International Journal Of Engineering Research And Development
e- ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 20, Issue 10 (October, 2024), PP 103-111

Causes and Delay Factors Affecting on Profitability of Building Construction Projects

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Abstract- *The construction industry is one of the main sectors that provide important ingredients for the development of an economy. The construction industry is the tool through which a society achieves its goals of urban and rural development. However it is becoming more complex because of the sophistication of the construction process itself and the large number of parties involved in the construction process, i.e., clients, users, designers, regulators, contractors, suppliers, subcontractors, and consultants. Modern construction projects are characterized by new standards, advanced technologies, multiparty participation, and frequent owner-desired changes. The aim of the work is to propose a model framework acting as a guideline for determine the profitability with respect to delay factors and find out preventive measures to maintain the profit level of the project. Delay are the amount of time that passes past the deadline for completion stipulated in a contract or past the delivery date agreed upon by the parties for a project. It is falling behind scheduled and is regarded as a typical issue with construction projects. One of the most frequent issues in construction projects is delays, which have a wide range of detrimental effects on both the project and the parties involved. Also, a comparative study describe with other previous works on the most critical effect of delays in construction projects has been conducted, and the results show that the main effects of delays in the construction industry are at the root of many constraints in reaching and achieving the objectives.*

Keywords: Construction, delay. Profitability, Critical factor, Causes of delay

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Date of Submission: 08-10-2024 Date of Acceptance: 20-10-2024

I. INTRODUCTION

The Indian construction sector has acted as an engine of growth for the Indian economy for over the past five-decades and becoming a basic input for the socio-economic development of the country. Construction is the second largest economic activity after agriculture, and has contributed around 6 to 9% of India's GDP over the past five years while registering 8 to 10% growth per annum. Contribution of the industry in terms of employment is also significant providing 31.46 million jobs with about 1.25 million engineering jobs in 2008–2009.

As per government data, the demand for construction manpower is projected to grow at a consistent pace of 8%–9%, thereby resulting in an annual addition of around 2.5 million jobs to the existing stock with approximately 125,000 new engineering jobs being added annually. Regardless of the economic importance and employment generation of the sector, issues such as low productivity, limited mechanization and lack of professionally qualified employees plague the industry. While the importance of Indian construction sector over the past five years has grown significantly, lack of sophistication across the construction supply chain is one of the key issues in the industry. There is strong evidence of inconsistent performance of Indian construction projects and the trend is growing rapidly. Projects are reportedly failing across all the key performance measures including cost, time and quality performances. Construction projects, especially infrastructure projects, in India have come under tremendous international scrutiny in the wake of the recent 2010 Commonwealth Games. Reasons for these problems range from land acquisition, improper planning and budgeting, to poor coordination and monitoring of the projects. With this growing volume, schedule performance of the Indian construction sector is a certainly significant topic for investigation. While many studies have published on causes and factors affecting schedule and cost performance, most of the studies are area specific. Applicability of such research in Indian construction context still remains unexplored. There is a strong need to understand the attributes that cause the delays, understand the impact of these attributes, combine them into factors, and decipher the interdependencies between these factors. Thus, the primary objectives of this research are to identify the various attributes for construction delay, to identify the relationship between these attributes by statistical methods and

to predict the impact of these identified attributes on construction delay using a regression model in the Indian construction sector.

For this research, a questionnaire survey approach has been adopted to find the impact of various attributes on delay in the Indian construction sector drawing from various international researchers mentioned above. A survey of construction professionals representing various stakeholders involved in construction projects in India was conducted.

II. LITERATURE REVIEW

N. Hamzah, M.A. Khoiry, I. Arshad, N. M. Tawil and A. I. Che Ani (2011), Delay can be defined as time overrun or extension of time to complete the project. Construction delay is something that cannot avoided especially in government agencies in Malaysia. Therefore delay is a situation when the actual progress of a construction project is slower than the planned schedule or late completion of the projects. The causes of delay are taken from the pass literature review. There are two main type of delay: excusable delay and non excusable delay. The literature reviews are summarized and the delay framework is constructed based on the literature review summary in context of public higher learning institution.

Hemanta Doloi, Anil Sawhneyb, K.C. Iyer, Sameer Rentala (2012), Construction projects in India are experiencing widespread delays. Due to a dramatic shift in the capacity and volume of the Indian construction sector over the last decade, the need of a systematic analysis of the reasons of delays and developing a clear understanding among the industry professionals are highly crucial. Using a selected set of 45 attributes, this research first identified the key factors impacting delay in Indian construction industry and then established the relationship between the critical attributes for developing prediction models for assessing the impacts of these factors on delay.

Berrak Bahadir, Olena Mykhaylova (2014), Housing supply is subject to several types of delays. On average, it takes 6 months to get approved for a residential building permit and another 2–4 quarters to complete a construction project. We present a simple two-sector model that incorporates these observations and show that the effect of these delays is not uniform: while they amplify the response of house prices to demand shocks, they dampen the effects of housing supply shocks. Moreover, construction activity depends on the relative duration of the shocks and the construction delays: delays dampen construction booms following temporary shocks, but exaggerate building activity following permanent changes in demand or supply conditions. Our results highlight the importance of capturing the nature and the persistence of the shocks when studying the effects of construction sector delays on housing market dynamics.

III. METHODOLOGY

1 Questionnaire Design

Data were gathered through a questionnaire. The questionnaire is divided into two main parts. Part I is related to general information for both the company and respondent. Both contractors and consultants were further requested to answer questions pertaining to their experience in the construction industry and their opinions about the percentage average time delay in projects and its relation with profit they experienced. Part II includes the list of the identified causes of delay in construction project related to profit. These causes are classified into nine groups according to the sources of delay: Factors related to project, owner, contractor, consultant, design-team, materials, equipment, manpower, and external factors.

For each cause/factor two questions were asked: What is the frequency of occurrence for this cause? And what is the degree of severity of this cause on project delay? Both frequency of occurrence and severity were categorized on afour-point scale. Frequency of occurrence is categorized as follows: always, often, sometimes and rarely. Similarly, degree of severity was categorized as follows: extreme, great, moderate and little.

2 Ranking of attributes

Mean and standard deviation of each individual attribute is not a suitable measure to assess overall rankings as they do not reflect any relationship between them and hence used RII which can be calculated using the following equation:

$$\boldsymbol{RII(Relative\ Importance\ Index)} = \frac{\sum \boldsymbol{w}}{\boldsymbol{A} * \boldsymbol{N}}$$

W =Weight given to each attribute by respondent

A= Highest weight

N =Total number of respondents

The attributes are arranged in ascending order of ranks, attribute with highest RII or rank 1 indicates that it has the maximum impact on the delay while the attribute with lowest rank indicates that it has the least impact on delay duration. However RII doesn't talk about the relationship between the various attributes. To identify if

there is a relationship between the selected attributes, Spearman rank correlation is used. It assesses how well the relationship between two variables can be described using a monotonic function. The sign of the Spearman correlation indicates the direction of association between X and Y. A Spearman correlation of zero indicates that there is no tendency for Y to either increase or decrease when X increases.

3. Data Analysis Approach

The collected data were analyzed through the following statistical techniques and indices: Frequency index: A formula is used to rank causes of delay based on frequency of occurrence as identified by the participants.

$$\boldsymbol{Frequency\ Index}\ (\boldsymbol{F.I.})(\%) = \sum \boldsymbol{a(n/N) * 100/4}$$

Where a is the constant expressing weighting given to each response (ranges from 1 for rarely up to 4 for always), n is the frequency of the responses, and N is total number of responses. Severity index: A formula is used to rank causes of delay based on severity as indicated by the participants.

$$\boldsymbol{Severity\ Index}\ (\boldsymbol{S.I.})(\%) = \sum \boldsymbol{a(n/N) * 100/4}$$

Where a is the constant expressing weighting given to each response (ranges from I for little up to 4 for severe), n is the frequency of the responses, and N is total number of responses. Importance index: The importance index of each cause is calculated as a function of both frequency and severity indices, as follows:

$$\textbf{Importance Index (IMP.I.)(\%)} = [\boldsymbol{F.I.}(\%) * \boldsymbol{S.I.}(\%)]/\boldsymbol{100}$$

4. Remedial Measurements Of Management

Multiple projects management is characterized by the complexity of the issues related to planning, organizing, coordinating and controlling a set of projects simultaneously. Thirty defines the management of the project portfolio as a process of analysis and allocation of resources between organizations, projects and programmes, conducted in order to achieve the organization's objectives and maximize value for stakeholders. In this dynamic process of decision-making the set of active projects is constantly reviewed and updated. The three main questions that need constant verification of answers in managing a set of projects can be formulated as follows.

- Whether the right projects are implemented in the context of the strategic development vision.
- Whether the expenditure incurred on projects are strategically justified.
- Whether the organization has the resources necessary for the implementation of these projects.

A comprehensive multi-project environment is formed mainly by two factors: uncertainty and links between projects. The notion of uncertainty brings another factor crucial for the management of a single project or a set of projects, i.e. risk. The common feature of the management of multiple projects is the necessity to solve the conflict of resources resulting from the links between the projects. The managers focus on the allocation of resources and their ongoing relocation, aiming to solve the problems at the interface of projects on a daily basis.

In a multi-project environment, management decisions connected with solving the Resource Constrained Multi-Project Scheduling Problem (RCMPSP) concern such allocation of limited projects that will allow for minimising the average delay within an individual project or shorten the completion period of an entire set of projects. The methods aiming to solve resource allocation problems classified as N-difficult include precise and heuristic methods, where the former are used with regard to simple scheduling issues, whereas the second group is suitable for solving complex problems, including in a multi-project environment.

In practice, due to a significant effort required when building a network, heuristic methods for calculation purposes are used to a limited extent algorithms based on the priority principle are more frequently used. The period of time in which a project must be completed is considered as one of the main constraints, which is due to three main reasons.

- A delay in project implementation has negative consequences regarding cash flow, related primarily to the increase of general costs (overhead costs)
- A delay in project implementation results also in a very high increase of cost contingency
- The expectations of stakeholders are modified and in a situation of extending completion times of the project or
- Project portfolios there may occur expectations to change the scope of the said projects, change the technology of
- Implementation of project tasks or changes the functionality of the subject of project activities.

IV. RESULT AND DISCUSSION

There are many factors affecting delay and directly related to profit of the construction site. Project related, site related, process related, human related, Authority related and technical issue related problems are identified to be major causes of delay affecting profitability of project.

Table No. 1 Relative Impact Index

Related Process	Note Rank	Description	%	Rank As Per Survey
Project related	R1	Increase in scope of work	81.33	4
	R2	Faulty soil investigation report	64.00	12
	R3	Rework due to change of design or deviation order	81.33	5
	R4	Unrealistic time schedule imposed in contract	68.00	11
	R5	Non availability of drawing/design on time	57.33	15
Site related	R6	Restricted access at site	60.00	14
	R7	Slow decisions from owner	60.00	13
	R8	Delay in material delivery by vendors	92.00	1
	R9	Site accidents due to negligence	40.00	26
	R10	Hostile political conditions	44.00	25
	R11	Inaccurate specification of site condition	48.00	21
Process related	R12	Delay in material to be supplied by the owner	68.00	9
	R13	Delay in approval of completed work by client (i.e. stage passing)	76.00	6
	R14	Delay in material procurement by contractor	40.00	28
	R15	Delay in approval of shop drawings and samples	57.33	16
	R16	Delay in running bill payments to the contractor	72.00	7
	R17	Delay in handing over of site	57.33	17
	R18	Delay in finalisation of rates for extra items	36.00	27
	R19	Improper storage of materials leading to damage	44.00	24
Human related	R20	Consultant or architect's reluctance for change	52.00	19
	R21	Poor site management and supervision	33.33	30
	R22	Poor coordination among parties	68.00	10
Authority related	R23	Obtaining permission from local authorities	40.00	20
	R24	Poor organisational structure for client or consultant	85.33	2
	R25	Changes in government regulations and laws	57.33	18
Technical issues	R26	Lack of motivation for contractors for early finish	36.00	29
	R27	Financial constraints of contractors	44.00	23
	R28	Poor labour productivity	72.00	8
	R29	Inadequate experience of contractor	81.33	3
	R30	Change in material prices or price escalation	48.00	22

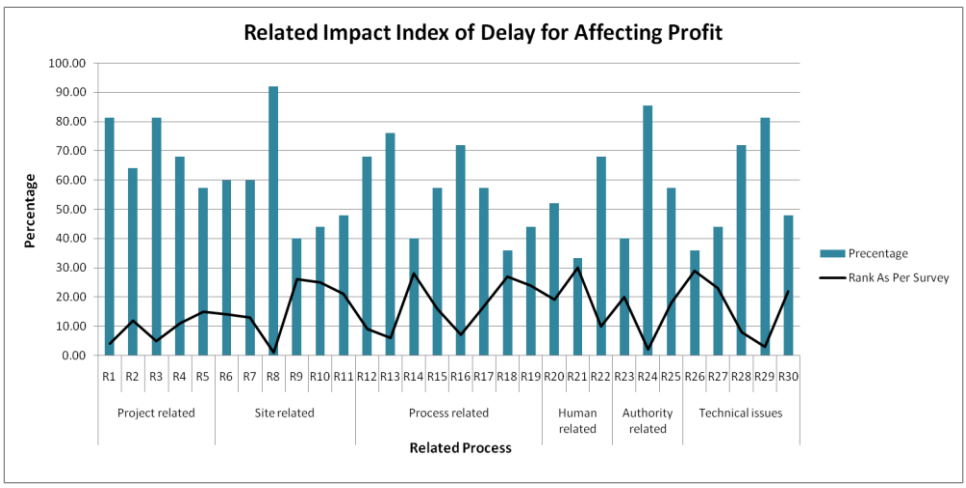

Figure No. 1 Relative Impact Index of causes of delay for Affecting Profit

4.1 Causes Of Delay

The three main parts in completion of the work as per schedule is done connecting owner contractor and consultants. Proper coordination between these 3 main members will improve the quality and effectively of the project work and completing a certain project in time. The following table describes the factor needed to be controlled by respective authority as shown in table.

Table No. 2 Causes of Delay

Sr. No.	Owners	Contractors	Consultants
1	Type of project bidding and award	Delay in progress payments by owner	Type of project bidding and award
2	Shortage of labors	Suspension of work by owner	Change orders by owner during construction
3	Ineffective planning and scheduling of project by contractor	Late in reviewing and approving design documents by owner	Shortage of labors
4	Low productivity level of labors	Change orders by owner during construction	Ineffective planning and scheduling of project by contractor
5	Unqualified work force	Late procurement of materials	Delay in progress payments by owner
6	Change orders by owner during construction	Mistakes and discrepancies in design documents	Low productivity level of labors
7	Hot weather effect on construction activities	Delays in producing design documents	Unavailability of incentives for contractor to finish ahead of schedule
8	Type of construction contract (turnkey, construction only)	Difficulties in financing project by contractor	Ineffective delay penalties
9	Poor site management and supervision by contractor	Late in reviewing and approving design documents by consultant	Hot weather effect on construction activities
10	Conflicts encountered with subcontractors schedule in project execution	Slowness in decision-making process by owner	Poor qualification of the contractors technical staff
11	Unqualified work force	Late in reviewing and approving design documents by owner	Shortage of labors
12	Effects of subsurface conditions (soil, existing of utilities, high water table, etc)	Inflexibility (rigidity) of consultant	Poor qualification of the contractors technical staff
13	Inadequate contractors experience	Late procurement of materials	Poor site management and supervision by contractor

4.2 Cost Comparison Due To Delay For The Case Study

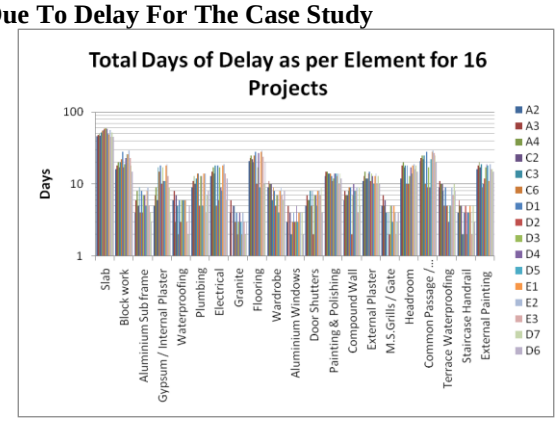

Figure No. 2 Total Days of Delay as per Element for 16 Projects

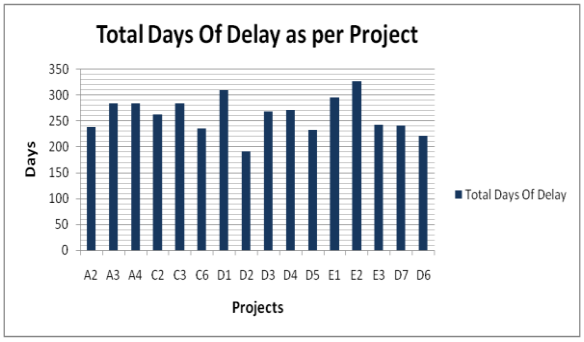

Figure No. 3 Total Days of Delay as per Project

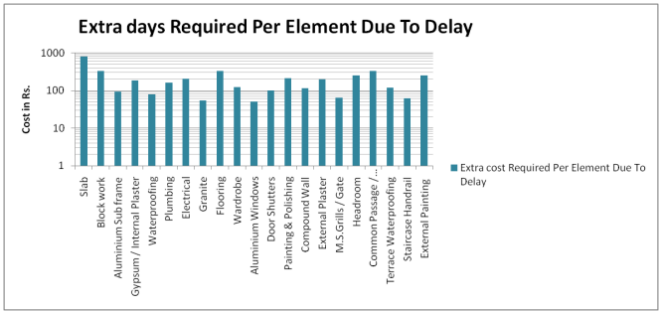

Figure No. 4Extra Days Required per Element Due To Delay

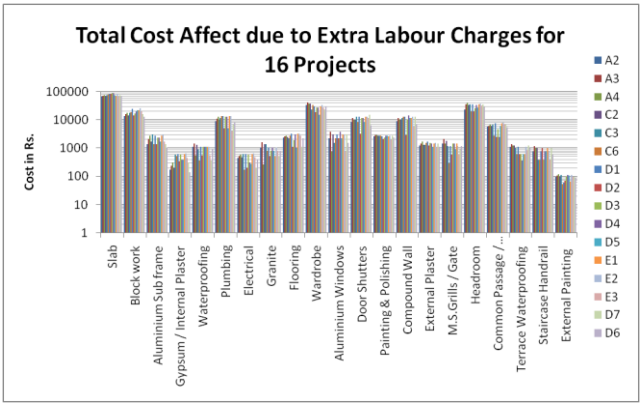

Figure No. 5 Total Cost Affect due to Extra Labour Charges for 16 Projects

Table No. 3 Extra Labour Cost Required per Element Due to Delay

Description	Labour Cost As Per DSR	Extra Cost Required	Profit Of Contractor	% Difference As Per Element To The Profit Of Contractor
Slab	1505	1246140	27371508	4.56
Block work	886	298582	27371508	1.1
Aluminium Sub frame	350	33600	27371508	0.13
Gypsum / Internal Plaster	35	6615	27371508	0.03
Waterproofing	186	14880	27371508	0.06
Plumbing	1000	166000	27371508	0.61
Electrical	35	7315	27371508	0.03
Granite	275	14850	27371508	0.06
Flooring	115	38870	27371508	0.15
Wardrobe	3883	481492	27371508	1.76
Aluminium Windows	770	39270	27371508	0.15
Door Shutters	1689	172278	27371508	0.63
Painting & Polishing	200	42400	27371508	0.16
Compound Wall	1505	174580	27371508	0.64
External Plaster	114	22800	27371508	0.09
M.S.Grills / Gate	300	19500	27371508	0.08
Headroom	2000	506000	27371508	1.85
Common Passage / Staircase Flooring	278	94520	27371508	0.35
Terrace Waterproofing	125	14875	27371508	0.06
Staircase Handrail	200	12400	27371508	0.05
External Painting	6	1512	27371508	0.01
Total	**15457**	**3408479**	**574801660**	**12.56**

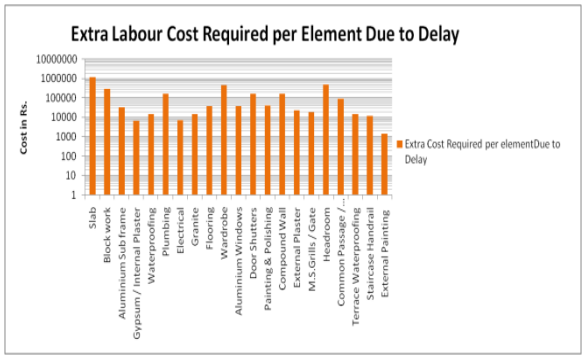

Figure No. 6 Extra Labour Cost Required per Element Due to Delay

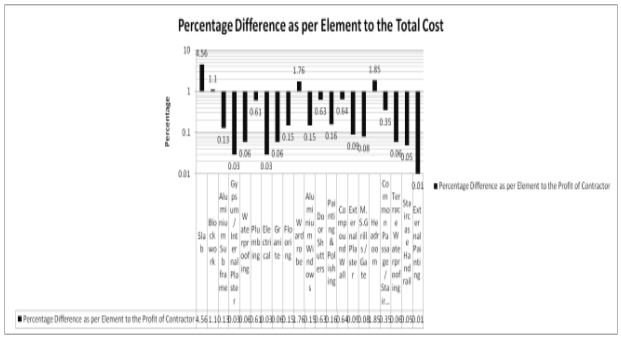

Figure No. 7 Percentage Difference as per Element to the Total Cost

Table No. 4Extra Labour Cost Required per Project Due to Delay

Project	Extra Cost Required Per Project Due To Delay	Cost Of Project	% Difference As Per Project To The Total Cost
A2	191012	17107192	1.12
A3	229926	17107192	1.35
A4	229187	17107192	1.34
C2	214469	17107192	1.26
C3	217182	17107192	1.27
C6	210241	17107192	1.23
D1	245064	17107192	1.44
D2	167936	17107192	0.99
D3	216868	17107192	1.27
D4	232121	17107192	1.36
D5	187493	17107192	1.1
E1	230480	17107192	1.35
E2	252786	17107192	1.48
E3	189352	17107192	1.11
D7	210807	17107192	1.24
D6	183555	17107192	1.08
Total	**3408479**	**273715072**	**19.99**

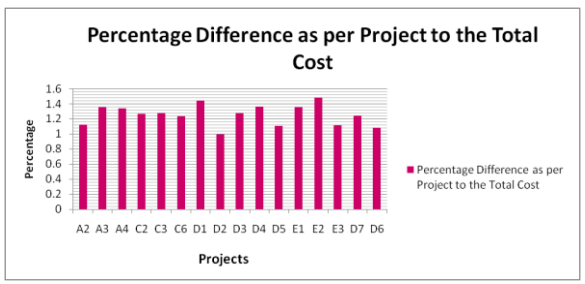

Figure No. 8 Percentage Difference as per Project to the Total Cost

4.3 Remedial Measures

The following points can be recommended by all parties in order to minimize and control delays in construction projects:

Owners should give special attention to the following factors

- Pay progress payment to the contractor on time because it impairs the contractor's ability to finance the work.
- Minimize change orders during construction to avoid delays.
- Avoid delay in reviewing and approving of design documents than the anticipated.
- Check for resources and capabilities, before awarding the contract to the lowest bidder.

Contractors should consider the following factors

- Shortage and low productivity of labor: enough number of labors should be assigned and be motivated to improve productivity.
- Financial and cash flow problems: contractor should manage his financial resources and plan cash flow by utilizing progress payment.
- Planning and scheduling: they are continuing processes during construction and match with the resources and time to develop the work to avoid cost overrun and disputes.
- Site management and supervision: administrative and technical staff should be assigned as soon as project is awarded to make arrangements to achieve completion within specified time with the required quality, and estimated cost.

Consultants should look to the following points

- **Reviewing and approving design documents:** any delay caused by the consultant engineer in checking, reviewing and approving the design submittals prior to construction phase, could delay the progress of the work;
- **Inflexibility**: Consultants should be flexible in evaluating contractor works. Compromising between the cost and high quality should be considered. Finally; Architect/design engineer should focus on the following issues:
- **Producing design documents on time:** A/E should set a schedule to complete design documents on time, otherwise result in a delay of work completion.
- **Mistakes and discrepancies in design documents**: They are common reasons for redoing designs and drawings and may take a long time to make necessary corrections.

V. CONCLUSION

- The delay on construction site in time affects the profitability of whole project directly. As the time elapses more funds are incorporated to complete the pending work which at times produces unnecessary consciences and disputes. The delay not only affects the time and schedule but also affects the profitability on a major scale. Respondents Average Percentage agree that:

1. 64% delay due to project,
2. 62% delay due to owner,
3. 55% delay due to contractor,
4. 43% delay due to Design,
5. 50% delay due to materials,
6. 58% delay due to equipment,
7. 61% delay due to labour and
8. 48% delay due to external factors affect the profitability of project.

- The relation between the profit and delay causes are studied conducting survey with respondents and experienced members and was found that main causes of delay affecting profitability are related to site related and authority related factors. The main factors are delay in material delivery, poor organizational structure, inadequate experience of contractor and increase in scope of work. The range of profitability hampering due to delay is 1.24% to 1.36% the whole cost of project.
- The points are noted for owner contractor and consultant to be handled on their own responsibility without interference of any of the authority in common. Coordination of these three authorities will solve maximum delay problem on site and will help in efficient execution of work. The range of profitability of the contractor hampering due to delay range from 9 to 15% pure profit in project.

VI. FUTURE SCOPE

- To study the factors affecting the decision making system at the higher authority and attitude causing loss in profitability of project.
- To study the ERP based process to optimize the delay and increase efficiency in whole construction process.

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