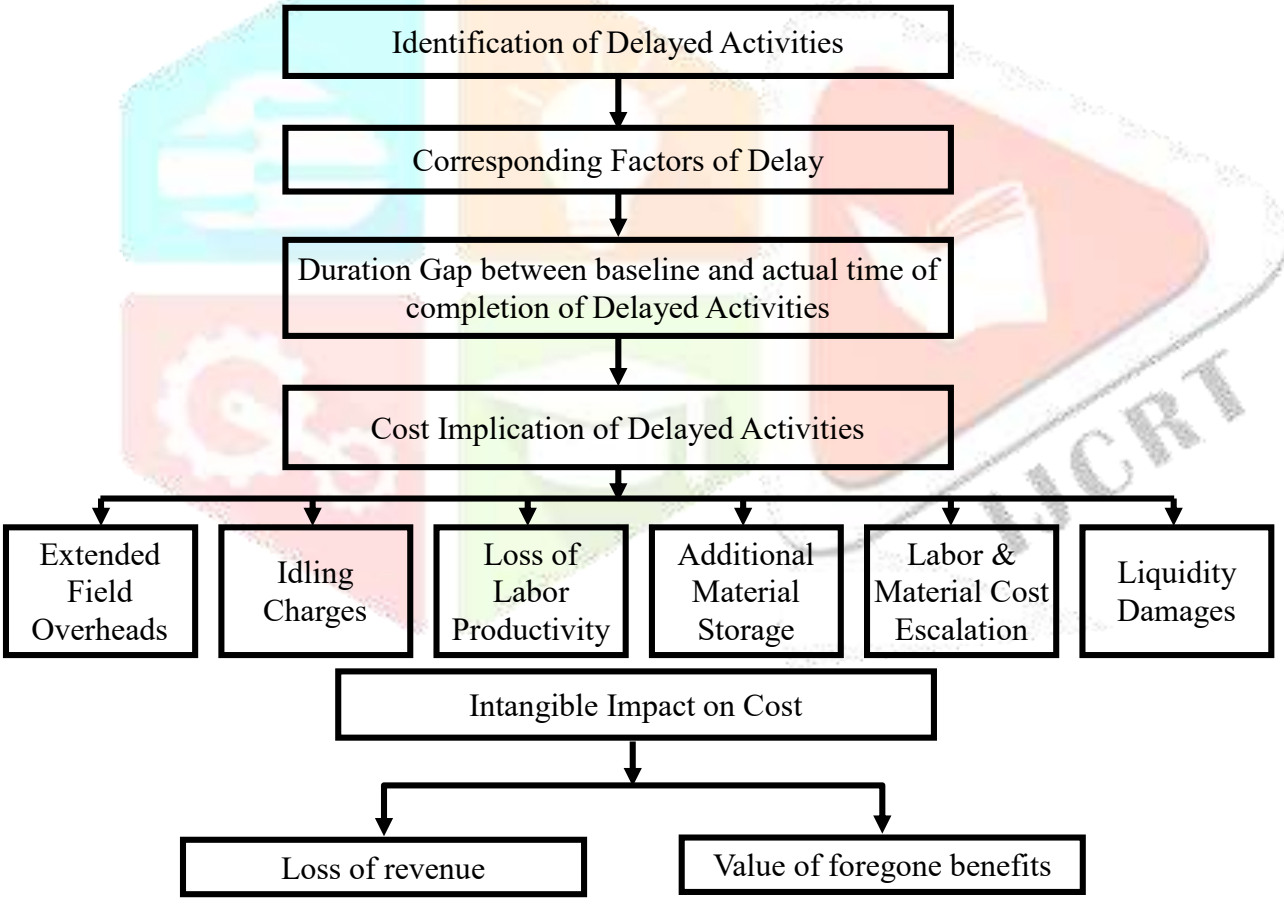

Figure 2 Calculation methodology of cost of delay

of the budget due to underestimation of the actual budgeting of costs. The difference between the cost at completion and the cost overrun that was originally projected, can be considered one of the most significant parameters representing project performance. Money spent on project change orders in the public sector results in increased construction time, which in effect limits the number and size of projects that can be completed in any given fiscal year (Nabil Al-Hazim, 2015).

The sections below show calculation of impacts of delay i.e. tangible and intangible for the selected case study project. The data for calculation of cost overrun and economic loss is referred from Bill of Quantities, Technical Due Diligence, DPRs, feasibility studies etc. In this study the delay-based cost overrun was calculated to be 35% of the total cost anticipated. This cost overrun is attributed to the factors of delay mentioned above.

Table 1 Calculation of tangible cost of delay

Extended Field Overheads		
S. No.	**Description**	**Equation Formulation**
1	Electricity consumption	Per Unit cost x Unit consumed/month= Monthly cost Cost/Day= Monthly cost/30 Cost of Delay=Delay Duration x cost/day
2	Potable water consumption	No of tank supply or No of water cans per day x Cost per tank or Cost per Can =Cost of water consumption per day Cost of Delay= Delay Duration x cost/day
3	Employees' Salary	Total Staff * Avg Salary/Day=Cost/Day Cost of Delay= Delay Duration x cost/day
4	Payroll and taxes	Taxes per month / 30= Cost/Day Cost of Delay= Delay Duration x cost/day
5	Workers' Insurance	Total Staff * Premium/365 = Cost/Day Cost of Delay= Delay Duration x cost/day
6	Accommodation and Food Expenses	Rent/Day + Food Expenses per day= Cost/Day Cost of Delay= Delay Duration x cost/day
Idling Charges		
7	Labour Idling Cost	Labour expertise * Total No of labour (Expertise based) * wages/day= Cost/day Cost of Delay= Delay Duration x cost/day
8	Machinery Idling	Cost Fixed Cost/day* Labour Cost/day * Operating Cost/day= machine Cost/Day Depreciation Cost= (Initial Purchase- Salvage value)/ Economic Life Cost of Delay= Delay Duration x Machine Cost/day
Loss Labour Productivity		
9	Loss of Prod. In Brick work	As described in section 3.7, DSR 2016
10	Loss of Prod. In R/F	As described in section 3.7, DSR 2016
Additional Material Storage		
12	Cost to Additional Material Storage	Rent of Storage space x loss of Material value / day x handling cost x Deterioration Cost = Cost/ Day Cost of Delay= Delay Duration x Cost/day
Labour and Material Cost Escalation		

13	Cost to Labour Escalation	Calculation of escalation/de-escalation section 33 based on CPWD works manual 2014
14	Cost to Material Escalation	Calculation of escalation/de-escalation section 33 based on CPWD works manual 2014
Liquidity Damages		
15	Direct % of LD	10% Max of Tendered Value

Source: (Seminar II, Evaluating the Cost of Delay to Contractors by Dipanshu Sharma, 2019)

Loss of Revenue

Revenue loss happens when it is due to external and internal causes that a company receives less from operations than anticipated. The loss of potential customers, industry constraints and market shifts can all contribute to significant loss of revenue. For the case project, loss of revenue can be rooted to membership charges, space rental charges from different types of spaces rented to general public for business like canteen, guest houses, auditoriums, bank etc. A template that can be followed for such space rentals are mentioned below in table.

Table 2 Intangible cost calculation of delay

Particulars	**Components**	**Quantification (Annually)**
Membership Charges	Library,	Number of members (Mn), Membership Charges (Mc) Mn x Mc = Rs. X (calculate for a month) (Multiply by 12 for annual charges)
Space Rentals	Legal aid Clinic, Canteen, Health Centre, Gym, Dispensary, Public Café, Bank, Restaurant, Post Office	Area of space (As), Rental Charge (Rc) As x Rc = Rs. Y (calculate for a month) (Multiply by 12 for annual charges)
Per day charges	Guest Room, Auditorium,	Number of rooms (Rn), Charges per day (Cd) Rn x Cd = Rs. Z (calculate for a month) (Multiply by 12 for annual charges)
Total Loss of Revenue in Rupees		**X + Y + Z**

Value of Foregone Benefits

If the date of completion of a project slips, the accrual of benefits shall be postponed proportionately. These schedule slippages also lead to increased costs due to further infrastructure degradation, prolonged delays and other operational disturbances, as well as price inflation. As the sum of a discounted source of foregone potential benefits, the increased operating costs incurred due to delays, and the cost increase due to inflation, the social costs of these schedule delays. It is imperative that policy makers and stakeholders clearly understand the magnitude of societal costs involved, and take serious steps to address the issues that lead to these delays. This includes developing workable, realistic funding solutions, as well as instituting effective project controls (Wu, 2012). In this study the percentage for the intangible cost can be articulated to 6% of total cost of delay.

Table 3 Intangible calculations of cost of delay

Particulars	**Quantification (Annually)**
Employment Cost	No. of Employees x Average Salary **(X)**
Training of Professionals	No. of professional trained x Average cost of training **(Y)**
Benefits from work done	Charges per work done **(Z)**
Total Loss of Revenue in Rupees	**X + Y + Z**

V. PROJECT RECOVERY AND ITS IMPLEMENTATION

When a project fails, the recovery process must begin immediately after it is brought to the attention of management. Early alert and project knowledge loss intervention are essential to a project's survival. Project recovery is the program and the activities associated with tackling failed projects. In other words, the actions that lead you to realize the project is in trouble, taking you to a decision point as to whether to save the project or not. Of example, if a project is behind schedule, there might be certain methods of schedule compression that can be used, but it will need to consider the budgetary impacts.

One of the first principles of project management is that unexpected problems can and do occur along the way, no matter how much planning is done for a project, and how these are handled is often what determines the success of a project. Here is where the project's turnaround strategy enters. The project's recovery plan is a map of direction from which project managers can steer a project back on track. Although the project recovery plan which differ depending on the type and nature of the project, there are several similar elements in all project recovery documents: an outline of where the project is currently located, a detailed summary of the problems or issues at stake, the design and description of the project recovery plan, and a list of project responsibility.

In order to minimize the financial loss to client & owner, brand image loss for contractor, project recovery is necessary for a delayed project. A troubled project can be described as a project where the gap between what is anticipated and what has been accomplished exceeds the appropriate limits of tolerance, pushing down a path which inevitably leads to failure.
By assessing the essence of the projects, we can conclude that every project is marked by a difficulty, be it because of its inherent complexity or its short or low-cost deadline. To this end, each project needs a higher level of supervision and management than normal responsibilities, requiring a separate effort from the project manager and his / her team several times over.

There can be numerous approaches to recover a delayed project. Firstly, the most used method is crashing of activity i.e. where the expenditure and the trade-off schedule are determined to assess the maximum amount of "compression" with the least expense. The approach recognizes the fact that only money can always solve the problem. The goal of crashing is to get the most time back for the least extra cost. Secondly, fast-tracking is also a widely used method. This is a schedule compression technique when performing tasks concurrently that would have been performed sequentially based on the initial schedule (in parallel or in part parallel). This technique is typically best started because fast tracking does not require extra energy.

VI. Framework for Project Recovery

To calculate project recovery cost of a delayed project, the responses from the stakeholders who were involved directly in construction project were considered as the first stepping stone. In order to achieve project recovery for a public sector government project it is essential to include every contingency that is involved with seeking permission and government agency in the upcoming schedule. The framework compares the respective factors of delay and the associated cost of delay with their corresponding project recovery response and the cost of recovery. The project recovery response is further divided into two major categories namely, management response and the on-site response. The key steps adopted to achieve the project recovery cost are as follows:

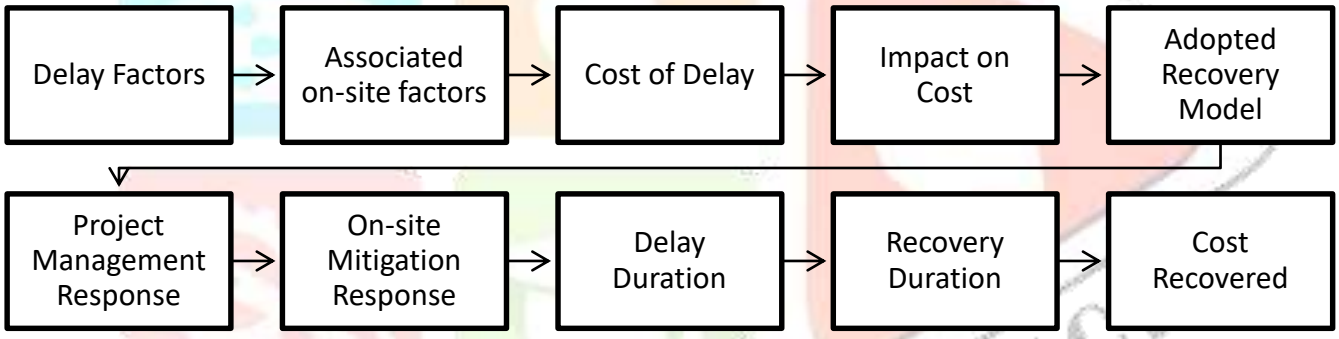

Figure 3 Methodology for project recovery framework

The decision-making process was affected due to involvement of multiple system contractors in the case project. To overcome this a hybrid method of fast tracking and activity crashing was adopted. Adopting clear information and communication channel, appointing experienced subcontractor with good reputation, conducting a process mapping exercise were some of the management responses implemented. Appointing of a competent contractor was the on-site method adopted. The location of the case project was in a high security premise. There was interference from local community comprising of prime government offices. Due to restriction in timings of movement of material carrier vehicles like trucks and trolleys which led to reduction in working hours. There was restriction in working hours of labours as well. To overcome these issues the management response implemented were adopting effective and efficient material procurement system, application of professional construction management systems, having enough resources to deal with the complexity, planning a time schedule for delivery process, quickly informing relevant parties when unforeseen circumstances affect the programme/ lead-in time. However, strict adherence to norms and guidelines pertaining to material transportation noise cancellation etc. to avoid any discomfort to local community, prior procurement of materials instead of just in time approach were some of the on-site approaches.

VII. RESULTS AND DISCUSSION

With the foresight of achieving the primary objective of timely completion, construction projects are considered and visualized. Construction projects sometimes suffer the consequences of a variety of factors that can go as far back as project inception through execution. A project's time to perform is usually the essence to both the employer and the contractor. This made it imperative for contracting parties to evaluate project delays in order to make the right decisions on future demands for time and/or expense compensation.
The initial part of the research aims at visualizing and analyzing the factors of delay in construction projects. However, it is oriented to government public sector projects because such projects are the ones that usually go through excessive delays due to the procedural issues and involvement of governmental agencies. A case example of Supreme Court of India which turned out to be a typical example government building of public sector. The project was delayed by approximately 1 year.

Factors of delay were studied, understood and evaluated in detail. After the literature study was done which brushed up and listed down the most common factors of delay. The most frequent factors were owner interference, delay in payments, external factors etc., amongst the top ten. A thorough study was completed to list down the factors which were further broken down to its associated construction activities. The latter part of the research deals with the project recovery of the same delayed case mentioned earlier. Questionnaire and survey were prepared which validated the study of factors responsible for delay. The stakeholders directly involved in the construction project also gave insightful knowledge of mitigation of delayed activities i.e. recovery responses to overcome time delay and cost overrun. The recorded responses were validated with studied project recovery measures.

Applicability of research framework

The research has attained the objective of establishing a continuity of framework which can be applied for various further research and data collection exercises. This continuum is interlinked and a series of steps is to be followed to calculate delay cost and project recovery cost. The first stage of framework is based on theoretical and on-site observations od delay factors which are used as basis to deal with quantification of cost of delay. This will deal with the tangible aspect of delay scenario in construction project. The second stage deals with quantifying intangible aspect. The calculation of loss of revenue and economic foregone benefits, however, will vary with different typologies of projects. But this research is mainly oriented towards public sector legal government buildings. The derived framework of this stage will deal with nuances of specifically of a legal building. The third stage lays down procedure of calculation of project recovery cost.

This comprehensive framework can be used for further researches with a similar ground for direct applicability for calculating delay and recovery cost. This framework can be used or is applicable for calculating the cost of delay and cost of project recovery by the contractor, owner and any stakeholder.

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