A Research on Various Aspects Affecting Time and Cost Overruns in Construction Industries

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Abstract – Construction industry is considered as one of the most important industries in India. It is well known that most construction projects exposed to time and cost overrun or both. These phenomena may affect the progress of construction industry in India as well as may expose many institutions of construction to be destroyed. Literatures of previous studies were classified into two main parts which are: (1) Factors influencing time overruns of project; (2) Factors influencing cost overrun. Most related studies were revised which included the study of these factors in many countries The aim of this study is to assess factors influencing time and cost overruns on construction projects in our country. The objectives of the study were achieved through valid questionnaire. The study illustrated that "delay in preliminary handing over the site" was one of the most important factors that may lead to cost overrun. Also it clarified that contractor's delay of material delivery and equipment has led to cost overrun. The study also clarified that prices inflation highly contributes to cost overrun.

INTRODUCTION

Successful management of construction projects is based on three major factors i.e. time, cost and quality. Time and cost are the lifelines of any and every project. The success or failure of any project depends largely on these two factors apart from its quality. They are vital, still they are neglected.

India is the tenth largest country in the World and yet her record of implementing major projects has been far from satisfactory. It has been observed very frequently that most of the projects in India ended with extra involvement of time, money and resources. It's a rare scene in construction industry, that a project is completed well within the estimated budget and time and with desired quality.

Our GDP factor cost in year of 2014 is 4.7% and construction sector 1.1% acquired, Time and cost overruns have significant implications from an economic. In general, time overruns and cost overruns reduce the G.D.P. (Gross Domestic Product) or productivity of available economic resources, edge the development potential and diminish the effectiveness of the economy. Government data suggest that a majority of projects close to 60 per cent are overwhelmed by time and cost overruns. If present trends continue over the Eleventh and Twelfth Plan periods (2008 to 2017), McKinsey estimates suggest

that India could suffer a GDP loss of US\$ 200 billion around 10 per cent of its GDP in financial year 2017.

A considerable number of international literatures opine that the inability to complete projects on time and within budget continues to be a chronic problem worldwide and a far worsening case (Azhar and Farouqui, 2008). However, as the trend of construction projects cost overrun becomes severe, a number of adverse consequences such as project failure, reduction of profit margin, loss of belief of citizen in government funded projects, would certainly take place. In Vietnam for example, a developing country in Asia, many problems had arisen during implementation of construction projects, out of which two main concerns were delay and cost overruns, and the frequently faced consequences were also project failure, reduction of profit margin, and loss of belief of citizen in government funded projects among others (Le-Hoai, Young, and Jun, 2008).

The construction industry is the total through which physical development is achieved, and that is truly the locomotive of the national economy. The more resources, engineering, labour, materials, equipment, capital, and market exchange are provided from within the national economy, the higher the factor of the extent of self-reliance. The increasing complexity of infrastructure projects and the environment within which they are constructed place greater demand on construction managers to deliver projects on time, within the planned budget and with high quality. It is known fact that a larger number of infrastructure projects in India have been delayed due to various issues. Infrastructure plays a paramount role in the economic growth of our country. Today, India is one of the leading outsourcing hubs in the world.

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Efforts directed to cost and time effectiveness were associated with managing time and cost, which in this study were approached via investigating time and cost overruns of construction projects in India. The formal sector consists of public and private contractors. The Construction industry of India is an important indicator of the development as it creates investment opportunities across various related sectors. The industry is fragmented, with a handful of major companies involved in the construction activities across all segments, medium-sized companies specializing in activities; and small and medium contractors who work on the subcontractor basis and carry out the work in the field.

In 2011, there were slightly over 500 construction equipment manufacturing companies in all of India. Time overruns is defined as the extension of time beyond planned completion dates traceable to the contractors. Delays are incidents that impact a project's progress and postpone project activities, delay causing incidents may include weather delays, unavailability of resources, design delays etc. In general, project delays occur as a result of project activities that have both external and internal causes and effect relationship. The actual date of completion is invariably different from the expected date. Further it is defined that the time overruns as the difference between the actual completion time and the estimated completion time. It was measured in number of days. Project delays are those that cause the project completion date to be delayed. Thus time overruns is defined as the time increased to complete the project after planed date which caused by internal and external factors surrounded the project. Delays are incidents that impact a project's progress and postpone project activities; delay causing incidents may include weather delays, unavailability of resources, design delays, etc. In general, project delays occur as a result of project activities that have both external and internal cause and effect relationship.

Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase, or "budget overrun." Cost overrun is defined as the change in contract amount divided by the original contract award amount.

Besides being unique, expensive and usually carried out within a limited time frame, construction projects have been described as complicated and uncertain in nature, as no two construction projects are ever exactly the same. Even if two construction projects are similar, the opportunity for exactly repeating the process of execution is very low, as most of the projects' elements are site-specific. Although the level of investment represented by construction projects has increased over the years, construction projects have a consistently poor record in finishing within budget. Morris (2000) considers cost overrun as a "regular feature" for public projects. Himansu (2011) defines cost overrun as "...the degree to which the final cost of the project exceeds the 'base' estimate".

LITERATURE REVIEW

Cost is the budgeted expenditure, which the client has agreed to commit for creating/acquiring the desired construction facility. Cost overrun is defined as the difference between the actual and estimated costs as a percentage of the estimated cost, with all costs calculated in constant prices. Actual costs are defined as the accounted costs actually spent, as determined at the time of project completion. Estimated costs at the time of project approval, which are typically similar to costs presented in the business case for a project (Lee, 2008).

The cost of a work unit is comprised of many cost elements. These cost elements include labour costs, material costs, plant and machinery costs,

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administration costs and other expenses. In order to identify costs associated with an activity, construction costs are categorized into "Direct costs" and "Indirect costs" or "Overhead costs". Direct Costs: Direct costs are costs that can be correlated to a specific activity or a work item, which is being done or produced. Direct cost of permanent work item = Direct material cost + Direct labour cost other direct expenses Direct material costs cover all costs connected with materials, which are incorporated into permanent works of the project. Direct labour costs cover net expenses far procurement, maintenance, and wages of all category of workers employed at the work site for the execution of an item of project. Other direct expenses include all other expenses on account of services rendered, which can be directly attributed to and clearly identified with the execution of an activity or work item. Indirect Costs: Indirect costs include all costs, which are attributable to a given project but cannot be identified with the performance of a specific activity or a work package. In other words, all costs other than direct costs are covered under indirect costs.

Alfredo Federico Serpella et.al. (2014), in Risk management in construction projects who addresses the problems of risk management in construction projects using a knowledge-based approach, and proposes a methodology based on a three-fold arrangement that includes the modelling of the risk management function, its evaluation, and the availability of a best practices model. This approach is part of a research effort that is underway. A major preliminary conclusion of this research is the fact that risk management in construction projects is still very ineffective and that the main cause of this situation is the lack of knowledge. Usama Hamed Issa in Implementation of lean construction techniques for minimizing the risks effect on project construction time that the construction projects involve various risk factors which have various impacts on time objective that may lead to time-overrun. This study suggests and applies a new technique for minimizing risk factors effect on time using lean construction principles. The lean construction is implemented in this study using the last planner system through execution of an industrial project in Egypt. Evaluating the effect of using the new tool is described in terms of two measurements: Percent Expected Time-overrun (PET) and Percent Plan Completed (PPC).

Construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time, and cost. In practice, however some construction projects encounter cost overrun, delay on completion time or poor workmanship upon completion. Cost overrun, bed quality workmanship and delay of construction projects require an in-depth investigation to improve the outputs of the construction industry. It is not uncommon to see construction projects failing to achieve their mission of creating facilities within the specified cost and time. Hardly few projects get completed on time and within budget since construction projects are exposed to uncertain environments because of such factors as construction complexity; presence of various interest groups such as the project owners, end users, consultants, contractors, financiers; materials, equipment, project funding; climatic environment; the economic and political environment and statutory regulations.

The successful execution of construction projects, keeping them within estimated cost and the prescribed schedules, primarily depends on the existence of an efficient construction sector capable of sustained growth and development in order to cope with the requirements of social and economic development and to utilize the latest technology in planning and execution adequate planning at the early stages of a project is crucial for minimizing delays and cost overrun.

Cost overrun is common in infrastructure and building construction projects. Researches on construction projects in some developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30%. One of the most comprehensive studies of cost overrun that exists found that 9 out of 10 projects had cost overrun. Overruns of 50 to 100 % were common Studies of construction projects in Madhya Pradesh, for example, found that more than 60 % of projects experienced up to 200 % time overrun and 75 % cost overrun.

FACTORS OF COST OVERRUN

There are 58 factors of cost overrun divided in to eight categories. They are: site management of contractor; management of contract and project; issues associated with labour; equipment and material; management of financial matters; communication and information; and outside reasons.

Factors That Cause Severe Price Fluctuation-The followings are some of the most common factors which cause severe price fluctuations: commodity prices throughout the world for basic supplies; the present position of the domestic economy; requirement of the quality of supplies and workmanship; and demand and supply.

Macro-economic Factors-Expense of a development would incorporate the expense of cash, the expense of work, the expense of material, and the expense of administration. The three main factors that affect cost are: fluctuation in raw material prices, manufactured materials, and cost of machineries. All three of them are market related. So it can be said

that the construction industry is driven majorly by market. There is a chance that the prices in the market can change almost daily. These changes make it tough for vendors to fix a price.

One of the most important parts of a country's socioeconomic growth is the construction industry. The construction industry forms quite an important part of the country's overall GDP (gross domestic product). It also develops the quality of life by creating and building new infrastructure like roads, hospitals, schools, and other important infrastructure. All these prove that the completion of a construction project under the expected time and meeting the expected quality is very important. However, the industry unfortunately faces chronic problems like low quality, cost overruns, time overruns, etc. very often. Out of all the problems faced by construction industry, cost overruns are probably the most important, because they can affect the overall development of a country.

This problem is a global one as the construction industry around the world exceeds the expected budget often. A global study (Flyvbjerg, Holm, & Buhl, 2003) on construction projects has found that cost overrun is the most faced problem. It is estimated that nine out of 10 projects faced the problem with an overrun of 50% to 100%. Another investigation on 87 projects conducted by Cantarelli (2009) has found that the problem of cost overrun exists in projects by an average of 10.3%. Even the construction projects in developed countries face this problem. In the UK, it is found that nearly one third of all clients have complained about their projects exceeding their allocated budget. Malaysia is also another country being affected severely by this problem. It is found that only 46.8% of public sector and 37.2% of private sector projects are being finished in the allocated budget (Rahman et al., 2013).

This issue has grown so much that it has become a major concern for investors. This is an issue which needs a solution by giving it a lot of attention and performing in-depth studies on it. Cost overrun can act as a great indicator of the success of a project. By overcoming it, a firm's productivity and profitability can be understood. So, solving this issue remains one of the most important things in the construction industry.

The construction industry has been showing poor performance very often. This is one of the reasons for the cost overruns. Most of the times, cost overruns have been investigated. The reason was found to be the poorly managed cost control systems. Some other sources for it were poor technological performance or inefficient equipment, improper materials from the local market, and site accidents.

A study performed by Olawale and Sun (2010) on the UK construction industry has found 21 major things that could factor in for cost overruns. They are: changes in design, risk and uncertainty that comes

with projects, lack of proper assessment of project time, poor act of subcontractors and selected dealers, high difficulty of works, conflicts among project parties, errors in project related documentation, different interpretations of the contracts, increase of prices, funding and payment for finished works, project manager lacking proper training and experience, lack of skill in human resources, bad climate conditions, depending on imported materials, unavailability of proper software, changing interest rate, changing exchange rates, improper regulation and control, frauds in project, corruption, and changing government policies.

Management Factors-On one hand, even though proper care is taken to prevent cost overruns, sometimes they are unavoidable because it is not possible to reasonably prevent them. This would include any unanticipated events. On the other hand, errors in design plan or project management can be foreseen and prevented thereby reducing a lot of chance for cost overruns. By using the project control procedure, the management can understand its present situation associated with a future position.

According to Sriprasert (2000), cost overrun problems occur as a result of ineffective construction management and other poorly designed control systems. The carelessness of project managers can be controlled if the management modifies the project schedule and other estimates, according to the changes or discrepancies that could happen while the project is being implemented (Azhar, Farooqui, & Ahmed, 2008).

Business and Regulatory Environment-The problem faced by the construction industry is that many of the players in the industry are small. They have weak financial positions and their technology is lower grade. They also lack proper organizational structure and a vision for growth. This makes these small players extremely susceptible to policies of government and changes in them.

The major cause of cost overrun associated with business and regulatory environment is the government implementing lowest bid price. This increases practices like corner cutting and usage of weak construction methods. The lowest bid price generally does not lead to best value. This is because the lowest bid price is usually made at 50% of the actual cost required. The lowest bid price system creates a lot of competition between contractors. As a result, the contractors submit a project for a bid price lower than required unintentionally or on purpose. Most of the times, this would lead to the harm for owner and contractor, as it creates cost overruns and schedule delays.

Methods Used to Avoid Cost Overrun-The proactive measures are those which should be adopted in the planning stage of project. The

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following list talks about the classification of some common planning strategies.

The proactive strategies include: efficient planning of strategies, and management of site and supervision of the project; appropriate planning and arrangement of project; organised regulatory mechanism; and using proper methods for construction (Azis et al., 2012).

The organisational strategies include: appropriate prominence on previous experience; regular coordination between the associated parties; increasing human resources in the industry; and complete administration of contracts.

Regular meetings on development, employing proficient subcontractors and suppliers, attributing less weight to prices, and more weight to abilities and earlier performance of contractors to improve the contracts and their procedures are some reactive and organisational strategies.

Using channels for perfect information and communication is a proactive and organisational strategy. Utilization of latest technology is a proactive and reactive strategy. Undertaking a preconstruction planning regarding the procedures and resources of project is a proactive, reactive, and organisational strategy.

CAUSES OF DELAY IN CONSTRUCTION PROJECTS

Construction Projects in India are scandalous for delays. Even the service of insights and Program Implementation (MOSPI) affirms that numerous projects are experiencing delays. In any case, the degree and the reasons behind the postponements have suggestions huge Economic and Political perspective. For one, as a rule, these activities are financed citizen's cash. In this way, individuals ought to know how productively their cash in used by the authorities while making procurements of open merchandise and benefits. Two, delays in Project execution implies that the general population and Economy need to sit tight for Construction Facilities Longer than it is vital. This thus restricts the construction capability of economy on the loose. Three, administrations gave by construction projects serve as info for some other segment of economy. Along these lines, time delays lead to increment in capital-yield -ratio for whole economy. Basically, postpones can decrease the productivity of accessible assets and limit the construction capability of whole economy. Therefore, the inadequacy of research on the subject is surprising.

Many construction projects suffer from delay. Suspension means stoppage of work directed to the contractor by a form from the client, while delay is a slowing down of work without stopping it entirely **Critical or non-critical delays-**Delays that affect the project completion or in some cases a milestone date are considered as critical delays, and delays that do not affect the project completion, or a milestone date, are noncritical delays.

Excusable or non-excusable delays-All delays are either excusable or non-excusable. An excusable delay is a delay that is due to an unforeseeable event beyond the contractor's or the subcontractor's control.

Compensable or non-compensable delays-A compensable delay is a delay where the contractor is entitled to a time extension and to additional compensation. Relating back to the excusable and non-excusable delays, only excusable delays can be compensable. Compensable delays are caused by the owner or the owner's agents.

Concurrent or non-concurrent delays-The concept of concurrent delay has become a very common presentation as part of some analysis of construction delays. The concurrency argument is not just from the standpoint of determining the project's critical delays but from the standpoint of assigning responsibility for damages associated with delays to the critical path. Many reasons can be identified for different sources in delay problem. These reasons are:

- a) Design related delay
- 1) Possible changes in initial design.
- 2) Complexity of the project.
- b) Construction related delay
- 1) Variations and claims
- 2) Change of scope of project
- c) Financial/ economic- related delay
- 1) Financial ability of the owner
- 2) Not enough funds

d) Management/ Administrative- related delay

- 1) Unavailability of suitable management team.
- 2) Unspecialized subcontractors.
- 3) Lack of project management.

- 4) Lack of experience of the consultant
- 5) Lack of experience of the contractor

e) Regulations and code- related key delays

1) New legal instructions or rules.

No	Causes of delay	Group
1	Delay in performing inspection and testing by consultant	Consultant
2	Delay in approving major changes in the scope of work by consultant	Consultant
3	Inflexibility (rigidity) of consultant	Consultant
4	Poor communication/coordination between consultant and other parties	Consultant
5	Late in reviewing and approving design documents by consultant	Consultant
6	Conflicts between consultant and design engineer	Consultant
7	Inadequate experience of consultant	Consultant
8	Difficulties in financing project by contractor	Contractor
9	Conflicts in sub-contractors schedule in execution of project	Contractor
10	Rework due to errors during construction	Contractor
11	Conjucts D/w contractor and other parties (consultant and owner)	Contractor
12	Poor site management and supervision by contractor	Contractor
14	Ineffective planning and scheduling of project by contractor	Contractor
15	Improper construction methods implemented by contractor	Contractor
16	Delays in sub-contractors work	Contractor
17	Inadequate contractor's work	Contractor
18	Frequent change of sub-contractors because of their inefficient work	Contractor
19	Poor qualification of the contractor's technical staff	Contractor
20	Delay in site mobilization	Contractor
21	Mistakes and discrepancies in design documents	Design
22	Delays in producing design documents	Design
23	Unclear and inadequate details in drawings	Design
24	Complexity of project design	Design
25	Insufficient data collection and survey before design	Design
26	Misunderstanding of owner's requirements by design engineer	Design
27	Inadequate design-team experience	Design
28	Un-use of advanced engineering design software	Design
<i>29</i>	Equipment breakdowns	Equipment
30	Shortage of equipment	Equipment
31	Low level of equipment-operator's skill	Equipment
32	Low productivity and efficiency of equipment	Equipment
33	Lack of high-technology mechanical equipment	Equipment
34	Effects of subsurface conditions (e.g., soil, high water table, etc.)	External
35	Delay in obtaining permits from municipality	External
36	Hot weather effect on construction activities	External
37	Rain effect on construction activities	External
38	Unavailability of utilities in site (such as water, electricity, telephone, etc.)	External
39	Effect of social and cultural factors	External
40	Iraffic control and restriction at job site	External
41	Accident during construction	External
42	Changes in government regulations and laws	External
45	Delay in providing services from utilities (such as water electricity)	External
44	Delay in providing services from antimites (such as water, electricity)	External
46	Shortage of Jahour	Labours
47	Unaualified workforce	Labours
48	Nationality of labour	Labours
49	Low productivity level of labour	Labours
50	Personal conflicts among labour	Labours
51	Shortage of construction materials in market	Materials
52	Changes in material types and specifications during construction	Materials
53	Delay in material delivery	Materials
54	Damage of sorted material while they are needed urgently	Materials
55	Delay in manufacturing special building materials	Materials
56	Late procurement of materials	Materials
57	Late in selection of finishing materials due to availability of many types.	Materials
58	Delay in progress payments by owner	Owner
59	Delay to furnish and deliver the site to the contractor by the owner	Owner
60	Change orders by owner during construction	Owner
<u>61</u>	Late in revising and approving design documents by owner	Owner
<u>62</u>	Delay in approving shop drawings and sample materials	Owner
63	Poor communication and coordination by owner and other parties	Owner
64	Slowness in decision making process by owner	Owner
65	Conflicts between joint-ownership of the project	Owner
66	Unavailability of incentives for contractor for finishing ahead of schedule	Owner
67	Suspension of work by owner	Owner
08	Uriginal contract duration is too short	Project
09	Legal disputes D/w various parties	Project
/0	Indaequate aejinition of substantial completion	Project
/1	Ineffective aelay penalities	Project
72	Type of construction contract (Turnkey, construction only,)	Project
13	Type of project buaing and award (negotiation, towest blader,)	Frojeci

Table – 1 : Causes of Delay Classified.

REASONS FOR COST OVERRUNS

Cost revisions and cost overruns are common across infrastructure projects. According to MoSPI, infrastructure projects in central Government sector costing INR 150 crore and above, are currently experiencing cumulative cost overruns of 16.9 percent1 of their planned cost. Our survey makes an attempt to identify the key factors, experienced by project owners, resulting in cost overruns in a project from the pre execution stage until the close out phase.

Infrastructure projects executed by State owned agencies usually involve a large number of stakeholders. It has been observed that in several projects, all functional teams were not involved in the conceptualization stage. This results in inadequate assessment of the risks and mutual interdependencies that projects could face in the execution stage. The desired level of collaboration between the project owners and the contractors also appears to be lacking. Consequently, projects face deviations in scope, which affect the delivery both in terms of time schedule as well as budgeted cost. Moreover, in case of Government infrastructure projects, the item rate contract system is the prevalent model used for allotment of contracts. Under this model, detailed drawing and designing of the projects at the time of award of contract is not mandatory.

As a result, divergence from the original estimation is quite common during project execution - often leading to cost escalations.

In majority of projects, scope creep and inadequate DPRs arises due to lack of holistic planning and limited ability of project managers to assess all potential risks; and could be easily mitigated by putting an effective project management system in place and providing training to project managers.



Figure 1: Reasons for cost overruns in preexecution phase.

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Cost overrun due to inadequate DPRs is prevalent across sectors. 73 percent of energy and transport and logistics sector respondents agree that inadequate DPRs lead to cost overruns in their respective sectors.

As Indian regulatory agencies tighten their noose by bringing in additional environmental regulations, infrastructure project owners need to ensure project compliance with stringent safety and environment standards. Adhering to the evolving environment and safety standards leads to additional costs.

The proactive approach of Ministry of Environment and Forest (MoEF) in recent years has forced project owners to include environmental safeguards in their project plans. Moreover, as environmental policies in the country are constantly evolving, an underconstruction project might need to comply with these standards midway through the execution stage. As a result,

the project can face cost escalations in order to comply with the approved design, technology, material etc.

While, 48 percent respondents agree that the high cost of the environmental safeguards leads to project cost overruns, 71 percent assign a high to medium probability of project cost overruns due to this reason.



Figure 2: Probability of reasons affecting project cost overruns in pre-execution phase.

Material price escalation is a business risk faced by all contractors. In recent years, costs of key inputs such as iron and steel, cement, bitumen, concrete, crude oil, etc. have fluctuated sharply. The risk of material cost fluctuation is inherent in infrastructure projects, and to some extent is taken into consideration in overall project cost estimates. However, the volatility in material prices makes forecasting a challenging and leads to inaccurate exercise forecasts. Furthermore, the cost estimate assumes the project completion as per the schedule and does not account for inflation beyond the schedule date. Thus, any delay in project completion makes the initial cost estimates obsolete leading to cost overruns.

Quite often, an increase in material cost over the agreed percentage leads to dispute between project owners and contractors. For example, the dispute between one of the India's largest State owned power generation company and its initial equipment supplier on price escalations (over 80 percent) delayed a three-unit 1,980 MW project in Bihar by two years².

Many a times, the variables used for cost estimation during project cost scheduling are not adequate to cover all aspects of project costs. As a result, various cost items that are necessary for the project budget estimation remain either unidentified or inadequately defined at the planning stage and lead to cost overruns at a later stage. Project teams need to be extensively experienced (should have costing personnel/engineers) and adequately equipped with scientific tools and techniques to develop a realistic budget estimate for the project.

CONCLUSION

The studies show that the main causes of cost overrun differ from country to country. As a result, it would not be accurate to identify the causes of cost overrun for a specific country from a global literature only.

One of the potential solutions to reduce the effect of the cost overrun in construction projects is the embedding of an effective resources (human, technical and material) management system within construction projects as it seems that most of the causes of cost overrun are related to poor resources management. Moreover, effective communication between a project's internal and external stakeholders is a very important task to deliver projects successfully and reduce cost overrun. This task is more important in construction megaprojects where different government authorities are involved. To help contractors' financially and reduce the effect of payment delay for the completed projects, government should be involved to help contractors find a middle way with banks and other surety groups.

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