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Cost Escalation of Residential Building Due to COVID-19 in Amravati (M.S.)

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Abstract: 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. 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. In this paper we studied what factors affect cost escalation, various methods which are used to calculate cost escalation as well as how COVID-19 has affected construction industry as well as residential construction sector.

Keywords: Construction Projects, Schedule Overruns, Project Costs, Cost Overrun, Cost Escalation, Price Index, Cost Contingency, COVID-19, Construction Industry, Residential Construction Sector.

I. INTRODUCTION

The Indian construction sector is an integral part of the economy and a conduit for a substantial part of India's development investment. The construction sector plays a pivotal role in developing the country's infrastructure, a pre-requisite for high levels of economic growth. India being a developing country is in a great need to develop the required infrastructure to cope up with the present growth demand of the country. To achieve the same government is stepping into development of mega construction projects having long gestation period and huge investment.

Major construction projects usually have long gestation periods which gave rise to many problems during construction. Rising market trends in prices is a common phenomenon in the developing countries. Multifarious risks and uncertainties are likely to arise over such long periods, a major chunk of these risk are mainly due to a sudden increase in the price of material, wages of labour and POL (Petrol, Oil and Lubricants) during the course of the project. The increase in the prices being always unforeseen and unpredictable and it is difficult to anticipate rate of increases at the time of quoting rates. It is therefore obvious that the contracting agencies cannot be expected to carry out the work rates quoted at the time of tender without getting compensation for escalation in prices during the execution of a project.

Generally, in the construction industry, the contractor works in an environment of risk and uncertainty caused by the economic factors such as fluctuations in the costs of materials, labour and equipment. Contractors and suppliers working in today's volatile materials market find that estimating, bidding and financing the construction projects are challenges. Many face significant losses or erosion of anticipated profits because many of them are locked into fixed price construction contracts where contractors bear the risk of material price and supplier cost increases.

II. AIM AND OBJECTIVE

Aim: To study, identify various factors influencing cost escalation and to understand the impact COVID-19 has caused on various aspects of construction.

Objective:

i.To understand the concept of cost escalation.

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ii. To study escalation clauses presently used in construction work adopted by various government/ department agencies in India.
iii. To observe how COVID-19 has impacted construction sector.
iv. To obtain expert view on current price variation system and scope of improvement.
v. To give suggestion those can be used to overcome the problem of price variation in current escalation system in building construction.

III. METHODOLOGY

In this project, a comprehensive literature review was conducted to identify the factors influencing cost escalation. In view of the factors affecting the cost escalation of residential construction projects in Amravati, a survey questionnaire was built. A pilot study was conducted before the questionnaire was distributable. The fundamental purpose of the pilot study was to verify that the questionnaire was complete in capturing factors relevant to project objectives. The questionnaire was distributed to 25 respondents and the data was collected. These questionnaires were based on the Likert's scale of five ordinal measurements ranging from 1 to 5 (very low effect to very high effect) according to level of contribution amount. Relative importance index method is used. Data is analysed, result are observed and at last suggestions are made to minimize cost escalation.

IV. LITERATURE ANALYSIS

1. **Minsoo Choi, Jinu Kim & Moohan Kim in their paper "A Study on the Price Escalation System in a Construction Contract",** explains that price escalation in a construction contract can be improved by following the policy Delphi technique. The study is done with keeping Korean policies as the mainstay but comparisons have also been made in various aspects with other countries/regions (USA, Japan, Philippines and nations following Fidic). Policy Delphi technique included two questionnaires followed by group discussions with 14 experts. Results of the Delphi showed that minimum fluctuation rate for price escalation was desirable at a level of 3%. Losses caused by price change should be shared between contractor and owner; therefore, a deduction rate should be introduced in contract price escalation. Meanwhile, overhead and profit should be adjusted in proportion to the fluctuation rate; but advance payment or the delayed construction should be deducted from adjusted amount. Thus the paper suggests ways in which various improvements can be made in escalation clause in construction contracts.
2. **S. Shanmugapriya & Dr. K. Subramanian in their study "Investigation of Significant Factors Influencing Time and Cost Overruns in Indian Construction Projects",** this research work was carried out on studying significant factors causing Time overruns and Cost overruns in Indian construction projects. A valid questionnaire for the survey was developed based on factors for time overruns and factors for cost overruns identified from literature review. These factors were grouped into 12 categories for time overruns and 8 categories for cost overruns and distributed to Contractors, Consultants, and Owners of Indian Construction Industry. The data from the questionnaire was analysed statistically. Relative important index method was used to found out the most significant factors affecting Time and Cost overruns. It was found that five most significant factors causing time and cost overruns in Indian construction are material market rate, contract modification, high level of quality requirement, project location, depends on the fresher's to bear the whole responsibility for time overruns and high transportation cost, change in material specification, escalation of material price, frequent breakdown of construction plants and equipment's, and rework for cost overruns. So this implies that a need of urgent attention is to be put on these factors to avoid time and cost overruns.
3. **K. Vamsidhar, D. A. Eshwarswaroop, K. Ayyappapreamkrishna & R. Gopinath in their work "Study and Rate Analysis of Escalation in Construction Industry",** compared the cost of construction such as building materials, labours and equipment for past six years from the year 2008 to 2013. It is found that steel, cement, bricks, composite materials, equipment, labours found to be critical parameters in increasing the project cost, cost of the construction has increased during 2008-2009, 2009 -20010, 2010-2011, 2011-2012, 2012-2013 by 10.61%, 9.00%, 13.21%, 13.26%, 10.24% respectively. Increase in labour component by 140% during 2008-2013 years, forecasted price for years 2013-2014, 2014-2015, 2015-2016 is 11.85%, 11.85% and 11.94% respectively.
4. **Prof. Yogini Patil & Prof. Pankaj P. Bhangale in their work "Investigation of Factors Influencing Cost Overrun in High-Rise Building Constructions",** investigated the factors influencing Cost overruns in Indian construction projects. A valid questionnaire for the survey was developed based on factors for cost overruns identified from literature review. These factors were grouped into 8 categories for cost overruns and distributed to Contractors, Consultants, and Owners of high-rise construction projects. It is found that high transportation cost, change in material specification, increase in material cost, frequent breakdown of construction plant and equipment and rework are leading to cost overrun in a high-rise construction.
5. **Soumi Majumder & Debasish Biswas in their paper "COVID-19 Impacts Construction Industry: Now, then and Future",** explains how COVID 19 has affected the construction industry. The current and lasting impact of the COVID-19 pandemic has been created a whole new set of risks for every construction project in India. It is the

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responsibility of the owners and contractors to identify and manage the risk with this changing scenario of the city due to this epidemic. The COVID-19 outbreak will surely change company policies, work culture and also increase the use of automatic machines in the construction sector. The clients will surely shift from the real estate industry to various diversified industries like e-commerce, Artificial Intelligence (AI) automation, logistics etc. AI will take a significant role in global construction market analysis (competitive landscape and detailed information on vendors), revenue, and forecasting (component, service model, and development model, vertical and geographical analysis) and growth. AI will also take an important role to predict cost overrun of a project (based on size, type of contract, competency level of risk mitigation, automation). Moreover, upcoming trends and changes in customer behaviors can also be predicted by AI. Besides these, the use of cloud computing will help in mobility and allow users to access relevant records and real-time monitoring. Companies may opt for contextual and/or scripted (or hybrid) chat bots to save time and money. Unmanned Aerial Vehicle (UAV) drone supported with artificial intelligence will monitor construction sites. It is expecting that the use of prefabricated construction, 3D printing (additive manufacturing), use of augmented reality/virtualization, use of big data and analytics, use of wireless monitoring and connected equipment, 3D Scanning, photogrammetry etc. will significantly increase in this industry.

V. COST ESCALATION

Construction industry now-a-days is facing severe problem of poor cost management resulting in huge amount of cost overrun. The problem of poor cost management and overrun in project cost is serious issue in both developed and developing countries. This needs serious attention for improving the construction cost performance as rarely projects are completed within budget. In any project Cost, time and Scope are the three major factors that are considered which affect the Quality of outcome. The construction of any project largely depends on Quality triangle, when there is delay in any activity or change in the scope of project, the cost of construction is affected and vice versa. Escalation is a phenomenon of economics reflected through rate of inflation computed from Wholesale Price Index data or Market Rate Method. Escalation is the change in cost or price of specific goods or services in a given economy over a period. It is the increase in the cost of any construction elements of the original contract or base cost of a project due to passage of time. Escalation affects the budget and causes severe financial overrun by the contractor. It also adds to contingency in the contractor's bid and is a major contributor to the overall cost uncertainty of escalation in his tender rates from the employer. Construction work is carried out according to the pre confirmed contract agreement. To cope up with the sudden price escalation, regulated provision is necessary in construction contract document.

VI. CAUSES OF ESCALATION

In general, construction projects are usually of quite lengthy ranging from several months to several years. Also, such construction projects are performed according to a pre-confirmed contract amount and contract agreement in principle. Therefore, there is a strong probability that the cost of labour and materials will rise and fall periodically, to a greater or lesser extent, during the life of the project. Following are the common causes of Escalation in construction projects:

1. Requisition:

i. The owner's requirements on the project are not defined clearly.
ii. Particularly technical specifications aren´t defined clearly.
iii. Modification of scope of work and planning, additional scope of work.
iv. Modification of already defined space program (increase of quality and quantity) because of new user / tenant new user requirements, new production conditions.
v. Technical Innovation / Progress & Quality Improvement.

2. Owner and other Project Participants (Architects / Consultants):

i. Separation of financing (owner) and user specifications (tenant/user).
ii. Missing owners discipline.
iii. Missing owner decision making.
iv. Bad quality of planning (e. g. technical mistakes, missing cost consciousness).

3. Cost Planning / Budget Determination:

i. The owner's budget for the wished construction works is too small (Aware / unconsciously).
ii. Bad quality of cost estimating and cost monitoring, lacking experience in cost estimation, cost estimation based on wrong assumptions (e.g. cost index).
iii. Difficulty in cost estimation of special trades (e. g. building services trades).
iv. Cost planner is inexperienced.
v. Faulty cost estimation because of insufficient project information / definition.
vi. High complexity, technical innovation.

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4. Project Organization:

i. Inefficient project organization.
ii. Too many project participants and unclear definition of interfaces.
iii. Insufficient project preparation (e. g. Investigation of the subsoil).
iv. Project accompanying planning because of temporal demands.

5. Market Impact:

i. Building material price increase.
ii. Market price development.

6. Building / Plot of Land:

i. Subsoil / foundation.
ii. Building licensing requirements (building law, fire protection etc.).
iii. Technical complexity of the project.
iv. Technical innovation (new for the first time).

7. Building Law:

i. Requirements of building law
ii. Requirements of fire protection

8. Construction Contract:

i. Bad quality of tender and contract documents

9. Risk:

i. Subsoil

VII. HOW COVID-19 HAS IMPACTED RESIDENTIAL CONSTRUCTION

The infectious disease COVID-19 caused by a newly discovered virus and that is Coronavirus. The first transmission of coronavirus from animal to human was in Wuhan, China in December 2019. Since then it has spread rapidly all over the globe through person to person contact. The World Health Organization declared the COVID-19 as pandemic on 11th March 2020. As the novel Coronavirus was continuously spreading and there was no vaccine or control mechanism many countries like China, France, Italy, Poland, New Zeeland, UK, and others took the action of most restrictive mass quarantines. When it came to India, the same decision of lockdown had been made by the Government of India. Due to this lockdown situation, almost every commercial activity is suffering the effects of ruthless COVID-19. In this pandemic, the hardest affected sector is the construction and engineering sector.

Residential areas are typically classified as providing varying amounts of living accommodation for people. Residential areas are usually designated as such by the development plan of the authorities of a city or municipality, including the amount of units and, consequently, the approximate number of people living in that area following the prescribed density. The amount of land zoned for residential development should be in line with the projected population growth figures, as set out in regional strategic development documents (such as Regional Planning Guidelines).

Residential areas will generally consist of various accommodation types: apartment schemes (medium to high density), detached or semidetached houses (low to medium density), or terraced housing (medium to high density). The character of a residential area can be influenced heavily by the mixture of tenures (owner occupier, private rental, social housing) which are available within an area. Residential building is a multi-residential space contained in a single structure where dwellers may rent or own their residences.

Globally, construction is more than USD 11 trillion industry, of which residential construction is the largest sector. The occurrence of COVID-19 has caused disruption in the residential construction sector. The main disruption is in the supply chain. The transformation of COVID-19 from a China-centric challenge to a global pandemic has resulted in shifting the impact to the global construction supply chains and markets.

The ongoing pandemic has created a number of challenges not only for the construction industry but also disrupted the global economy. The global crisis, duration of the recession, and path of recovery will largely determine the nature and severity of these challenges. The construction industry, particularly the new residential segment, was performing well and witnessing a surge in activity across many sectors in 2020. Owing to the rising number of cases in across the globe, many ongoing projects that were considered essential by the government authorities were not stopped, but new residential construction permits were suspended. Following are the impacts of COVID-19 on construction sector which has resulted in escalation of total project cost:

i. Shortage of labour
ii. Labour productivity
iii. Skilled labour availability
iv. Safety and health issues
v. Labour working shifts
vi. Residential construction cost

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vii.Construction equipment availability
viii.Construction equipment rental rates
ix.Hike in fuel prices
x.Transportation problem
xi.Availability of material
xii.Material shortage
xiii.Price hike in construction materials
xiv.Suspension or termination of project
xv.Effectiveness of organization

VIII. DESIGN OF QUESTIONNAIRE

A questionnaire survey is one of the most cost effective ways to involve a large number of people in the process in order to achieve better results. In this project, the questionnaire has been designed to get information from experienced personnel from the construction field. Questionnaire is divided into two parts. First is demographic survey which includes the general information of respondent like name of the builder, gender, age, name of the project and its location. Second part of questionnaire is detailed survey which consist various questions on cost escalation of material, labour, fuel and various aspects related to COVID-19 impact on construction sector.

IX. RESULT AND DATA ANALYSIS

The procedure used in analysing the data is aimed at establishing the relative importance of the various factors that contribute to causes of cost escalation due to COVID-19. The steps used in analysing the data: calculating the relative importance index; ranking of each factors based on relative importance index.
The contribution of each of the factors causing cost escalation is examined and the ranking of the attributes in terms of their criticality as perceived by the respondents is done by use of Relative Importance Index (RII) which is computed using Equation and the results of the analysis are presented in Tables. To determine the ranking of different factors from the viewpoint of owner, contractors and consultants, the Relative Importance Index (RII) is computed using RII Equation.

A. Relative Importance Index

Relative Importance Index (RII) applied to measure the response related to the rating of each variable. This method is used to determine the significance of variables. It is also well known as a noted technique for generating scores of the variables.
It measures the importance level of each element based on 5 points “Likert Scale”, from strongly unimportant (=1) to strongly important (=5).
In case of 5 point Likert Scale

$$\text{Relative Imporantce Index (RII)} = \frac{5\,n_5 + 4\,n_4 + 3\,n_3 + 2\,n_2 + 1\,n_1}{A \times N}$$

Where, n_5 = Number of respondents for Strongly Agree
n_4 = Number of respondents for Agree
n_3 = Number of respondents for Neutral
n_2 = Number of respondents for Strongly Disagree
n_1 = Number of respondents for Disagree
A = Highest weight i.e. 5
N = Total number of respondents

Table Shows the Demographic Characteristics of the Respondents

Demographic Characteristics		Frequency	Percentage
Age	0-20 years	0	0
	21-40 years	12	48
	41-60 years	7	28
	More than 60 years	6	24
Gender	Male	23	92
	Female	2	8

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Work Experience	Less than 5 years	4	16
	5-10 years	5	20
	11-15 years	7	28
	16-20 years	4	16
	More than 20 years	5	20
Designation at Site	Engineer	7	28
	Manager	4	16
	Consultant	3	12
	Contractor	6	24
	Supervisor	5	20

Survey conducted shows that among 25 respondents 28% are engineer while 16% are manager, 12% consultant and 24% respondents are contractor while 20% are supervisor. Above table indicates 5 respondents (20%) have over 20 years' experience working in the construction industry, 11 respondents have experience ranging between 11 and 20 years, while 36% have at least 10 years or less. As the experience of the respondents is quite respectable, opinions and views obtained through the survey can be regarded as important and reliable. Majority of respondents had reasonable experience in sustainable construction which further shows that respondents are sufficiently experienced enough to provide data which are credible.

Table Shows Ranking of Factors Which Got Impacted Due to COVID-19

Sr. No.	Factors	RII	Rank
1	Construction material cost escalated	0.944	1
2	Residential construction cost increased	0.912	2
3	Shortages of labour has led to increased wages	0.904	3
4	Hike in fuel prices	0.872	4
5	Overall project cost increased	0.864	5
6	Availability of material disrupted	0.856	6
7	Pandemic has affected labour productivity	0.816	7
8	Financial loss	0.808	8
9	Effectiveness of organization decreased	0.8	9
10	Safety measurements	0.792	10
11	Construction machinery rental rates increased	0.776	11
12	Material shortage frequency	0.76	12
13	Transportation problem	0.736	13
14	Working shifts of labour affected	0.728	14
15	Quality of work life of employees and employers	0.704	15
16	Health issues in labours	0.672	16
17	Availability of construction equipment	0.576	17
18	Damage to Stored Material/Equipment	0.552	18
19	Suspension or termination of project	0.528	19
20	Availability of skilled labour	0.52	20

Hierarchal assessment of factors is carried out to determine ranking of the factors based on level of significance. It was assessed based on Relative important index (RII) value and calculated for each group of respondent's i.e. owners, contractor and consultants and also the overall respondents as presented in above. It shows that top 10 most significant

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factors which got impacted due to COVID-19 are cost escalation of construction materials, increase in residential construction per Sq. Feet, shortage of labourers led to increase in wages, hike in fuel prices, overall project cost increased, availability of materials disrupted, pandemic affected labour productivity, financial loss, decreased effectiveness of organization, safety measurements.

X. CONCLUSIONS

COVID-19 has done a lot of damage to the society. It has affected the society as well as our Indian economy. This study presents the important conclusions drawn from the analysis of perception regarding factors which got affected due to pandemic are cost of construction materials, cost of residential construction per Sq. Feet, labour rates, fuel prices, overall project cost. From the study it is observed that maximum number of respondent gave importance to cost escalation of materials which has led to overall increase in project cost.

In order to manage or measure escalation on construction projects, it is important to find out driving forces behind it which is very difficult to predict or estimate what prices for the bid to be considered, as current market is very fluctuating. The economist's future predictions about escalation of prices should be taken into consideration during formation of contract to avoid financial impact on the project.

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