

Analysis & Identification of Time and Cost Overruns in Built Environment, India

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Abstract - Construction sector is emerging new drifts and developments, which are contributing for innovation and increase of global collaborative projects. Factors like TIME, COST and QUALITY are measured to sustain and to increase market of the company/business. To co relate those parameters, business strategies are to be implemented to meet the project needs and factors like KPI's (Key performance Indicator's), CSF (Critical Success factors) and early identification of risks etc. are the considerations. So, stake holders of the company are very much involved in performance of the project with Time and cost analysis. In Indian scenario, projects with large investments are getting delayed due to time and cost overruns only few of them are getting delivered in time and within the budget. The identification of problems behind the overrun of time and cost will have more factors and possibly severe at its impact to the overall project. So, this paper was drafted to evaluate the construction projects of having more investment and to acquire overruns, about 48 responses are analysed to evaluate the major and minor problems and risks also on the other hand mock interviews are also conducted with construction professionals to understand impacts from key stakeholders by using PCAS and RI.

Keywords: Gross Domestic Product (GDP), Principal Component Analysis (PCAS), Relative Importance Index (RI) method.

I. INTRODUCTION

In India, infrastructure industry assumes a huge part in national monetary development and financial change of the country with global presentation. The occurrence between the infrastructure business and the more extensive economy gets generally from three of the business highlights in particular: people in general segment as its real customer, its huge market measure with the capacity to create venture which contribute essentially to the national GDP, and as a noteworthy wellspring of work both specifically and by implication by its multiplier impact. In the other hand, development part is the most elevated beneficiary of government planned activities as far as government improvement designs.

For any successful construction project there are three measurable performances (time, cost & quality) are taken into considerations. While planning for a project, the planner will assume for completion of projects in stipulated time with minor delay, but as a matter of fact there are many other factors that can be considered for delay. The important is that the builder/ contactor have the responsibility and his experience towards performing every activity properly will show the difference in overall progress. Negligence and poor performance are the main problem for delaying the project. This paper will investigate the reasons behind time & cost overruns occurred in built environment through the questionnaire survey. Different attributes were included to the survey to identify the reasons for delaying the projects and increase of Time, Cost and Quality of project. The research project **II. LITERATURE REVIEW** The expression "project delay" might be viewed as an inadequacy of the undertaking group in the customer and

will apply the quantitative analysis involving the case

studies and it is useful for getting the conclusions gathering

from qualitative analysis by using questionnaire survey.

inadequacy of the undertaking group in the customer and partner imminent, however the components asserting the deferral ought to be seen in more extensive planned. As indicated by Rowland (1981) and Hinze, et al. (1992) the expansion in project time won't just influence the cost, yet in addition relates the multifaceted nature of dealing with the occupations because of number of changes in the proposed plans and schedules of the undertaking orders. With reference to the worldwide overview on development and framework extends on cost accelerations with crossing 20 nations and five continents, it was discovered that cost increment of 45% for rail projects, 34% for transport roads and extensions and 20 % for tunnels and bridges (Flyvbjerg et al.2003), in the other examination Flyvbjerg et al. (2002) had discovered that 90% of development projects are under-evaluated expenses and overwhelms of 50-100% were normal. In a noteworthy report for the World Bank, Kenny (2010) distinguished India had spent portion of all transport projects have taken a toll invades over 25% and time surpassing half. Bartholomew (1998)has characterized the deferment as stoppage of work coordinated to the temporary worker by a customer, while delay is alluded as backing off of work without ceasing it totally. Abu Hammad, et al (2010) and Ozcen-Deniz, et al (2012), development delay is thought to be a standout

mongst the most incessant and essential test in the development business. In the examination led by Hutchings and Christofferson (2001), little volume private development organizations in the United States had distinguished the key variables to organization's prosperity can be found in the accompanying parameters, for example, workmanship, genuineness, having quality good subcontractors, client interchanges, notoriety, having great representatives and completing task occasions and exercises on time. A portion of the inquires about corresponded to progress elements of the organizations can be recognized that the organization's administration frameworks and practices Lussier (1995), According to Saleh et.al (2009) has characterized the associated sorts of delays as under:

Sorts of Delays in Construction industry:

In order to determine the compensations for delays, the delays may be explained into the following two categories:

- unforgivable delays
- forgivable delays

Unforgivable delays:

The delays which are caused due to negligence of performing working in terms areas like slow process, low quality materials, poor work man ship and other variables. This may have direct and indirect impact on overall progress of the project, unforgivable delays may also encounter with client late decision making, delay in assessing the quality of materials and other contractual issues.

Forgivable delays:

- a. Non-compensable postponements
- b. Compensable delays

III. METHODOLOGY

A methodology to diagnose, evaluate and identify the time and cost overrun issues in built environment. A thorough literature review was carried out along with case studies and one to one interviews to professionals involved in ACE industry. The questionnaire is design to identify significant factors that influence the cost overrun and time delays in construction projects to rectify these factors, supporting literature reviews from previous journals papers, writings from various authors, conference proceedings and conversation with participants of all groups involved in ACE had co-operated in preparing the notable factors in the ACE industry.

The questionnaire is designed based on the literature review and to support all the players of the industry as it is easy to read and the responses are easy to fill in. The questionnaire will be conducted among the different parts of India, where cash flow is identified as high in infrastructure development from construction professional of both public and private sectors to obtain feed from the survey. These questionnaires was distributed with both contractors & project management team of construction industry, the below flow diagram can elaborate the distribution process towards the respondents.

Project Management Team (PMT) ^{(Ch} in Engine Main Contractor Team

Ouestionnaire

- 1. Project Managers
- 2. Senior Engineers
- 3. Site Managers
- 4. Design Team

Principal Component Analysis (PCAS) is a quotable methodology that uses an orthogonal change of pattern over set perceptions of potentially related factors into an arrangement of assessments of directly unlinked factors called Principal Components. Generally PCAS is utilized as a part of exploratory information examination and for making prescient models. The quantity of main parts is not exactly or equivalent to the first factors.

The RI was utilized to rank (R) the distinctive causes. These rankings made it conceivable to cross-think about the relative significance of the components as saw by the two groups of respondents (for both project management team and contractors). The data received from the questionnaire

- 1. Contractor
- 2. Sub-Contractor
 - 3. Suppliers
 - 4. Non-Technical Contractors

is analysed by Relative Important Index (RI) method to describe the relative importance of factors causing time with cost overruns of the construction projects. The ranking of factors is calculated by following formulae.

$$RI = \frac{\Sigma W}{A * N}$$

RI= Relative Important Index'

W = Weightage given to every issue by the respondents commencing the questionnaire circulated

(Ranging from 1 as minimum and to 5 as maximum)

A = Highest weightage (i.e. 5 as maximum),

N = overall number in the sample.



The data from the questionnaire was analysed statistically. These sections are designed to obtain the responses on an ordinal scale that indicates the relative importance of various time and cost overrun risk factors. Ordinal scale used in the study will be adopted for each factor to rate using five point scale of 1 to 5 is considered. The weightage was given as follows; 1=Not Sure, 2=Strongly Disagree, 3=Disagree, 4=Agree, 5=Strongly Agree

IV. RESULTS AND ANALYSIS

To assist the objectives from the case studies a qualitative approach was performed in the form of questionnaire survey. The questionnaire was distributed to the personnel in various cities around India and collect data from the survey. In part A the questionnaire was analysed by using Principal Component Analysis (PCAS). In this Extent Index and Standard deviation of the collected responses were calculated and separately calculating Extent Index and Standard Deviation for Contractor related factors and PMC related factors.

PMC related factors:

Table 4.1: Extent Mean to the Factors

	Su	Extent	Standard
FACTORS	m	Mean	Deviation
Lack of construction planning	49	3.612245	1.12152095
No familiar skills to manage all parties	49	3.42857 1	1.06904496
Slow-implementation of decision with project team	48	3.583333	1.13345587
Out run from project schedules & controlling	48	1ter	1.37878267
Misguided thinking in evaluating time and assets	48	3.770833	0.96262625

Contractor related factors:

Arbitrations with contractor	48	2.916667	1.32024829
Lack of information flow between			
project team members	48	3.1875	1.25260146
Project period with milestone			
deadlines	47	3.06383	1.03972695
Disputes and negotiations among			
the other players	47	2.93617	1.07987894
Poor documentation and no			
scheduled procedures	48	3.125	1.40867845
Delays in designing & lack of			
instructions	48	3.4375	1.13479531
T · C1 ·	40	2 222222	1.0/710727
Inexperience of designers	48	3.333333	1.06/18/3/
Not pro-active with events and			
activities	48	3.270833	0.97338719
Bad contact management by			
consultants	48	2.791667	1.30636795
Delay of materials approved by			
supply chain	48	3.458333	1.15394853
	40	2 1 2 5	1 19265605
No proper quality with materials	48	3.125	1.18303005
Late approval for insitu tests	48	3 020833	1 14545448
Late approval for filsitu tests	0	5.020055	1.14545440
Delay in payments	48	3.729167	1.11317083
Absonce of consultants site staff	19	2.0625	1 20752271
Absence of consultants site staff	40	5.0025	1.29/353/1

From table 4.1 it was identified that "Misguided thinking in evaluating time and assets" has the highest mean of 3.77. "Bad contact management by consultants" was voted as lowest mean of 2.79 in PMC related factors point of view. From these criteria, key factors among the others in table 4.1 are, "Misguided thinking in evaluating time and assets", "Delay in payments", "Poor planning of events and activities ", "Slow-implementation of desicion with project team " and "Delay of materials approved by supply chain" are the major 5 PMC related factors causing time and cost overruns.

FACTORS	Sum	Extent Index	Standard Deviation
Improper site management	43	3.7906977	0.903691127
Deficient with technical staffs	43	3.627907	0.965046229
Machinery and tool shortage on site	43	3.3488372	1.097221034
Dishonourable actions performed by the contractors to gain the highest possible form of profit	43	2.5116279	1.086322857
Workmen ship during construction	43	2.8604651	1.152981884
Lack of skill- with the activities	41	3.3902439	1.079251068
Poor planning of events and activities	43	3.1627907	1.413065817
Poor Management with sub contractors	43	2.7906977	1.423362209
Lack of decision making with onsite problems	43	3.1627907	1.461605243
Re-construction of structural components due to bad quality	42	2.7857143	1.406375183
Scarcity of construction materials during work time	43	4.1395349	1.090794363
Delay of material delivery	43	4.0697674	1.246303349
Poor planning with supply chain	43	3.6976744	1.023784219
Poor handling of material	43	2.9534884	1.140246574
Shortage of skilled labour	42	3.952381	0.924594659
Inaccurate prediction of equipment performance	42	2.8571429	1.301490511
Breakdown of Equipment and its availability	43	3.4186047	1.061647647
Poor maintenance of equipment	43	2.8837209	0.993216582
Circumstances of local people	43	3.4418605	1.126887576
Poor site conditions (Location, Ground, etc.,)	43	3.8837209	1.242826904
Arbitrations with contractor	43	3.0232558	1.171132866
Lack of information flow between project team members	42	2.9285714	1.369616859
Quality of finishes furnished	43	3.1395349	1.047286535



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Changes proposed during construction	43	3.2093023	1.303985653
Changes proposed by the client	42	3.0714286	1.261005969
impractical owners initial requirement	42	2.8571429	1.456862718
Disputes and negotiations among the other players	43	2.8604651	1.322108875
Poor maintenance of contract related documents	42	2.9761905	1.336094081
Project period with milestone deadlines	43	2.8837209	1.3155475
Poor selection of sub-contractors	43	3.3255814	1.376225547
Assigning responsibilities to low skilled players	43	3.4418605	1.225738042
Un aware of consultant instructions	43	3.0930233	1.177580363
Flow of cash for day to day activities	43	3.9534884	1.160462786
Lack of protection for tested material	43	3.3255814	1.005124781
Lack of contractor competition to the project	43	3.0930233	1.326193249
No previous experience with site staff (managerial and supervisory personal)	43	3.2093023	1.090298434

Table 4.2: Extent Mean to the Factors

From table 4.2 it was identified that "Scarcity of construction materials during work time" has the highest mean of 4.139" and "Unethical behaviours used by the contractors to gain the highest possible form of profit" has the lowest mean of 2.511 in Contractor's point of view and other key factors from table 4.2, "Scarcity of construction materials during work time", "Delay of material delivery", "Flow of cash for day to day activities ", "Shortage of **PMC related factors:**

skilled labour ", "Poor site conditions (Location, Ground, etc.,)" are the major 5 Contractor related factors causing time and cost overruns.

RI is an indicator of recurrence of variable from the respondent point of view. The indices can be used to determine rank of each factor. The RI results are shown in table 4.3 and table 4.4 below,

Factors	Sum	Ν	Mean	RI
Poor planning of events and activities	49	50	3.54	0.708
Poor Management with sub contractors	49	50	3.36	0.672
Slow-implementation of decision with project team	48	50	3.44	0.688
Out run from project schedules & controlling	48	50	2.76	0.552
Misguided thinking in evaluating time and assets	48	50	3.62	0.724
Arbitrations with contractor	48	50	2.8	0.56
Lack of information flow between project team members	48	50	3.06	0.612
Project period with milestone deadlines	47	50	2.88	0.576
Disputes and negotiations among the other players	47	50	2.76	0.552
Poor documentation and no scheduled procedures	48	50	3	0.6
Delays in designing & lack of instructions	48	50	3.3	0.66
Inexperience of designers	48	50	3.2	0.64
Not pro-active with events and activities	48	50	3.14	0.628
Bad contact management by consultants	48	50	2.68	0.536
Delay of materials approved by supply chain	48	50	3.32	0.664
No proper quality with materials	48	50	3	0.6
Late approval for in situ tests	48	50	2.9	0.58
Delay in payments	48	50	3.58	0.716
Absence of consultants site staff	48	50	2.94	0.588

Table 4.3: Relative Importance Indices to the Factors

Table 4.3 shows "Misguided thinking in evaluating time and assets" has the highest RI of 0.724 and "Bad contact management by consultants" has the lowest RI of 0.536. The major 5 factors causing time and cost overruns from RI are "Misguided thinking in evaluating time and assets", "Delay in payments", "Poor planning of events and activities", "Slow-implementation of decision with project team", "Poor Management with sub contractors".

Contractor related factors:

FACTORS	Sum	Ν	Mean	RI
Improper site management	43	50	3.26	0.652



Deficient with technical staffs	43	50	3.12	0.624
Machinery and tool shortage on sight	43	50	2.88	0.576
Dishonourable actions performed by the contractors to gain the highest possible form of profit	43	50	2.16	0.432
Workmen ship during construction	43	50	2.46	0.492
Lack of subcontractor's skills	41	50	2.78	0.556
Poor planning of events and activities	43	50	2.72	0.544
Poor Management with sub contractors	43	50	2.4	0.48
Lack of decision making with onsite problems	43	50	2.72	0.544
Re-construction of structural components due to bad quality	42	50	2.34	0.468
Scarcity of construction materials during work time	43	50	3.56	0.712
Delay of material delivery	43	50	3.5	0.7
Poor planning with supply chain	43	50	3.18	0.636
Poor handling of material	43	50	2.54	0.508
Shortage of skilled labour	42	50	3.32	0.664
Inaccurate prediction of equipment performance	42	50	2.4	0.48
Breakdown of Equipment and its availability	43	50	2.94	0.588
Poor maintenance of equipment	43	50	2.48	0.496
Circumstances of local people	43	50	2.96	0.592
Poor site conditions (Location, Ground, etc.,)	43	50	3.34	0.668
Arbitrations with contractor	43	50	2.6	0.52
Lack of information flow between project team members	42	50	2.46	0.492
Quality of finishes furnished	43	50	2.7	0.54
Contract clause changes	43	50	2.76	0.552
Changes proposed by the client	42	50	2.58	0.516
Impractical owners initial requirement	42	50	2.4	0.48
Disputes and negotiations among the other players	43	50	2.46	0.492
Poor maintenance of contract related documents	42	50	2.5	0.5
Project period with milestone deadlines	43	50	2.48	0.496
Poor selection of sub-contractors	43	50	2.86	0.572
Assigning responsibilities to low skilled players	43	50	2.96	0.592
Un aware of consultant instructions	43	50	2.66	0.532
Flow of cash for day to day activities	43	50	3.4	0.68
Lack of protection for tested material	43	50	2.86	0.572
Lack of contractor competition to the project	43	50	2.66	0.532
No previous experience with site staff(managerial and supervisory personal)	43	50	2.76	0.552

Table 4.4: Relative Importance Indices for the Factors

From table 4.4, "Scarcity of construction materials during work time" has the highest RI of 0.712 and "Dishonourable actions performed by the contractors to gain the highest possible form of profit" has the lowest RI of 0.432. The major 5 factors causing time and cost overruns from RI are "Scarcity of construction materials during work time", "Delay of material delivery", "Flow of cash for day to day activities ", "Poor site conditions (Location, Ground, etc.,)", "Shortage of skilled labour".

4.1 Comparison between Extent Index and Relative Importance Index (RI):

The comparative study between Extent index and RI can provide substantial review on the key factors of delay, to perform the comparison; each factor should be given with ranking, i.e. the results which are obtained through both the methods can be seen in table 4.5.

PMC related factors:

Factors	Extent Index	Rank	RI	Rank
Misguided thinking in evaluating time and assets	3.770833	1	0.724	1
Delay in payments	3.729167	2	0.716	2
Poor planning of events and activities	3.612245	3	0.708	3
Slow-implementation of desicion with project team	3.583333	4	0.688	4
Delay of materials approved by supply chain	3.458333	5	0.664	6
Delays in designing & lack of instructions	3.4375	6	0.66	7
Poor Management with sub contractors	3.428571	7	0.672	5
Inexperience of designers	3.333333	8	0.64	8
Not pro-active with events and activities	3.270833	9	0.628	9
Lack of information flow between project team members	3.1875	10	0.612	10
Poor documentation and no scheduled procedures	3.125	11	0.6	11
No proper quality with materials	3.125	11	0.6	11



Project period with milestone deadlines	3.06383	13	0.576	15
Absence of consultants site staff	3.0625	14	0.588	13
Late approval for insitu tests	3.020833	15	0.58	14
Disputes and negotiations among the other players	2.93617	16	0.552	17
Arbitrations with contractor	2.916667	17	0.56	16
Out run from project schedules & controlling	2.875	18	0.552	17
Bad contact management by consultants	2.791667	19	0.536	19

Table 4.5: Comparison between Extent Index and RI of PMC related Factors.

Contractor related factors:

FACTORS	EXTENT INDEX	RANK	RI	RANK
Scarcity of construction materials during work time	4.13953	1	0.712	1
Delay of material delivery	4.0697	2	0.7	2
Flow of cash for day to day activities	3.9534	3	0.68	3
Shortage of skilled labour	3.9523	4	0.664	5
Poor site conditions (Location, Ground, etc.,)	3.8837	5	0.668	4
Improper site management	3.7906	6	0.652	6
Poor planning with supply chain	3.6976	7	0.636	7
Deficient with technical staffs	3.6279	8	0.624	8
Circumstances of local people	3.4418	9	0.592	9
Assigning responsibilities to low skilled players	3.4418	9	0.592	9
Breakdown of Equipment and its availability	3.4186	11	0.588	11
Lack of subcontractor's skills	3.3902	12	0.556	15
Machinery and tool shortage on sight	3.3488	13	0.576	12
Poor selection of sub-contractors	3.3255	14	0.572	13
Lack of protection for tested material	3.3255	14	0.572	13
Contract clause changes	3.2093	16	0.552	16
No previous experience with site staff(managerial and supervisory personal)	3.2093	16	0.552	16
Poor planning of events and activities	3.1627	18	0.544	18
Lack of decision making with onsite problems	3.1627	18	0.544	18
Quality of finishes furnished	3.1395	20	0.54	20
Un aware of consultant instructions	3.0930	21	0.532	21
Lack of contractor competition to the project	3.0930	21	0.532	21
Changes proposed by the client	3.0714	23	0.516	24
Arbitrations with contractor	3.0232	24	0.52	23
Poor maintenance of contract related documents	2.9761	25	0.5	26
Poor handling of material	2.9534	26	0.508	25
Lack of information flow between project team members	2.9285	27	0.492	29
Poor maintenance of equipment	2.8837	28	0.496	27
Project period with milestone deadlines	2.8837	28	0.496	27
Workmen ship during construction	2.8604	30	0.492	29
Disputes and negotiations among the other players	2.8604	30	0.492	29
Inaccurate prediction of equipment performance	2.8571	32	0.48	32
Impractical owners initial requirement	2.8571	32	0.48	32
Poor Management with sub contractors	2.7906	34	0.48	32
Re-construction of structural components due to bad quality	2.7857	35	0.468	35
Dishonourable actions performed by the contractors to gain the highest possible form of profit	2.5116	36	0.432	36

Table 4.6: Comparison between Extent Index and RI for Contractor related factors

From the results out of 19 PMC related factors, 7 major factors were identified as most important and need to have keen observation with the help of KPI's, which are having

RI greater than 0.65 effects and causes time and cost overruns. And out of 36 Contractor related factors, 6 factors which have RI greater than 0.65 may show severe impacts on delay of project cycle. More emphasis is needed to identify different types of risks and implementation of assessing tools for work evaluation.

V. CONCLUSIONS AND RECOMMENDATIONS

This research paper finding had explored the factors which majorly effecting and causes of delays in built environment by the individuals during different stages of construction. From the data analysis, the factors which cause delays were identified with the help of Principal Component Analysis (PCAS) and Relative Importance Index (RI) methods is applied to analyse the major contributing factors.

The complied results phrases five key factors in both PMC and Contractor as a main attributes. As an outline, areas like shortage of material on site, lack of materials on site and slow-implementation of decision with project team are the key contributing factors for delaying the project. To overcome the problems, contractors are suggested to maintain enough storage in order to store needed construction materials with in the project environment. If the Main/sub contractor was not prepared for such situations lag of activities may delay overall project duration. In the other hand skilled labour will show the level of quality and easy of handling the technical issues to compete with complexity of works and can show progress with successful finish. Therefore contractor should maintain skilled labour at site to execute the work in time. The documentation sufficiency relies upon the experience of the contractual worker to upgrade the advance and finish the undertaking on time.

It was prescribed to the temporary workers should enroll qualified specialized staff with proper involvement with the project. The staff will be more successful comprising with enough number of engineers, technicians and supervisors and KPI's. Documentation process for all the activities in the site should be maintained properly. So, that they would be easily monitor the progress of work flow and follow the time schedule properly. Contractor should not relay on the lowest price materials to execute the project. Consultants could give proper instructions to the contractor in execution of project and should prepare day to day activities schedule to track lagging activities and should be trying to avoid delay in decision making for minor risks that may causes delays in progress. Mean of communication and organization between various parties should be maintained properly during the construction project. In PMC point of view, design problems can be caused by different reasons, such as design changes, delays in payments; delays in design approvals by government authorities, contradictions between design documents, Poor planning of events and activities and lack of experience to the design engineers are the design related factors. The above listed factors can directly influence in the project cost. To overcome the PMC problems, the design team and other technical staff should have dedication over the work and should update themselves for trending technology, whilst companies can

provide platform for the employees to have interactive sessions on the technology innovations. So that the construction process can show more promising results from client prospective, the finding of this study can help micro & macro scaled construction companies to understand and prevent the root causes of overruns in their further project.

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