

Influencing Factors caused for Time & Cost Overruns in Construction Projects in Pune-India & their Remedies.

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Abstract

The Construction industry is one of the key economic industry in India and is the main motivating force in Indian national economy. But, it suffers from a number of problems that affect time, cost and quality performances. Successful management of construction projects is based on three major factors i.e. time, cost and quality. The successful completion of construction projects within the specified time has become the most valuable and challenging task for the Managers, Architects, Engineers and Contractors. How to achieve this task is a problem, which should be solved. The overall objective of this study is to identify the factors responsible for overruns in time and cost of the construction project and suggest the suitable remedial solutions. The study is limited to a sample interview for several projects which are real estate projects & could vary for infrastructure projects. Poor project appraisal & formulation, poor implementation of plans, no advanced action taken by any of the parties involved, no advanced clearances from the local authorities & other agencies, delays in decision making, poor monitoring & control over activities, insufficient use of modern technologies available, no adequate measures were taken for the availability and proper flow of funds, loosely framed contracts are the main reasons for time and cost overruns in construction projects in India. Since most of the reasons are well known and can be controlled if a proper arrangement is made.

This paper recommends some clues as a remedial solutions such that better formulation & appraisal of projects, Sound implementation planning, advance action, assurance funds resources, better contract management, penalties & incentives, monitoring, management techniques & Systems.

Keywords – Cost overrun, Time Overrun, Construction Projects, Remedial Measures.

1. Introduction

1.1 Background

The Construction industry is one of the key economic industry in India and is the main motivating force in Indian national economy. But, it suffers from a number of problems that affect time, cost and quality performances.

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(Gupta et al., 2009).

The Delhi Metro Rail Corp. had submitted detailed proposed for Pune metro in 2009, estimating project cost to be Rs.7984 crore, which was now revised last year to Rs.10869 crore. This is cost for only two routes. This is very effective and live example of cost overrun due to delays.

That is why to manage and successfully coordinate and complete a project is a formidable problem. The client and contractor in a project, although, have a common objective i.e. to complete the project on time. The client in order to utilize the end result of the project, which has a value to him, the contractor in order to terminate indirect expenditure on it as early as possible in order to start further projects. Still, most of the projects cross the limits of time. Delay in completion results in definite increase in cost, because of immense sums held up, which bring no income. In fact, some projects often become uneconomical due to the time and cost overrun.

Time or Money used unnecessarily is of course 'time' and 'money' wasted. Hence, an efficient control system must be employed to achieve desired results. Effective and meaningful control must begin at design stage and should be backed up by proper and scientific estimation and data analysis.

1.2 Objective of the study

The main objective of this study is to identify the major causes of delays of building a construction projects in Pune using an opinion survey. The primary aim is to identify the perceptions of the three main parties regarding the causes of delays and to suggest possible ways of eradicating or minimizing them. Despite the importance and the significance of the construction sector in Pune, it is noted that the clients, consultants, and contractors don't give its importance to evaluate the time and cost overruns at the end of project. It is therefore essential to identify actual causes of time overruns to minimize and avoid delays and increasing cost in any construction project. Also research and studies in this field in Pune are few compared to worthy expected results.

The overall objective of the study is to identify the factors responsible for the over-runs of time and cost in a construction project and suggest suitable remedial solutions. The specific objectives of the study are as follows:

- a) To find causes of time & cost overruns in construction projects in Pune.
- b) To rank these causes according to their relative importance.
- c) Study the trend followed by organizations of good repute, by conducting surveys.
- d) Suggest remedial measures to combat time & cost overrun in terms of modifying strategies.

1.3 Limitations

The study is limited to the following respects

- The sample interview was for several projects & could vary for other projects.
- Reluctance from the part of the project authorities to reveal the data

2. Literature Review

2.1 Factors causing project cost & time overruns:

In this section, few research papers were studied in order to find causes of time & cost overruns in various construction projects. For this, a brief objective, methodology, findings and remedial measures of these papers are presented as below:

Aftab et al.,^[1] (2012), this study assessed the cost and time performance of construction projects in Malaysia

using structured questionnaire survey. Questionnaire survey were conducted as a methodology and analysis were done by RII method. Findings of the study revealed that 92% of construction projects was overrun and only 8% of project could achieve completion within contract duration. In terms of cost performance only 11% of respondents mentioned that normally their projects were finished within the budgeted cost while 89% of respondents agreed that their projects were facing the problem of cost overrun with average overrun at 5-10% of contract price. The major contributors of this poor performance were includes a) Design & document issues b) Financial resource management c) Project management & Contract management issues

Further they find 15 mitigation measures to improve cost performance includes: 1) Effective strategic planning 2) Proper project planning & scheduling 3) Effective site management and supervision 4) Frequent progress meeting 5) Proper emphasis on past experience 6) Use of appropriate construction methods 7) Use up to date technology utilization 8) Clear information and communication channels 9) Frequent coordination between the parties 10) Perform a preconstruction planning of project tasks and resource needs 11) Developing human resources in the construction industry 12) Comprehensive contract administration 13) Systematic control mechanism 14) Improving contract award procedure by giving less weight to prices and 15) more weight to the capabilities and past performance of contractors.

Findings of the study were concluded as

- Time overrun was major issue in cost projects as agreed by 92% of respondents.
- Cost overrun was major issue in cost projects as agreed by 89% of respondents.
- Amount of cost & time overrun is commonly in between 5-10% of contract duration and price of project.

S. Shanmugapriya & Dr. K. Subramanian^[10] (2013), this research were carried out on studying significant factors causing time & cost overruns in Indian construction projects. Questionnaire for the survey was developed based on 76 factors of time overruns and 54 factors of cost overruns and grouped into 12 & 8 major groups. It is resulted from various factors which had been identified in this study. A total of 70 samples were found as valid and analysed statistically using RII method on 76 & 54 factors on time & cost overruns.

It was found that 5 most significant factors causing time overruns in Indian construction projects such as: 1) Material market rate 2) Contract modification 3) High level of quality requirement 4) Project location 5) Depends on the fresher's to bear the whole responsibility and for Cost overruns the most significant factors were: 1) High transportation cost 2) Change in material specification 3)

Escalation of material prices 4) Frequent breakdown of construction plants and equipment's and 5) Rework.

T. Subramani et al.,^[14] (2014), found that major causes of cost overruns such as:

- a. Slow decision making
- b. Poor schedule management
- c. Increase in material/machine prices
- d. Poor contract management
- e. Poor design/ delay in providing design
- f. Rework due to wrong work
- g. Problems in land acquisition
- h. Wrong estimation/ estimation method and
- i. Long period between design and time of bidding/tendering.

Lucius Balayi & Michiel Bekker^[06] (2011), indicates that

the most significant factor contributing to cost overruns were "Material Cost and price fluctuation \`" and to time delays were Client related such as

- a. Incomplete drawings
- b. Design changes
- c. Slow Decision making
- d. Delay in Payments.

M. Haseeb et al.,^[08] (2011) found the 16 important causes of delays in construction projects of Pakistan such as:

- 1) Finance & Payments 2) Inaccurate time estimation
- 3) Quality of material 4) Delay in payments to supplier and sub-contractor 5) Poor site management 6) Old technology 7) Natural disasters 8) Unforeseen site conditions
- 9) Shortage of materials 10) Delays by subcontractors
- 11) Changes in drawings 12) Improper equipment
- 13) Inaccurate cost estimation 14) Change orders
- 15) Organizational Changes 16) Regulatory changes

Walid Kholif et al.,^[12] (2013), identified the 14 most important factors caused for time and cost overruns in educational buildings in Egypt such as: 1) Political insecurity instability 2) Escalation of material prices 3) Difficulties in getting work permit from government 4) Practice of assigning contract to lower bidders 5) High cost of skilled labor 6) Financial difficulties of contractor 7) Slow payment of completed works 8) High insurance and high interest rates 9) Bureaucracy in bidding/tendering method 10) Financial difficulties of owner 11) Inaccurate bill of quantities 12) High transportation cost 13) Inaccurate cost estimation 14) Mistakes in soil investigation

Sambasivan & Soon^[09] (2007), identified 10 most important causes of delays in Malaysian Construction industry 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 sub-contractors 6) Shortage in material 7) Labor Supply 8) Equipment availability and failure 9) Lack of

Communication between Parties 10) Mistakes during the construction stage.

Assaf et al.^[5] (1995), determine the main causes of delays on large building projects in Saudi Arabia. The result of this study showed that contractors believed that: 1) Preparation of shop drawings 2) Delays in contractor's progress and 3) Payment by owners were the most important factors contributing to time delays.

Al-khalil & Al-Ghafly^[2] (1999), identify the main causes of delays in construction projects in Saudi Arabia. This research found that contractors considered as 1) Delay in claim settlement 2) Slow decision-making and 3) Delays in progress payments as the most important delay factors. Owners believed that 1) Poor early planning 2) Scope changes and 3) Financial difficulties by the contractors' were the major causes of delay.

Apolot et al.,^[4] (2013), the main objective of study was to investigate the causes of construction project delays and cost overruns in Uganda's public sector & the five most important causes of delays in construction projects were found to be the following: 1) Changes to the scope of work 2) Delayed payments 3) Poor monitoring and control 4) The high cost of capital and 5) Political insecurity and instability.

2. Research Method

Research method is the systematic stepwise process to carry out any survey work. This study is conducted through several phases that include literature reviews and research papers, data collection and discussion and conclusion. From the literature review we identified 40 influencing factors causing for delays and cost overrun in Pune construction industries. Then the data collection was carried out through questionnaire amongst the various parties like Contractors, Clients, Consultants involved in handling construction projects in Pune. The questionnaires were distributed to clients, consultants and contractors of Pune construction industry. The respondents involved in the survey had several years of experience in handling various types of projects. The characteristics of the respondents participated in survey are summarized in (chart) indicates that majority of the respondents are working with contractors organizations followed by consultants and owners. Assessment of causes of time & Cost overrun was carried out using 4-point Likert scale from 1 to 4 representing can be neglected, low influence, medium influence & high influence respectively. Data analysis was done calculating Relative Importance Index (RII) by following formula, adopted from Memon et al. 2002 as RII is best suitable method to do the ranking analysis.

$$RII = \frac{\sum_{i=1}^4 W * X}{A * N}$$

Where, RII = Relative Importance Index
 W = Weighting given to each factor by respondents and its ranges from 1-4
 X = Frequency of it response given for each factor
 A = Highest weight (i.e. 4 in case)
 N = Total no. of participants.
 From RII results, the ranking for different factors was determined to discover the influencing factors causing time overrun in construction projects.

3. Data Collection

Our study included:

A. Data Collection from project authorities:

- a) Key personals involved in Planning, Design & Engineering, Finance, Project Management, Procurement & Materials Management, Contracts Management and Construction
- b) Consultants
- c) Contractors
- d) Talk with Engineers, Supervisors and sub-contractors

B. Questionnaire included:

- a) Factors responsible for time and cost overrun before and during the construction of project.
- b) It also includes external reasons, management problems, storage in resources and other reasons responsible for time and cost overrun.

4. Data Analysis

A total of one hundred & sixty (160) sets of questionnaires were sent to various construction companies (Clients, Consultants and Contractor) located in Pune. Out of 160, ninety two (92) 57.5 % completed sets were received back which were evaluated with Microsoft Excel program in order to find the importance factors causing time & cost overrun in construction. Following section discusses analysis of given by respondents from survey.

4.1 Demographics of Respondents

Demography of the respondents was assessed to see the factual data of respondents involved in the data collection. The respondents represented three categories of the personnel with 20% (19 respondents) from client category, 29% (27 respondents) from consultant category and 51% (46 respondents) from contractor category. These findings are presented in figure 1.

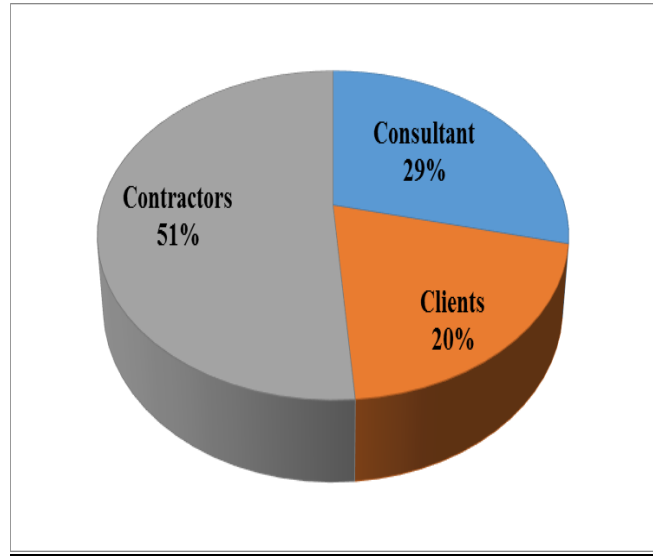


Fig 1. Percentage of Respondents

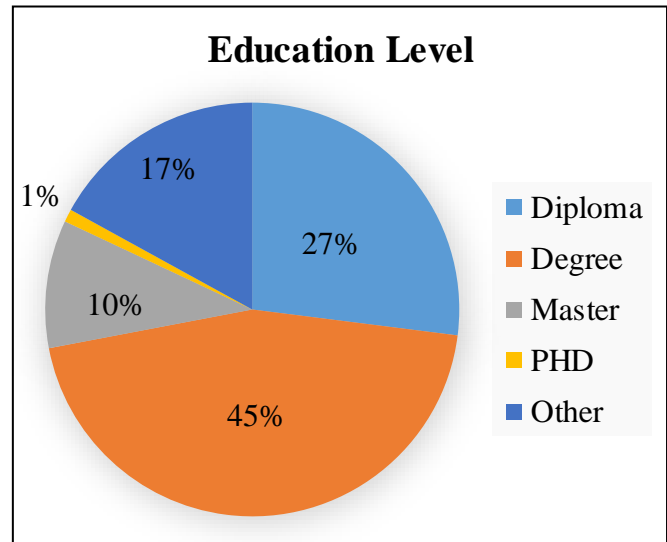


Fig 2. Academic Qualifications of the Respondents

From above fig. 2, it can be seen that most of the respondents involved in the survey were holding bachelor degree in term of educational qualification with the highest percentage 45%. 27% of respondent were diploma holders; master holders were 10% of respondents and PHD holders 1%. While 17% of respondents consists of certificates such as engineering certificate.

Table 1: Respondents 'Working position in the Organization

Position	Frequency	Percentage	Cumulative %
Project Manager	10	10.7	10.7
Director	9	9.3	20
Engineer	24	25.6	45.6
Assistant Engineers	14	15	60.6
Site Supervisors	18	20	80.6
Quantity Surveyor	16	16.9	97.5
Technician	2	2.5	100
Total	92	100	

Results show that mainly three types of position were held by most respondents including 24 (25.6%) engineers, project managers with 10.7%, 9 directors with 9.3% and the rest were others. Besides these, other respondents included assistant engineers, site supervisors, technician and quantity surveyor. The respondents involved in the survey had several years of experience of handling construction projects. Survey statistics showed that 56% of the respondents have experience below 10 years, 31% of respondents with 11 to 20 years' experience, 10 % with 21 to 30 years of experience and 2% of respondents with above 31 years' experience.

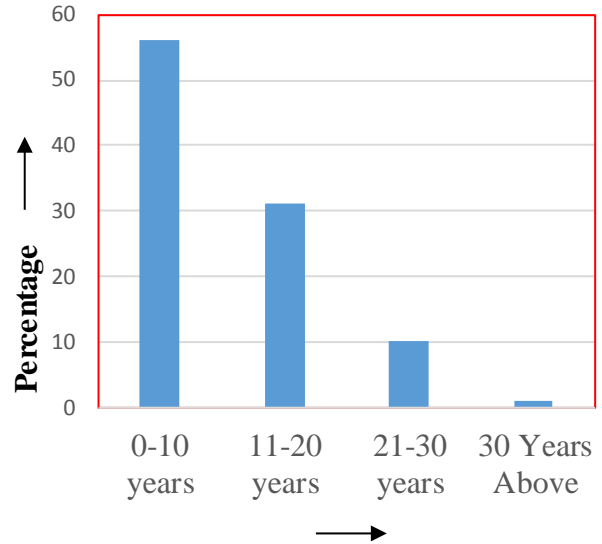


Fig 3. Working Experience of the Respondents

4.2 Ranking for Influencing Factors Causing Time & Cost Overrun

Significance of major influencing factors causing construction time & cost overrun was identified in the questionnaire survey. Respondents were asked to rank the factors with 4-likert scale as:

- 1- Can be neglected
- 2- Low influence
- 3- Medium influence
- 4- High influence

4.3 Influencing factors

Data were analysed by using Relative Importance Index method (RII); the factors were ranked by dividing the factors in various phases such as before construction, during construction, external reasons, management problem, and shortage in resources and find the most influencing factor according to contractor, consultant and client.

Following table shows the overall analysis of data by RII method and giving the ranks to each influencing factor in group wise as well as overall.

In table no.2, C & T means factor caused for Cost overrun & Time overrun, CONS means Consultant, CONT means Contractor, EXT means External related factor.

Table No. 2 Data Analysis by RII

S. No.	INFLUENCING FACTORS	Weight (1-4)				N	$\sum w \cdot x$	RII	Group wise Rank	OVERALL RANK	RELATED
		1	2	3	4						
BEFORE CONSTRUCTION											
1	Inaccurate estimate of cost and time (C & T)	8	25	24	35	92	270	0.734	2	4	CLIENT
2	Poor bidding process (T)	20	36	29	7	92	207	0.563	6	30	CONT
3	Faulty designs (C & T)	15	15	22	40	92	271	0.736	1	3	CONS
4	Intentional low-bidding (C)	25	34	23	10	92	202	0.549	7	31	CLIENT
5	Improper site planning (T)	10	22	39	21	92	255	0.693	4	9	CONS
6	Delay in Approval of Drawings (T)	14	38	25	15	92	225	0.611	5	23	CONS
7	Land acquisition problem (T)	12	17	36	27	92	262	0.712	3	8	CLIENT
8	Errors in Contract Documents/ Schedule (T)	32	28	25	7	92	191	0.519	8	35	CONT
DURING CONSTRUCTION											
9	Redesigning (C & T)	17	30	19	26	92	238	0.647	2	15	CONS
10	Disputes and clashes on site (T)	27	44	17	4	92	182	0.495	7	36	CONT
11	Use of costly material/poor market survey (C)	12	29	36	15	92	238	0.647	3	16	CONS
12	Poor quality of work/ Rework (C & T)	8	22	37	25	92	263	0.715	1	7	CONT
13	Non adherence to the contract conditions (T)	12	39	34	7	92	220	0.598	4	25	CONT
14	Primitive technologies used (T)	28	27	29	8	92	201	0.546	6	32	CONS
15	Location of site/ difficult terrain/ lack of proper access (T)	25	18	41	8	92	216	0.587	5	27	CLIENT
EXTERNAL REASONS											
16	Irregular Flow of Finance (C & T)	7	24	24	37	92	275	0.747	1	1	CLIENT
17	Fluctuation in Price (C)	5	31	49	7	92	242	0.658	2	11	EXT
18	Cut in Water & Electrical Supply (T)	38	26	24	4	92	178	0.484	5	37	CLIENT
19	Weather Conditions (T)	41	33	14	4	92	165	0.448	8	40	EXT
20	Political & Other External Influence (T)	13	41	29	9	92	218	0.592	4	26	EXT
21	Wire/ Theft of Materials (T)	41	27	22	2	92	169	0.459	7	38	EXT
22	Government Influence (T)	12	41	26	13	92	224	0.609	3	24	EXT
23	Work Stay Due to Act of God (T)	47	18	13	14	92	178	0.484	6	39	EXT
MANAGEMENT PROBLEMS											
24	Lack of Experience (T)	16	23	36	17	92	238	0.647	4	17	CONT
25	Delay in Decision by Client (T)	6	43	31	12	92	233	0.633	8	22	CLIENT
26	Delay in Decision by Architect (T)	0	27	47	18	92	267	0.726	1	5	CONS
27	Delay in Decision by Consultant (T)	12	29	43	9	93	235	0.639	7	20	CONS
28	Delay in Decision by Contractor (T)	22	24	40	6	92	214	0.582	9	28	CONT
29	Delay in Payment for Work Order (T)	16	30	24	22	92	236	0.641	5	18	CLIENT
30	Inadequate Safety Measures/ Accidents (C & T)	33	25	25	9	92	194	0.527	10	34	CONT
31	Lack of Supervision (C & T)	7	32	42	11	92	241	0.655	2	13	CONT
32	Lack of Co-ordination between Different Parties Involved (C & T)	17	22	34	19	92	239	0.649	3	14	CONT
33	Lack of Efficient Staff (T)	12	34	28	18	92	236	0.641	6	19	CONT
SHORTAGE IN RESOURCES											
34	Delays in Purchasing of Materials (C & T)	13	29	37	13	92	234	0.636	5	21	CLIENT
35	Delay in Supply of Material (T)	7	30	40	15	92	247	0.671	4	12	CLIENT
36	Delay in Procurement/ Supply of Equipments (T)	3	29	50	10	92	251	0.682	3	10	CLIENT
37	Equipment Breakdown/ Non Availability (T)	20	32	30	10	92	214	0.582	6	29	CLIENT
38	Improper Material Management (T)	3	28	38	23	92	265	0.720	2	6	CONT
39	Improper Labour Management (T)	2	30	29	31	92	273	0.742	1	2	CONT
40	Labour Strike (T)	36	24	15	17	92	197	0.535	7	33	CONT

5. Discusson of Results

This section discusses the results obtained by analysis of data collected from various construction personnels by Relative Importance Method and finding the most important influencing factors caused for cost & time overrun in groupwise.

5.1 Before Construction

Based on the ranking, Figure 4 shows the top three most influencing factors caused for time and cost overrun before construction were:

- a. Faulty designs (RII= 0.763) (C & T)
- b. Inaccurate estimate of time and cost (RII= 0.734) (C & T)
- c. Land acquisition problem (RII= 0.712) (T)

Note - Here C means Cost overrun & T means Time overrun

5.2 During Construction

From fig. 5, based on ranking, during construction the top three most significant factors caused for both cost & time overrun were:

- a. Poor quality of work / rework (RII-0.715) (C & T)
- b. Redesigning (RII-0.647) (C & T)
- c. Use of costly material/poor market survey (RII-0.647) (C)

5.3 External Reasons

From figure 6, based on ranking, following are the top three external significant factors caused for both cost & time overrun were:

- a. Irregular Flow of Finance (RII-0.747) (C & T)
- b. Fluctuation in Price (RII-0.658) (C)
- c. Government Influence (RII-0.609) (T)

5.4 Management Problem

From Figure 7 based on ranking, the top three factors caused for time & cost overrun regarding management problem were:

- a. Delay in Decision by Architect (RII-0.726) (T)
- b. Lack of Supervision (RII-0.655) (C & T)
- c. Lack of Co-ordination between Different Parties Involved (RII-0.649) (C & T)

5.5 Shortage in Resources

From Figure 8, based on ranking, following top three factors caused for cost and time overrun because of shortage in resources were:

- a. Improper Labour Management (RII-0.742) (T)
- b. Improper Material Management (RII-0.720) (T)
- c. Delay in Procurement/ Supply of Equipment's (RII-0.682) (T)



Fig 4: RII of Influencing Factors Occurs Before Construction

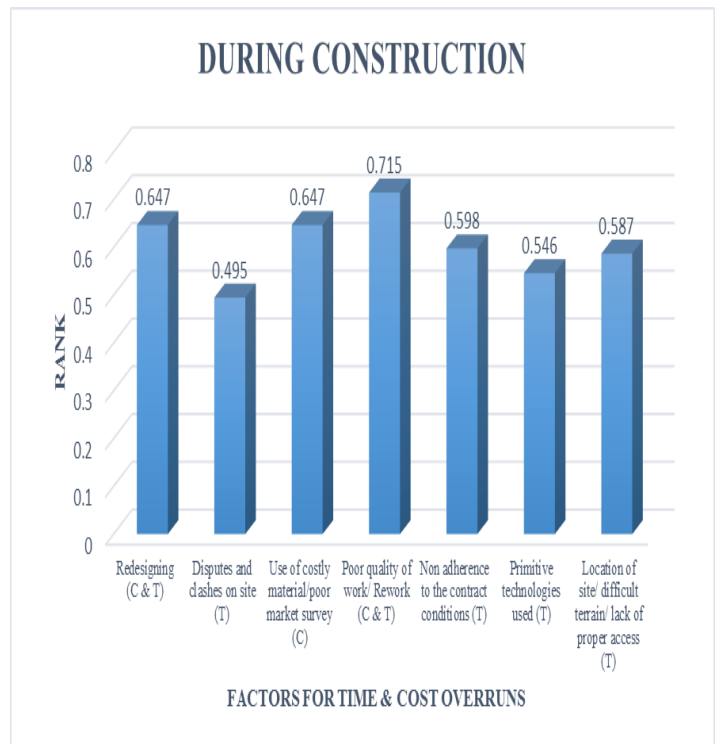


Fig 5: RII of Influencing Factors Occurs During Construction

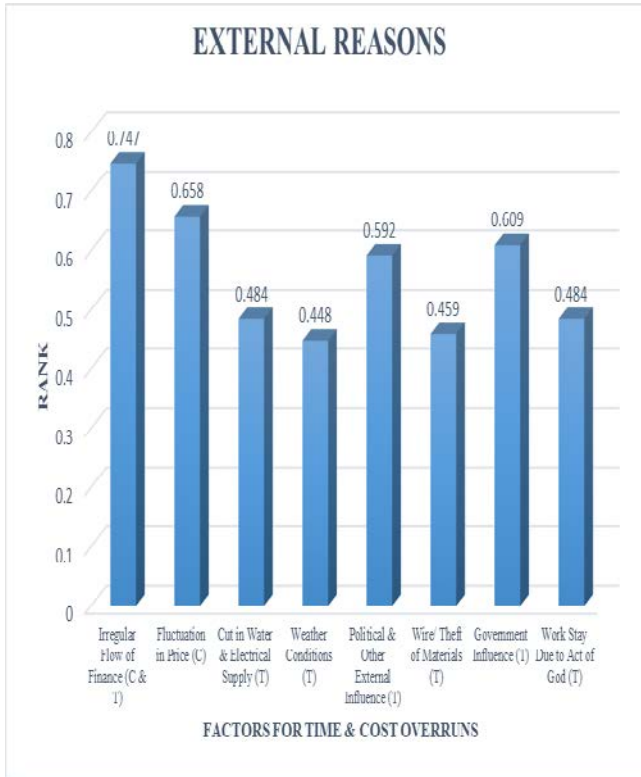


Fig 6: RII of Influencing factors of External Reasons

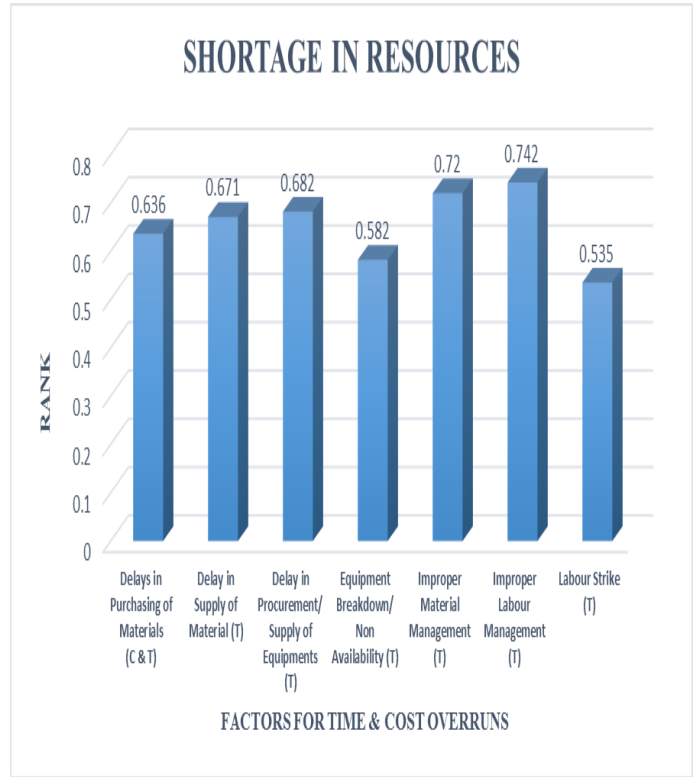


Fig 8: RII of Influencing Factors Due To Shortage in Resources

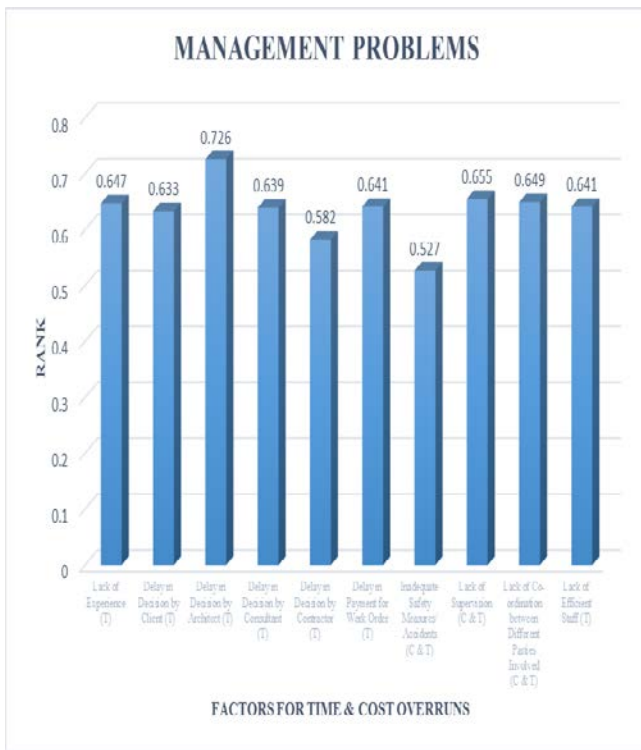


Fig 7: RII of Influencing Factors of Management Problem

5.6 Ranking of top ten causes of cost & time overrun (based on overall ranking)

Table no.2 also Shows that top ten influencing factors such that (1) Irregular Flow of Finance (RII-0.747) which leads to both cost & time overrun and which is client related factor. (2) Improper Labor Management (RII-0.742) which is caused for time overrun and it is contractor related factor. (3) Faulty designs (RII-0.736) which leads to both cost & time overrun and which is consultant related factor.(4) Inaccurate estimate of cost and time (RII-0.734) which leads to both cost & time overrun and which is client related factor. (5) Delay in Decision by Architect (RII-0.726) which leads to only time overrun and which is consultant related factor. (6) Improper Material Management (RII-0.720) which leads to time overrun & which is contractor related. (7) Poor quality of work/ Rework (RII-0.715) which is caused for both cost & time overrun and it is contractor related factor. (8) Land acquisition problem (RII-0.712) which leads to time overrun and which is client related factor. (9) Improper site planning (RII-0.693) which leads to time overrun and which is consultant related factor. (10) Delay in Procurement/ Supply of Equipment’s (RII-0.682) which leads to time overrun and which is client related factor.

6. Case studies

In the case study, we have studied the causes responsible for time overruns and cost overruns of a construction project and suggest the probable measures through a questionnaire survey, which was filled by various project heads, consultants and contractors. We have studied several projects in and around Pune.

Following Companies selected as a case studies:

- Madhuban Builders
- Sai Mangal construction
- Nyati Construction
- Yashada Develope

7. Findings of the study and recommendation

The specific findings from the cases and the survey are as follows:

7.1 Inference from the case studies

After doing the case studies it is clear that the problem of time and cost overrun is not bound to any particular type or size of project, neither has it had any limitations for the location or region. All of them faced more or less similar problems of time and cost overruns. The difference was only in the quantum of these overruns. The reasons of these overruns were mostly known and controllable.

Still they are facing these problems because of the following reasons:

- i. Poor project appraisal and formulation
- ii. Improper implementation of plans
- iii. No advanced action taken by any of the parties involved
- iv. No advance clearances from the local authorities and other agencies
- v. No adequate measures were taken for the availability and proper flow of funds
- vi. Delays in decision making
- vii. Loosely framed contracts
- viii. Poor monitoring and control of activities
- ix. Insufficient use of modern technologies available

In all, poor planning, implementation and management are the main reasons for time and cost overruns in both the projects. Since most of the reasons are well known and can be controlled if a proper arrangement is made.

7.2 Inference from the survey

The following inferences can be drawn out from the opinion survey, the time and cost overrun of any project are mainly due to

- a. Irregular Flow of Finance
- b. Improper Labour Management
- c. Faulty designs
- d. Inaccurate estimate of cost and time

- e. Delay in Decision by Architect
- f. Improper Material Management
- g. Poor quality of work/ Rework
- h. Land acquisition problem
- i. Improper site planning
- j. Delay in Procurement/ Supply of Equipment's

Note – The factors above are written in a decreasing order of ranking from factor with affects the project highest. The ranking is derived from the survey conducted.

7.3 Recommendations to minimize time and cost overruns

Since the time and cost overrun and in control is extremely vast and complex subject which requires in-depth studies and it also requires a sound knowledge of other specialized subjects like Financial management, Risks Management, Legal Frameworks for construction, Project Management and others, it becomes difficult to suggest any solution to minimize overruns.

However, the foregoing analysis of the reasons for time and cost overruns definitely provides some clues for the remedial steps. These can enumerated as follows:

a) Better formulation and Appraisal of Projects

Investment decision on a project should be undertaken only after full investigation, collection of data, analysis and crystallization of the concept. Since in many projects, this analysis may be expensive and may require preparation of the detailed project report, the fast stage clearance should be used to eliminate those project ideas which are prima-facie not viable and on which expenses for detailed analysis may not be incurred. For this purpose, suitable databank for project analysis containing data about other similar projects (past & present) should be developed. Evaluation studies of completed projects should also help in developing this bank data. Once final investment decision after sound appraisal is taken, no significant change in project concept, location, technology and scope should normally be permitted.

b) Sound Implementation Planning

Sound implementation planning is a pre-requisite for effective implementation. Realistic, resource - based (resource requirements matched with availability constraints) implementable plans can be formulated by using techniques such as PERT/CPM and estimating activity times, linkages and resource requirements realistically through an inter-disciplinary group-process where experiences of many persons is pooled together. Here also a data bank on similar projects (past and present) would be useful. Where protect authorities do not have sufficient experience or data, consultants can be employed for this task. Generally, a slack of about 10-15 per cent should be kept in reserve and an internal network for shorter duration

may be drawn up which may be used by the implementing staff. Alternatively, the 10-15% stock may be implicitly included in the time duration of the last one or two activities. This 'reserve' is a means to meet the contingency of unforeseeable delays. Good computer software packages are available for project planning with PERT/CPM, equipment scheduling, manpower planning, cost optimization and control, monitoring etc. which could be effectively used. With sound implementation planning after proper project formulation more than half of the battle is won.

c) Advance Action

Even after the government approval of the project, there may be many clearances required from various government agencies, in order to save time, there may be one or more 'Empowered Committees', consisting of the of the secretaries or senior officials from concerned ministries, which may give some of the necessary clearances. Some major projects, for which such committees were constituted, were successful in minimizing time and cost over-runs.

d) Assurance of Funds Resources

Once a project is approved for investment and 'go ahead' is given, funds should be committed to meet the requirements (both for the project and for the inter-linked activities/projects of other agencies on which it is dependent) as determined from the Programme of work projected by resource-based network. There should not be piecemeal or adhoc based network. It may be advisable to determine year-wise requirement of funds for all projects under implementation for the whole plan period, which may be updated at each annual plan. Similarly, year-wise requirements for key materials like cement; steel can also be worked out in advance which should be committed by the respective allocating agencies, till the completion of the project.

e) Better Contract Management, Penalties and Incentives

Since in majority of projects, execution is through contracts, their proper management is a key to minimize time and cost over-runs. The contract planning (both for works and equipment supplies) has to be linked closely to resource-based implementation planning of the projects. Contractors and suppliers should be bound to give their resource and time plans integrated with project plans (based on PERT/CPM) and follow them. Each contract's dates should be as per the detailed network. There should be close follow-up and interaction. Existing penalties and incentives need to be considerably enhanced so that contractors are also interested in on-time performance. Where delays are anticipated, project authorities should be able to off-load contracts (partially or fully) to other parties (either within the country or abroad) well in time. Target cost contracts with incentives for savings should be encouraged to minimize time over-

runs. Where consultants are used for planning, awarding and following up the contracts, the effectiveness of consultants in contract management should be properly evaluated. 'Expeditors' from project authorities or consultants can be helpful in watching progress, expediting deliveries and giving advance warnings, as they will be stationed at or visiting the suppliers' shops. Contractors should be considered as partners in project execution and help should be provided in solving their genuine problems, as otherwise project execution will be help up.

f) Monitoring

A simple and effective monitoring system is essential to identify and anticipate the deviations from implementation plan, analysis the underlying problem areas and suggest corrective action. Anticipation is important from the point of view of preventing or overcoming the problems before they occur or taking alternative steps to minimize their impact on project time and cost. A good data bank on implementation of activities of this and other similar projects (past and present) could greatly help in the monitoring process. Over-monitoring should be avoided as it leads to unnecessary paper work, tying up of project manpower resources and viewing of monitoring as an end in itself rather than as means to achieving the ends. Emergence of 'Project Monitoring', as a specialized profession should be encouraged. The objective of external agencies, which are monitoring the performance, should also be to provide help in solving problems rather than finding faults. Joint 'Monitoring groups' can be established, which may consist of representatives of the project as well as inter-linked agencies and the parties concerned. The groups could monitor and review the progress of the complete system -the project and the inter-linked activities/projects. For problem solving and action, the primary agency is the project authority.

g) Management Techniques, Systems, Incentives

Industrial engineering and management techniques such as method study, value engineering, etc., can help in reducing time duration of activities and giving up of unnecessary items/activities. Over-specification can be avoided so that the costs can be reduced. The project organization should be distinct, separate from operation side, complete with all functions, under the charge of one competent project leader and with all responsibilities clearly defined. There should be full delegation to project leader and his team and down the line. The systems and methods should be clearly laid down and manualized. Human side of project management is an important (if not more) as the quantitative techniques and attention to inter-personal skills, interaction, human resources development etc. is important from the very initial stage. After all, implementation of a project is a group or team effort. It is the effectiveness of this team effort, which will determine the success of the project. In the projects

which were successful in meeting their time cost targets, the core project management team, starting from the top person, had full commitment and made it a mission or a goal to complete the project within its time schedule/cost, whatever may be problems and they achieved this. This spirit should also be followed up with incentives (in the form of rewards, promotions, recognitions etc.) for those who achieve time and cost targets and punishment for those who fail badly, and this linkage between project performance and incentives/punishment should be clearly visible. The core project team should be properly chosen and placed preferably during the formulation stage and thereafter it should stay till the completion of the project. Changes in the team, particularly, the project leader, should be made only in exceptional cases.

8. Conclusions

Time & Cost are the lifelines of every construction project. The successful completion of construction projects within the specified time has become the most valuable and challenging task for the Managers, Architects, Engineers and Contractors. This study provides most influencing factors caused for time & cost overruns. The relative importance index (RII) can be used as an effective tool for analysis on time & cost overruns.8.2

8.1 Important causes of time & cost overrun:

This study conducted through questionnaire survey for finding factors caused for cost and time overruns in construction projects in Pune. Out of 160 sets of questionnaire survey, 92 (57.5%) sets were received back, data were analyzed by RII method and finding most important factors overrun by giving ranking to them. Two samples of case studies were studied in detail for finding the same. This study identified 10 most important factors caused for time and cost overrun in construction projects in Pune from questionnaire survey were:

- Irregular Flow of Finance
 - Improper Labor Management
 - Faulty designs
 - Inaccurate estimate of cost and time
 - Delay in Decision by Architect
 - Improper Material Management
 - Poor quality of work/ Rework
 - Land acquisition problem
 - Improper site planning
 - Delay in Procurement/ Supply of Equipment's
- And from **Case Studies in Pune** were:
- Poor project appraisal and formulation
 - Improper implementation of plans
 - No advanced action taken by any of the parties involved

- No advance clearances from the local authorities and other agencies
- No adequate measures were taken for the availability and proper flow of funds
- Delays in decision making
- Loosely framed contracts
- Poor monitoring and control of activities
- Insufficient use of modern technologies available

8.2 Learnings:

After doing the analysis over the time & cost overrun of construction projects in Pune the following learnings have been made

- It will not possible to execute the construction projects within the desirable schedule and cost without sound implementation of planning. Management needs to focus on sound planning.
- Most of the labours working in Pune coming from other state and having a poor knowledge regarding the new techniques in construction. It will need to focus on arranging proper training programs for the skills improvement of labours by the management.
- From the case studies it has been found that Government sanction authority for getting permission of new construction projects changed from TP (Town Planning) to PMRDA (Pune Metropolitan Region Development Authority) which needs more time. So it is need to focus on such sanctioning process of projects.
- Since most of the projects in Pune delayed due to improper management of manpower resources by the contractors. It will need to focus on such issue by the management.
- Finally management also needs to increase the efficiency of works by conducting labour welfare, recognition programs for the motivation of labours.
- Every activity as per planned schedule of contractor must be recorded by the project manager weekly and take the sign of contractor, check the executed activity regularly by the PM whether it is completed or not as per the schedule. This practice may reduce time as well as cost overrun considerably.

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