Escalation Cost Management in Building Projects

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Abstract- Historically construction projects have been inundated by cost and schedule overruns. In too many cases, the final project cost has been higher than the cost estimates prepared and released during initial planning, final design and estimation or even at the start of construction. Over the time span between project initiation, concept development and the completion of construction many factors may influence the final project costs. Organizations face a major challenge in controlling project budgets over the time span between project initiation and the completion of construction.

In theory cost may overrun or under run in construction projects. But the frequency of overrun is much higher when compared to under run. Cost escalation in construction project refers to anticipated increase in cost of constructing a project over a period. Cost increase usually occur as a result of market forces and reflect increases in the cost of material/ labour and higher levels of construction activity. Escalation is usually calculated by examining the changes in price index measures for a good or service. Future escalation can be forecast using econometrics. In cost engineering and project management usage, escalation and cost contingency are both considered risk funds that should be included in project estimates and budgets. The focus is on deriving conclusions from the study undertaken and making recommendations to stake holders in construction industry regarding their responsibilities to overcome the problem of construction project cost escalation. Apart from this the detailed study of existing price variation methods and opinions of the experts are collected to give suggestions about price variation in building construction industry. The data collection and survey is done for Navi Mumbai city.

Index Terms— ABC analysis, ABC curve, building project, cost escalation, data collection, price index, price variation.

1. INTRODUCTION

Price variation compensation clauses for buildings which are in practice are collected. These methods are mostly based on the price indices published time to time by the Government organizations. So collection of cost indices for important construction commodities and minimum labour wages for past five years is collected. These are tabulated and changes in trends are studied.

Based on the weightage and cost indices in existing price variation clause for each commodity, percentage of escalation compensated for optimum scheduled project of duration 12, 15, 18 and 24 months are computed. In the same price variation clauses, based on weightage of each commodity and actual market price variations, percentage of escalation compensated for optimum scheduled project of duration 12, 15, 18 and 24 months are computed. Both the results are compared. For this purpose important construction commodity such as steel, cement, labour, fuel, sand, aggregates, bricks, natural stones, etc. A cost index is a normalized average of prices for a given class of goods or services in a given region during a given interval of time. Here the cost indices for the construction commodities that are used in escalation clauses are collected. In India cost indices are published by Economic advisory of India. They publish indices based on weekly basis, monthly basis and yearly basis. The index is usually expressed as a percent change in price over a given time period, or an index representative of the price level at a given time. For example if the price index for a product is given as 1.00 for 2017, and prices increase 5.0 percent to 2018, the index for 2018 will be 1.05.

Measuring and tracking cost escalation requires a reasonably accurate index based on information that is reliable and captures a wide enough spectrum of data that all aspects of escalation are covered.

2. OBJECTIVE OF STUDY

1. To prepare a data regarding price variation in construction commodities that may help estimators.
2. To obtain experts view on current price variation system and scope of improvement required.
3. To give the suggestions those can be used to overcome the problems of price variation in current escalation system in building construction.

3. LITERATURE STUDY:

3.1 Construction Economics

Gunasekera et.al. states that, prior to 2002, construction cost escalation had a stable linear growth trend that was in line with general inflation. Since 2002, the variance between construction cost escalation and general inflation has significantly increased. This divergence between general inflation and construction cost escalation has been driven largely (although not entirely) by volatile growth in key global commodity prices, particularly oil and steel. November 2008 through January 2009 saw the biggest widening in the variance, due in part to the run up in steel and fuel prices from the second quarter of the year, which had

impacts that lagged declines in overall inflation. Symptoms of the drop off in economic activity are already setting in as a result of the mounting world financial crisis. Due to this increased variance, federal, state, and local agencies, as well as private investors, have recognized the importance of obtaining construction cost escalation forecasts that reflect factors specific to construction rather than relying on forecasts of general inflation. While the current recession has changed the escalation environment for now, recovery and a resumption of global economic growth, when it occurs, is likely to be accompanied by a return to the upward pressure on commodity and thus construction prices.

3.2 Cause and Effects for Cost Escalation in Construction Projects

A cause and effect diagram was constructed using the 33 cost increase categories (Khaled M. Nasser et al. 2005). A cause and effect chart (often called a fishbone chart because of its appearance) is a simple graphical representation of potential causes of a certain undesirable effect, namely here, cost overrun. The process of constructing the cause and effect chart itself is a useful tool for getting participants of the construction project involved in identifying root causes of the problem.

One of the most important contributing factors to the magnitude of cost overrun in large infrastructure projects are project delays (Daniel C Okpala et al. 2007). Furthermore, the length of project development phase from planning to construction, seem to be a major factor in the extent of cost overrun (Flyvbjerg et al. 2004).

Overwhelming empirical evidence shows that many psychological, political, and economic reasons are not fully reflected as risk factors in the project budget, with similar trends shown for European and North American projects.

The causes of cost overruns can be grouped into several major categories (Jin-Kyung Lee 2008): Changes in the scope of the project, construction delays, unreasonable estimation and adjustment of the project cost, and no practical use of the earned value management system.

3.3 Construction Project Cost Escalation Factors

Jennifer S. Shane et al. (2009) made an attempt by triangulation analysis from past studies and interviews to create a categorization for the causes of cost escalation. A better understanding of the cost escalation factors is achieved through understanding the forces driving each factor or where the factor originates. With this understanding it is possible to design strategies for dealing with these cost escalation factors. The factors that affect the estimate in each project development phase are by nature internal and external. Factors that contribute to cost escalation and are controllable by the agency/owner are internal, while factors existing outside the direct control of the agency/owner are classified as external. It is important to note that one of the factors points to problems with estimation of labor and material cost, but most of the factors point to "influences" that impact project scope and timing.

3.4 Misplaced Optimism

There is a general under appreciation for the complexity, interdependencies, and risks associated with the megaproject environment. Many risks are strategic (often considered as outliers), are in the hands of the senior executive management, and are partially addressed by the project management team as they do not have the control or the capacity to manage them. Most megaprojects are in remote locations. The cost of attracting and maintaining on-site labour (including camp development, training to suit local conditions, operations, and personnel transport costs) is often underestimated. Alternative regional and national demands restrict the availability of craft labour and put upward pressure on wages as an incentive to relocate. There are also real productivity losses associated with working in cold climates and shorter daylight hours in northern regions.

3.5 Misguided Objectives

Much of the problem starts with inadequate front-end loading or incomplete definition of project scope, design/execution requirements, or risk/alternative analyses. The recent trend toward project fast tracking, for example, often means that appropriate planning time is traded for ambitious building speed. When clients and engineering firms push work into the field early, construction contractors must deal with unrealistically compressed schedules. Overtime wages, materials, and equipment expenses all increase. Also, given the long duration of most megaprojects, it is common for customer and other stakeholder requirements to change over a project's life cycle - yet, there is a lack of understanding of the cumulative impact of these scope changes. Deviations from the plan are simply costly.

3.6 Misaligned Strategies

Some project strategies deployed do not properly consider the level of scope definition, the fast-track nature of the megaproject environment, market condition, owner participation, owner control, and risk management. Additional cost overruns result from late consideration of:

- Project management strategies such as risk management, project control, communications, organization, and responsibilities.
- Contract strategies relating to management, design, construction, and commissioning services.
- Design strategies such as contributions from client business, operation, project team, contractors, and suppliers.
- Procurement strategies including preferred suppliers, progressing, inspection, and expediting, storage, spares, and documentation.
- Construction strategies such as site layout, power, utilities and drainage, off-site prefabrication and assembly, and industrial relations.

• Commissioning strategies including schedule and integration with construction, training and validation, engineering and trade support, and provision of operating materials.

3.7 Misdirected Execution

If engineering or material delivery takes longer than scheduled, construction is forced to make up for lost time. Alternatively, when a project is fast tracked, construction problems arise that are the result of inadequate engineering or design planning. While construction often bears the brunt of blame for overruns, the expectations and pressures are unrealistic and misplaced. Notwithstanding, there are mismanagement issues within the construction discipline itself:

• Inexperienced or poorly equipped project management personnel and supervisors coupled with the inability to understand, plan, adapt, or implement project management procedures or systems.
• Lack of standardization and fit for purpose including inadequate use of shop fabrication, modularization strategy, and constructability reviews.
• Poor communication, team work, and alignment between the players leading to adversary relationships and protracted disputes.
• Poor site organization and layout leading to excessive time wastage and productivity loss during construction.
• Joint venture (JV) of project partners, contractors, and engineering firms that are not aligned to work effectively due to different cultures, internal JV conflicts, and diverging visions of the way that the EPC project should be structured and managed.

3.8 Missing Links

Learning from all these experiences, many megaproject owners and EPCM contractors are now investing more in cost and supply chain management expertise and quality and project management training programs to improve and synchronize their planning, budgeting, and operations processes. Other evolving solutions include a preference for closer working relationships with fewer companies throughout the supply chain (in order to reduce costly redundancies in bidding and coordination activities), performance contracts, greater management team continuity, more centralized decision-making authority, and more realistic interdisciplinary and intercompany communication. The goal, of course, is to close the gap between top-level objectives at the beginning and the realities of front-line engineering and construction through the end. Keys to project success can be summarized as follows:

• Effective early planning includes early involvement of key contractors and suppliers, proper project governance, clear definition of decision-making responsibilities, and the development of a comprehensive execution plan.
• Critical issues and risk identification include the early identification and management of local and global issues, stewardship of mitigation plans, and proper strategies for sharing risks (contracting arrangements, use of the international market place, harmonizing stakeholder goal, supply chain relationships, etc.).
• Early definition of scope that allows the development of achievable cost and schedule and without rushing into construction prematurely.
• Appropriate contracting strategies such as the use of a program management contractor, interface management for multiple large contracts, lump sum versus reimbursable compensation, effective work breakdown structure, and early contractor evaluation and selection.
• Proper execution strategy that considers the applicability of phased execution, use of modularization, early identification of constraints such as engineering, manpower, supervision, camp, logistics, and material delivery.

3.9 Cost Control

A fundamental tool in managing escalation is high quality cost management (Peter Morris and William F. Willson, 2006). This involves development of a realistic cost model with appropriate recognition of risk, regular cost monitoring throughout the project, and a commitment to address issues as they arise. The keys to successful cost planning & management are high quality information and good communication.

To effectively minimize the cost risk of a project the project owner, as well as the entire project team, must assess the potential cost risks in a project to identify all risk factors and profiles, calculate the range of outcomes for each of these factors, identify the level of potential loss for each outcome, and determine the level of control over each factor and outcome that the project team can reasonably be expected to have.

Cost models can be developed from the program and statement of condition by establishing key parametric quantities for the estimate. These are then reviewed with the design and owner teams to ensure complete understanding of the available funds, and the anticipated scope and quality. The budgets include recognition of the risks inherent in the budgeting process through the application of appropriate design and bidding contingencies. The project should not move ahead without complete buy-in from all interested parties, nor should it proceed without solutions or strategies for addressing the cost risks. Following establishment of a budget and cost plan, the approach is to provide both periodic cost checks at design milestones, and ongoing cost validation and reporting to identify any significant changes. As with the cost plan, the efficient flow of information and the active development of solutions are the key to the success of the process.

4. Price Variation Clauses for Building Works

If the prices of materials and / or wages of labour required for execution of the work increase, the contractor shall be compensated for such increase as per provisions detailed below and the amount of the contract shall accordingly be varied, subject to the condition that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the contract including the justified period extended under the provisions.

Escalation normally will be paid quarterly. It is found that in building works, escalation is given for the components such as cement, steel, Fuel and power, labour and all other materials in single group. The weightage for each component are different in different organizations.

(i) The base date for working out such escalation shall be the last date of receipt of tenders.

(ii) The cost of work on which escalation will be payable shall be reckoned as below:

a) Gross value of work done upto this quarter = (A)

b) Gross value of work done upto the last quarter = (B)

c) Gross value of work done since previous quarter (A-B) = (C)

d) Full assessed value of Secured Advance fresh paid in this quarter = (D)

e) Full assessed value of Secured Advance recovered in this quarter = (E)

f) Full assessed value of Secured Advance for which escalation payable (D-E) = F

g) Advance payment made during this quarter = (G)

h) Advance payment recovered during quarter = (H)

i) Advance payment for which escalation is payable in this quarter (G-H) = (I)

j) Extra items / Deviated quantities of items paid based on prevailing market rates during this quarter = (J)

Then,

M = C + F + I – J ……. (4.1)

N = 0.85 x M …… .(4.2)

k) Less cost of material supplied by the Dept. & recovered during the quarter = (K)

l) Less cost of services rendered at fixed charges & recovered during the quarter = (L)

Cost of work for which escalation is applicable,

W = N - (K + L) …… (4.3)

(iii). Components of Cement, Steel, Materials, Labour, P.O.L., etc. shall be pre-determined for every work and incorporated in the conditions of contract.

(iv) The compensation for escalation for Cement, Steel, Materials, P.O.L. shall be worked as per the formulae given below:

(a) Adjustment for component of "Cement"

$$Vc = W \times \left(\frac{Xc}{100}\right) \times \left\{\frac{(CI - CIo)}{CIo}\right\}$$

…… (4.4)

Vc : Variation in cement cost i.e. increase or decrease in the amount in rupees to be paid or recovered based on Equation 5.4.

W: Cost of work done from Equation 4.3

Xc : Component of cement expressed as percent of the total value of work.

CI: All India Whole Sale Price Index for Cement for the period under consideration as published by the Economic Adviser to Government of India, Ministry of Industry and Commerce.

CI0: All India Whole Sale Price Index for Cement as published by the Economic Adviser to Government of India, Ministry of Industry and Commerce as valid on the last date of receipt of tenders.

(b) Adjustment for component of "Steel"

$$Vs = W \times \left(\frac{Xs}{100}\right) \times \left\{\frac{(SI - SIo)}{SIo}\right\}$$

…….. (4.5)

VS: Variation in steel cost i.e. increase or decrease in the amount in rupees to be paid or recovered based on Equation 4.5.

W: Cost of work done from Equation 4.3

XS: Component of steel expressed in percent to the total value of work.

SI: All India Whole Sale Price Index for Steel (Bar & Rods) for the period under consideration as published by the Economic Adviser to Government of India, Ministry of Industry and Commerce. However, the price index shall be minimum of the following:

i) Index for the month when the last consignment of steel reinforcement for the work is procured

ii) Index for the month in which half of the stipulated contract period is over.

iii) Index for the period under consideration.

SI0: All India Whole Sale Price Index for Steel (Bar & Rods) published by the Economic Adviser to Government of India, Ministry of Industry & Commerce, as valid on the last date of receipt of tender.

(c) Adjustment for Civil component (Except cement & steel) / Electrical component of construction Materials

$$V_M = W \times (X_M/100) \times \left\{\frac{(MI - MIo)}{MIo}\right\}$$

…….. (4.5)

VM: Variation in Materials cost i.e. increase or decrease in the amount in rupees to be paid or recovered based on Equation 4.6.

W: Cost of work done from E (5.4)

XM: Component of Materia percent of the total value of work.

MI: All India Whole Sale Price Index for civil component / electrical component of construction material as worked out on the basis of All India Whole

Sale price Index for individual commodity / group items for the period under consideration as published by the Economic Adviser to Government of India, Ministry of Industry and Commerce and applying weightage to the individual commodities / group items.

MI0: All India Whole Sale Price Index for Civil component / Electrical component of construction material as worked out on the basis of All India Whole Sale price Index for individual Commodities / Group Items valid on the last date of receipt of tender, as published by the Economic Adviser to Government of India, Ministry of Industry and Commerce and applying weightage to the individual commodities / Group items.

(d) Adjustment for component of "POL"

$$V_F = W \times \left(\frac{X_F}{100}\right) \times \left\{\frac{(FI - FIo)}{FIo}\right\} \quad \ldots\ldots (4.7)$$

VF: Variation in cost of Fuel, Oil and Lubricant i.e. increase or decrease in the amount in rupees to be paid or recovered based on Equation 4.7.

W: Cost of work done from Equation 4.3.

XF: Component of Fuel, Oil and Lubricant expressed as percent of the total value of work.

FI: All India Whole Sale Price Index for Fuel, Oil & Lubricant for the period under consideration as published by the Economic Adviser to Government of India, Ministry of Industry & Commerce.

FI0: All India Whole Sale Price Index for Fuel, Oil and Lubricant valid on the last date of receipt of tender.

(e) The compensation for escalation for labour

$$V_L = W \times \left(\frac{X_L}{100}\right) \times \left\{\frac{(LI - LIo)}{LIo}\right\} \quad \ldots\ldots (4.8)$$

VL: Variation in labour cost i.e. amount of increase or decrease in rupees to be paid or recovered based on Equation 4.8.

W: Value of work done from Equation 4.3.

Y: Component of labour expressed as a percent of the total value of the work

LI Minimum wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration.

LI0: Minimum daily wage in rupees of an unskilled adult male mazdoor, fixed under any law, statutory rule or order as on the last date of receipt of tender.

5. WEIGHTAGE OF COMPONENTS

Components of Cement, Steel, Materials, Labour and P.O.L shall be pre-determined for every work and incorporated in the conditions of contract. It is found that different organizations are different weightage. Here we have collected the data's about CPWD, DAE and MHADA.

5.1 Component Weightage in Central Public Works Department (CPWD):

For the building categories labor component is worked out as 25 % and for cement, steel and all other materials it is worked out as 75%. For POL no weightage is given in CPWD price variation clause for building works.

5.2 Component Weightage in Department of Atomic Energy (DAE)

For building works they are same as CPWD component weightage. Labour component is 25 % and for cement, steel and all other materials it is worked out as 75%.

5.3 Component Weightage in MHADA

For the building categories labour component is worked out as 22 % and for cement, steel and all other materials it is worked out as 73.5% (Further breakup for cement, steel and all materials are respectively 9%, 17.5% and 47%). For POL weightage is given as 4.5% for building works.

5.4 Component Weightage in CIDCO

For the building categories labour component is worked out as 35 % and for cement, steel and all other materials it is worked out as 60%. For POL weightage is given as 5% for building works.

6.0 COST INDICES

A cost index is a normalized average of prices for a given class of goods or services in a given region during a given interval of time. Here the cost indices for the construction commodities that are used in escalation clauses are collected. In India cost indices are published by Economic advisory of India. They publish indices based on weekly basis, monthly basis and yearly basis.

The index is usually expressed as a percent change in price over a given time period, or an index representative of the price level at a given time. For example if the price index for a product is given as 1.00 for 2016, and prices increase 5.0 percent to 2017, the index for 2017 will be 1.05.

Measuring and tracking cost escalation requires a reasonably accurate index based on information that is reliable and captures a wide enough spectrum of data that all aspects of escalation are covered.

7.0 MARKET RATES

To compare the fluctuation of price indices with actual market price, the market prices of important construction commodities are collected. The rates collected are whole sale rates in Mumbai region including all Taxes and Levis. When there is a different in prices of different manufacturers the average rate is taken for study.

8.0 CONCLUSION:

From the studies it is clear that the change in market prices are not reflected in cost indices published by the authorities time to time. The comparison of actual market prices of cement, steel and all construction material with its corresponding cost indices shows that there are significant variations between these. In this regard author it is felt that that more attention must be given while preparing indices and due consideration should be given for actual market prices at different locations.

Around 70 construction project cost escalation factors are collected and responsible stake holder for every factor is studied. From this it is understood that owner and contractor plays major role in terms of responsibility in construction cost escalation. Identified cost escalation factors in this study will help different stake holders in construction industry to understand the causes of project cost escalation. This understanding permits them to develop different strategies, methods, and tools for better cost estimation and escalation management. Project participants can also take action to limit or control the effects of these identified cost escalation factors.

Price indices for important commodities like cement, steel, all construction materials and Fuel are collected for past and the same is compared with actual market prices in Mumbai area. In this it is found that the price indices are not reflecting the actual market prices. Also it is very difficult to predict the future trend based on past indices.

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