

Analyzing the Critical Factors Influencing the Time Overrun and Cost Overrun in Construction Project

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Abstract : Construction industry plays a vital role in socio-economic development of country and generates substantial employment. The issue of time overrun and cost overrun is a global challenge in construction industry. Time overrun is an unanticipated delay in construction project due to unavailability of adequate resources and other administrative problems. Similarly, cost overrun which involves unexpected cost incurred in excess of budgeted amounts due to under estimation of the actual project cost during planning of project. The objective of this study is to identify and analyze the critical factors influencing time overrun and cost overrun affecting the performance of construction project. In this study, different factors such as poor site management and supervision, problems with sub-contractors, inadequate planning and scheduling of project, problem associated with material management, lack of coordination among stakeholders etc. are discussed. The findings of this study indicate that Ishikawa diagram is an important tool which can be used to identify and analyze the cause and effect in delay related to labor, material and equipment's. Thus, it can help the project management for the smooth completion of project as per planned schedule and cost. Since materials accounts nearly 70% of total construction cost, therefore implementing effective material management is necessary for timely procurement and issue of an inventory to reduce delay due to shortage of materials. Resource smoothing and resource leveling can be adopted to optimize its utilization with zero wastage. Also this study suggests that modern project management tools such as MS project, Primavera, Newton software etc. can be employed to control the cost and time of construction project through effective monitoring of project schedule.

Keywords: Construction, Cost overrun, Project Management, Time overruns

I. Introduction

1. Construction industry plays a vital role in Indian economic development. It contributes to about 5-6% for gross domestic production and provides second highest inflow of FDI. Construction creates employment for more than 30million people by becoming the second largest substantial employment provider. It generates assets worth more than ₹200 billion. In infrastructure, amount of ₹55, 74,663crores are to be invested during the Twelfth Five Year Plan Period from 2012 to 2017.

For any project to be delivered successfully the criteria's such as completing projects on time, within the budgeted cost and the quality standard should be satisfied. Construction industry is the most complex and one of the dynamic industry with lot of uncertainties incorporated. This industry is continuously facing

the globally concerned issue of time overrun and cost overrun during the construction process.

Time overrun can be defined as the time required to complete the project work beyond the contract time. It often leads to disorder in workflow, budget overrun, contractual claims and reduces the productivity. The factors affecting time overrun are delay in execution, incorrect construction methods, insufficient funds, improper project feasibility, poor communication among the parties, poor supervision, underestimating the project completion time, shortage of materials and skilled labors, poor professional management etc. Cost overrun can occur due to wide range of causes depending on the type of project. It is very frequent phenomenal problems in many construction projects. Cost overrun is defined as the difference in cost between the final cost of a construction project at completion and the contract amount, agreed among the owner and the contractor during the contract.

II. Material and Methodology

A. Delay in Project

In construction projects, where the projects are to be executed according to the schedule to work the plan, delays are bound to happen most of the time. Construction delay is mostly due to miscommunication between contractors, subcontractors, and client. Delays in construction project leads to payment of extra charge interest for the loan taken. Due to delays in implementing the project, people have to unnecessarily wait for the provision of public the services and goods.

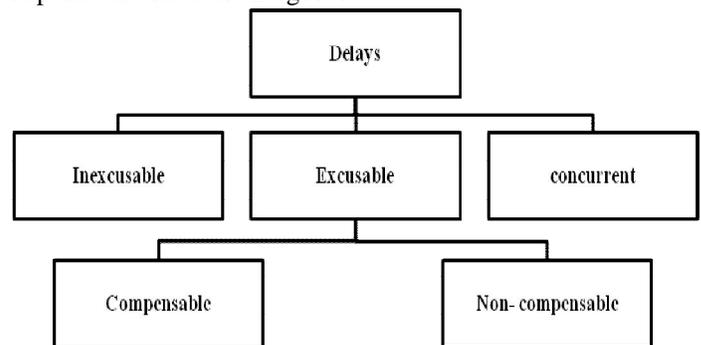


Figure 1: Types of Delays

Delays can be classified into two different categories with respect to liability: excusable and inexcusable (Fig. 1). Project delays are capable of being attributed to negligence on the part of contractor, which in many cases lead to penalty in payment. In inexcusable delay, contractor is responsible for the causes of delay and cannot obtain a time extension. Excusable delay can be further classified into compensable and non-

compensable delay. Compensable Delays are unforeseeable beyond the control of contractor, but the contractor is entitled to both time extension and additional compensation. It can be caused by the Government, direct changes, work suspension, constructive changes, and owner's failure to grant site access, changes in scope of work. In Non-Compensable delay, neither the owner nor the contractor is responsible for delay. Contractor is given time extension; however, he is not entitled to any additional monetary compensation such as in case of severe weather and acts of God. Concurrent delay occurs when two or more delays take place or overlap during the same time period, either of which occurring alone would affect the ultimate project completion date

B Time overrun

Time overruns occur when projects is not completed within the time the project plan specifies. This can occur due to many reasons. Time overruns leads to disruption of work and project productivity, disputes, late project completion, increase in time related cost and third party claims and abandonment or terminate of contract. Mathematical representation:

Net duration = Date of project commencement – Date of project approval

Time overrun = Net duration – Project duration

Various studies have investigated the causes for project time overruns on construction projects:

Mundie Muya, Kanyuka Mumbai (2009), Used a detailed literature review, structured interviews and questionnaire surveys to identify causes and effects of cost escalation and schedule delays in road construction. Results of the study confirmed that delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, economic problems, materials procurement, changes in drawings, staffing problems, equipment unavailability, poor supervision, construction mistakes, poor coordination on site, changes in specifications and labor disputes and strikes were found to be the major causes of schedule delays in road construction projects.

R.Sweis, A. Abu Hammad&A.Shboul (2008) concluded that most correspondents agreed that, financial difficulties faced by the contractor and too many change orders by the owner are the leading causes of construction delay. Severe weather conditions and changes in government regulations and laws ranked among the least important causes for delay in construction projects.

A questionnaire survey was conducted by Yau Wen Soon (2007) to solicit the causes and effects of delay from clients, consultants, and contractors. Out of 150 respondents, the study identified the 10 most important causes of delay from a list of 28 different causes and 6 different effects of delay. Ten most important causes were: (1) contractor's improper planning, (2) contractor's poor site management, (3) inadequate contractor experience, (4) inadequate client's finance and payments for completed work, (5) problems with subcontractors, (6) shortage in material, (7) labor supply, (8) equipment availability and failure, (9) lack of communication between parties, and (10) mistakes during the construction stage. Six main effects of delay were: (1) time overruns, (2) cost overrun, (3) disputes, (4) arbitration, (5) litigation, and (6) total abandonment. This study

has also established an empirical relationship between each cause and effect.

K. Al-Rashid & N. Kartam (2005) studied the Time-delays and cost-increases associated with the construction of private residential projects in the State of Kuwait. The three main causes of time-delays were found to be changing orders, owners' financial constraints and owners' lack of experience in the construction business. They stated that minimization of time delays and cost overruns in private residential projects would require: the availability of adequate funds, allocation of sufficient time and money at the design phase, and selection of a competent consultant and a reliable contractor to carry out the work.

Yaw Frimpong & Jacob Oluwoye (2003) observed that in groundwater construction projects, many variables affect construction schedule and cost overruns. The data was analyzed and ranked, based on the profession of the respondents and their roles in the industry (i.e. owners, contractors and consultants). The questioner survey concludes that all the three groups felt that project financing, micro-economics, natural conditions and materials factor categories play a predominant role in causing delay to groundwater construction.

In Saudi Arabia, Assaf and Al-Hejji (2006) conducted a field survey and identified seventy-three causes of delay. They found that only 30% of construction projects were completed within the scheduled completion dates and average time overrun was from 10% to 30% of the original duration.

Kumaraswamy& Chan (1998) studied time delays on Hong Kong projects and found that unforeseen ground conditions, poor site management and slow speed of decision-making were the most prominent causes of time delays.

Al-Khalil & Al-Ghafly (1999) studied public utility projects in Saudi Arabia and found that contractors considered „delay in claim settlement□, „slow decision-making□ and „delays in progress payments□ as the most important delay factors. Owners believed that „poor early planning□, „scope changes□ and „financial difficulties by the contractors□ were the major causes of delay. The consultants somehow supported the owners' views by indicating „financial difficulties by the contractor□, „improper contract knowledge□ and „ineffective planning□ as the most significant delay factors.

C. Cost overrun

Cost overrun occurs when the expenses required to complete a project, or one aspect of a project, exceeds the amount which is budgeted. This cost overrun is common in construction projects and can happen for any number of reasons. Any delay in completion of project makes the initial cost estimates obsolete leading to cost overruns. If budget overruns are not under control it can inhibit the desired growth thereby adversely affect the project completion.

Various studies have investigated the causes for project cost overruns on construction projects:

The study by ChabotaKaliba & MundiaMuya (2009) established that bad or inclement weather due to heavy rains and floods, scope changes, environmental protection and mitigation costs, schedule delay, strikes, technical challenges, inflation and local

government pressures were the major causes of cost escalation in Zambia's road construction projects.

K. Al-Rashid & N. Kartam (2005) studied causes of cost overruns; the three main causes were identified as contractor-related problems, material-related problems and, again, owners' financial constraints. The minimization of time delays and cost overruns in private residential projects would require: the availability of adequate funds, allocation of sufficient time and money at the design phase, and selection of a competent consultant and a reliable contractor to carry out the work.

Yaw Frimpong & Jacob Oluwoye (2003) concluded that the surveyed groups generally agreed that the project financing category is the main reason for groundwater construction delay and cost overruns in Ghana, whereas the labor category is the least; owners, consultants and contractors substantially agree on the ranking of the major categories of delay and cost overrun factors. The paper concludes that all the three groups felt that project financing, micro-economics, natural conditions led to cost overrun.

S. Shanmugapriya, Dr. K. Subramanian (2013), who found reasons for Cost overruns were high transportation cost, change in material specification, and escalation of material price, frequent breakdown of construction plants and equipments and rework.

T. Subramani, P S Sruthi, M. Kavitha (2014), who found 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.

D. Major Factors influencing time overrun and cost overrun

1 Poor site management and supervision

Poor site management and supervision are the major causes of delay. It results in conflicts, defects, cost overrun, rework due to miscommunication between the supervisor and labors. To overcome these problems, proper site management and effective supervision should be adopted which can be done by recruiting well qualified site managers and supervisors for executing site operations efficiently and satisfy the desired level of quality, allocating the required number of workers per supervisor, and ensure that the supervisor is suitable for their respective work.

2 Problems with sub-contractors

The involvement of subcontractors in construction projects is common, particularly in large projects. The results of this study show that problems with subcontractors is one of the major causes of project delay, and this finding is consistent with that of Sambasivan and Soon (2007) and Fallahnejad (2013). Problems with subcontractors can be minimized by implementing a careful selection process of qualified subcontractors that considers not only cost, but also quality, safety, and environmental aspects. It is also recommended by Enshassi et al. (2012) to select contractors according to their previous experience, reputation, and capabilities in terms of labor, equipment, and machinery. Moreover, subcontractors should be involved in the initial stages of the project through a balanced flow of information between them and the main contractor (Enshassi et al., 2012). Most

important, it is highly recommended that the contractor regularly monitor the activities of each subcontractor and indicate any evidence of schedule overrun (Proctor, 1996).

3 Inadequate planning and scheduling of project
Planning and scheduling is very important to adopt so as to perform the project tasks on time and to keep updates to prevent delay. Previous literature (e.g., Assaf and Al-Hejji 2006; Sambasivan and Soon 2007) has determined inadequate planning and scheduling of projects by contractors as one of the most important causes of project delay. This problem can be overcome by implementing techniques for managing projects with planning and scheduling software packages, as well as by improving the communication of schedule control data between construction site management and field supervision (Kratt 1989). Moreover, contractors should establish a dedicated team for planning and follow-up of pending issues.

4 Problem associated with material management

The majority of the material management problems at the job site include material tracking, bid procurement, material purchasing, material procurement, storage issues, material distribution, material damage and rehandling. Delay in the supply of materials is identified as another important cause of project delay. Frimpong et al. (2003), Sambasivan and Soon (2007), and Zou et al. (2007) also identified this as a cause of project delay. Although this factor could delay any construction project, it is compounded in oil and gas projects by transportation problems due to the remote location of construction sites with little or no transport infrastructure and by complications in project buyout management because most of the materials required for these types of projects are usually imported from overseas. To deal with these two issues effectively, it is highly recommended that a management group be formed specifically for logistics planning (Heimer et al., 1978) and that an appropriate management buyout system be developed (Hu et al., 2008).

5 Lack of coordination among stakeholders

Undoubtedly, effective communication among project stakeholders is crucial for project success. Consistent with the findings of Sambasivan and Soon (2007), Oman's oil and gas construction projects suffer from poor communication among project stakeholders. This communication problem invariably leads to rework, and thus project delay. Therefore, in order to minimize the risk of project delay, it is imperative to establish appropriate formal communication channels among all project stakeholders during the conceptual phase. It is also recommended that informal communication channels be established since they enable easier information flow within a shorter span of time (Al-Rawas and Easterbrook, 1996; Bassi et al., 2012).

6 Bad Weather

The contractor must keep in mind the climatic changes that may occur unexpectedly. In order to improve productivity, the contractor should adjust working hours, plan most of the work in shade or indoor if it is possible, hurry work on enclosures of the building, provide shade, and schedule people to breaks. Being able to maximize the productivity will reduce the cost and reduce the chances of failure (Barrak, 1993).

7 Scope of Work

A contractor sometimes shifts from one type of construction to another or add a new type to the current work. Contractors rarely stop current field and start with new field. However, expanding into new types of construction is quite common. The contractor should recognize the importance of researching and planning before taking a new type of construction. The entrance cost which is the money paid for learning period during which a contractor needs to learn a new type of work, is always under estimated. A contractor may complete one or two losing projects before he can build a new type of construction profitably. A contractor must determine what type of work he can do best and even in which part of work he can do better, then, he can move forward in the type of work with more confidence and less risks. If he wants to expand into other types of work, he should evaluate all the risks first, take a small project, and proceed with another. Expanding into a new type of work can cause contractor's failure if he does not know his specialty (Barrak, 1993).

8 Controlling Equipment Cost and Usage

Equipment's are very important to contractors. They could save time and money. There are two reasons to buy them either to replace old or to save money by owning equipment's. Equipment costs which included maintenance, operation and replacement must be estimated well. Contractor may loose because of not recognizing, recording and planning for all equipment cost. In calculating the replacement cost, it is important to update the recent cost of the equipment. Contractor should include the cost of idle equipment in estimating job profitability. Contractor having very expensive equipment must have very effective program to calculate equipment cost or he may lose money. The equipment repair cost must be accounted from the first month; it is put into the service (Barrak, 1993).

9 Cash Flow Management

Most of the contractor's expenses are paid in cash. Therefore, availability of cash flow is very important for a contractor to run the business. A contractor could find few shops which would give him credit. However, there are two problems associated with purchasing in credit, prices would not be cheap as compared to cash payment and a contractor is limited to items which are available in the shop which gives him credit. A contractor should plan for cash flow, or one day he will not have money to pay his expenses, and also there is no progress payment ready for collecting. The plan for cash flow needs cooperation between all company's divisions. Consequently, the cash flow with high priority in the management. Also, the meeting could help to solve all problems related to delay in progress payment. If the contractor is able to manage his cash flow effectively, his business will run smoothly (Barrak, 1993).

10 Bad Decisions in Regulating Company Policy

Most contractors believe that the only reasons for failure are labor problem, inflation, high costs of equipment, and tightening of market. Although there are contractors who are exposed to the same factors but they are making profits. They do not know that they may contribute to failure due to bad management decisions. These management decisions might not cause failure directly but they lead to failure. Decisions in regulating the company policy should not be taken unless all significant factors involved not only be considered but also handled in an accurate and correct

manner. So that the results will be satisfactory from all point of view. Contractor could avoid this factor by hiring consulting office or full time consultant. Consulting office or consultant should be chosen according to the previous experience with the work qualifications and capabilities (Barrak, 1993).

III. Results and discussion

The interference in project due to time and cost overrun can be minimized by adopting few

A Use of Project Management Techniques

Management is the heart of organization and is the integral part any construction project. They include planning, coordination of subcontractors, contactor ,resource scheduling, cost control, labor, billing, purchasing, and other related to the project. In Construction Company, project manager plays an important role to track these functions and has the responsibility to successfully deliver the project. The project management techniques should be used to have proper coordination and make efficient use of labor, skills, materials, and equipment's which are used in construction and need daily application of proper project management techniques. Computers have multiple applications in the construction industry which includes cost estimation, planning and scheduling, accounting, and calculations. All these applications can help the contractor to get the work done easily, quickly and accurately. To optimize the utilization of resources, resource smoothing and resource leveling technique can be used.

B Proper project planning and scheduling

The project cannot be successfully executed and delivered on time if it is not properly planed and implemented according to the schedule. It ensures that the resources (labor, material, equipment) are used efficiently with no wastage and by following the schedule there will be no shortage of resources. The most important factor time and money can be best efficiently utilized. If the project tasks are not performed in its duration then, additional resources should be deployed to avoid delay.

C Client, consultant and contractor

The approval of the tender should not be done just on the basis of low bid but should also consider their experience, effectiveness and technical knowledge of the contractor and availability of enough resources to complete the project on time. The clients and contractors should not delay the progress payment. Thus they should have good financial capability to make the payment on schedule. The consultants should make on time project drawings and plans and get them approved by the respective authority. The progress of the project should be checked by the consultant by inspecting at regular intervals on the site and the paper work. The contractor should have well experienced and qualified project managers and supervisors, skilled labor to run the activities smoothly. Contractor should have sound financial capability. There should be regular scheduled meetings among the three to keep the updates and check the problems and resolve them.

D Fish bone diagram

Fishbone diagram, also called a cause and effect diagram or Ishikawa diagram is a visualization tool for categorizing the potential causes of a problem in order to identify its root causes. It is a self -diagnostic-technique.

Dr. Kaoru Ishikawa, a Japanese quality control expert, in 1960s is credited with inventing the fishbone diagram to help employees avoid solutions that merely address the symptoms of a much larger problem. The technique was then published in his 1990 book, "Introduction to Quality Control"

A fishbone diagram is useful in brainstorming sessions to focus conversation. After the group has brainstormed all the possible causes for a problem, the facilitator helps the group to rate the potential causes according to their level of importance and diagram a hierarchy. The design of the diagram looks much like a skeleton of a fish. Fishbone diagrams are typically worked right to left, with each large "bone" of the fish branching out to include smaller bones containing more detail.

The left side of the diagram is where the causes are listed. The causes are broken out into major cause categories. The causes identified will be placed in the appropriate cause categories as to build the diagram. The right side of the diagram lists the effect. The effect is written as the problem statement to identify the causes. Thus, Fishbone diagrams are an excellent way to explore and visually depict the causes of a problem. They enable the root causes of a problem to be determined. This helps to be more effective by focusing the actions on the true causes of a problem and not on its symptoms.

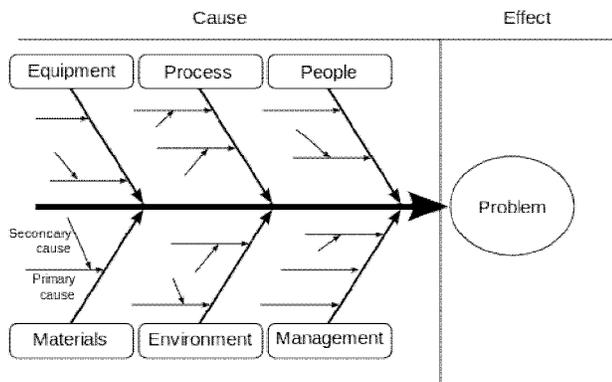


Figure 2: Fishbone diagram

https://en.wikipedia.org/wiki/Ishikawa_diagram

E Effective Material Management.

Successful project completion needs effective management of all resources. By definition, material management is the management system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost, and are available at the point of use when required (Roundtable, 1982). Each firm has its particular materials management system. The building and construction projects are realizing the tremendous potential that material management can do to increase the productivity and safety in construction projects. It provides an alert for potential shortage of material. Computerization is necessary for large projects and for smaller projects, manual methods or spread sheets can be used.

On-site productivity can be improved by good material management to reducing waiting time for materials and material handling. Techniques like item bar coding for inventory

identification can help to control the cost, technical issues, prevent of theft and unauthorized issue.

IV Conclusion

Time overruns and cost overruns are most commonly observed phenomenon in construction projects. The major factors influencing them are poor site management and supervision, problems with sub-contractors, inadequate planning and scheduling of project, problem associated with material management and lack of coordination among stakeholders. Other factors such as bad weather, scope of work, equipment cost and usage, cash flow management and decision making policy also affect up to certain extent. These factors may vary for different projects, places and country. It has been reported that lack of qualified staff also results in time overruns. Project management techniques such as, fishbone diagram, effective material management, resource smoothing and leveling, monitoring and scheduling, proper coordination between the parties can be used for the satisfactory completion of a project. Apart from this, it is necessary to give adequate training to consultants and project engineers to minimize time overruns in regulating company policy.

Acknowledgement

The financial support received from Sardar Patel College of Engineering, Mumbai under TEQUIP II to publish this work is duly acknowledged.

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