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Delays and its Analysis: Indian Residential Construction Projects

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Abstract: ***In almost every construction project, delay is an inevitable yet controllable phenomenon. The Indian construction industry encounters an enormous amount of delays in projects. Delay affects both time and money in the forms of schedule and cost overruns, respectively. Due to impressive and dynamic growth in the Indian construction sector, planned efforts are essential to limit these undesirable delays. On account of the surge in the rate of residential building construction, the task of identification and analysis of the delays in residential projects in India has been attempted by the authors. A questionnaire survey was conducted involving 100 stakeholders. Further analysis included an Importance Index to rank the identified delays, Principle Component Analysis for advanced statistical analysis, and Correlation Analysis to check the extent of agreement amongst stakeholders. Conclusions drawn with reference to the analysed data eventually reflected finance-related issues, as well as labour related problems as the dominating causes of delays. The aim of the research is to provide insight to the construction stakeholders and researchers, on an international scale, with the obtained results.***

Keywords: Residential Projects, Construction Delays, Importance Index, Correlation Analysis, Principal Component Analysis.

I. INTRODUCTION

The construction sector is a major contributor in almost every developed or developing economy. Indian economy is the second fastest growing economy in the world. The construction industry is large, volatile, and requires tremendous capital outlays. Construction offers low rates of return compared to the amount of risk involved. The commercial importance of such delays can be inferred from the fact that the growth rate of GDP for the construction industry in India is 8.1% for 2014-15, and USD 650 Billion of investments in urban infrastructure is estimated over the next 20 years according to Ministry of Statistics and Program Implementation (MOSPI) data from 2017. Since India is a developing country, the contribution of the construction sector in Indian economy is immense. The share of Gross Value Added (GVA) in the construction sector is 7.74%. The industry's contribution regarding employment has also been significant, as employment in the construction industry has grown from 1.09 million in 2004-05 to 50.25 million in 2011-12, with a 72.75% CAGR [2]. Processes in the construction industry are subject to many variables and unforeseeable factors. It is rare that a project gets completed within the specified time. There is substantial evidence of the inconsistent performance of Indian construction projects, and this trend is proliferating. Projects are reportedly failing across all key performance measures, including cost, time, and quality of work. The Infrastructure and Project Monitoring Division (IPMD) monitored the implementation status of central sector infrastructure projects. Their analysis of such 1174 projects at the end September 2016 shows that 333 projects were running behind their original schedule. The time overrun of these projects were ranging from 1-261 months, and the cost overrun in the delayed projects has resulted in a 20.95% increase in the original cost, which is USD 97.326 Billon [1]. Construction project delays have a detrimental effect on stakeholders (developer, contractor, and consultant) such as an increase in adversarial relationships, distrust, litigation, arbitration, cash-flow problems, compromises in safety and quality, and a general feeling of apprehension towards each other. Thus, delay becomes a very sensitive part of this macrocosm. Delays directly cause the projects to attain time-overrun and indirectly leads to cost-overrun. Most of the projects that are or will be undertaken by construction stakeholders will be residential projects.

- *Objectives:*
  1. Identification of the causes of delays in construction of residential buildings in Indian context.
  2. To determine relative importance between the causes of delays as per data acquired through professional construction stakeholders.
  3. To study the difference in perception towards delays amongst stakeholders.

This research is intended to cater to economical as well as educational needs. The growing Foreign Direct Investment (FDI) in Indian construction sector makes this study more significant. The methodology used in this research is standard. Thus reconciliation of results is possible effectively for other developing countries.

II. LITERATURE REVIEW

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Delay and its inherent ability to cause time overrun and cost overrun is considered an important factor in deciding the success of a construction project. It has been a topic of discussion for many researchers since 1960. Researches that took place in Construction Sector explain the causes of delays either theoretically or statistically. Researches have been ramified as either 'Attribute determination and explanation' or 'Attributes determination and its analysis.' Every study presented perspectives of stakeholders and also projected their contribution in these construction delays. Primary attributes were drawn by reviewing such studies. Also, some attributes were included in this study as per the recommendations given by the interviewee (stakeholders). This wide range of study available has been referred and summarized in the following table.

TABLE I
Literature Review

Authors	Summary	Major Attributes
Mansfield et al., 1994 [20].	Researchers examine causes of delays and cost overrun in Nigerian construction projects. An analysis is performed on completed highway projects. Recommendations are provided to improve conceptual and detailed planning stages of the project.	• Improper construction methods • Natural disasters • Changes in prices of materials and equipment
El-Razek et al., 2008 [3].	Authors assess the leading cause of construction projects in Egypt from the point of view of stakeholders and determine conflict of interest amongst them, and recommend that joint efforts are required to mitigate the effect of delay significantly.	• Unqualified and low productivity level of labours • Lack of effective communication and coordination with project stakeholders • Accidents during construction
Sambasivan et al., 2007 [23].	The study takes an integrated approach to analyze the impact of distinct causes in Malaysian construction industry and its effect. Authors have also determined an empirical relationship between delay cause and its consequences.	• Late in providing design documents by consultant • Problem with neighbors
Aibinu et al., 2002 [5].	Authors analyze the causes of delays in completed building projects in Nigeria by considering the actions and inactions of project participants and external influences. This inference suggests interdependent nature of activities and Stakeholders as well as indicates area of improvement in construction industry.	• Unclear and inadequate details in drawings • Personal conflicts among labours and labour groups • Delay from customer for payment to developer
Al-Khalil et al., 1999 [6].	The author determines important causes of delay in public utility project in Saudi Arabia by using Frequency Index and Severity Index. The analysis inferred lack of agreement amongst parties.	• Shortage of equipment and equipment failure • Low productivity and efficiency of equipment
Assaf et al., 2006 [9].	Researchers analyze causes of time overrun in Saudi Arabia and their importance according to each stakeholder. Surveys conducted by researchers concluded that 70% of projects experienced time overrun in Saudi Arabia	• Delay in site mobilization and beginning of work • Legal disputes b/w various parties
Al-Kharashi et al., 2009 [7].	The author describes major causes of delays in Saudi Arabian public sector construction project by using ANOVA method of analysis. Its result states that shortage of unskilled workforce is the predominant reason for the delay.	• Delay in approving major changes by owner/contractor • Delay in clearance of bills and respective payments from developer
Iyer & Jha, 2005 [16].	The author assesses major factors affecting cost performance in Indian construction project. Factor analysis was performed on the success and failure attributes. It also indicates co-ordination amongst project participant as the most significant influence on cost performance	• National insecurities • Rework due to improper construction
Faridi et al., 2006 [14].	The study determines significant factors causing delays in UAE construction industry and its analysis by using Relative Importance Index; the research revealed that 50% of the construction projects encounter delays.	• Delay in performing inspection and testing by consultant • Shortage of construction materials • Delay in provision of daily wages of labours from subcontractor
Arditi et al., 1985 [8].	The author reported the reason for delays in public projects in Turkey (from 1970 to 1980) by surveying a large number of public agencies and contractors involved in governmental project. This study divides the factor into those that can be handled by public agencies and by national economic policies.	• Quality problem with procured materials • Poor qualification of developers own technical team
Kumaraswamy & Chan, 1998 [18].	Authors determined significant principal delay factor affecting construction industry in Hong-Kong. They also established the high degree of disagreement in between stakeholders which indicates a lack of effective communication.	• Improper scheduling • Ineffective supervision

Assaf et al., 1995 [10].	Authors determined and ranked causes of delays in Saudi Arabian construction projects. Study inferred that financial group of delay factors were predominant compared to other groups.	• Delay in delivery of construction materials • Effect of social and cultural factors • Delay in provision of daily wages
Yakubu & Sun, 2010 [22].	The authors assess the common factors that inhibit both time and cost control was identified for the UK construction project. To control this, 90 mitigating measures have been developed and classified as preventive, predictive, corrective, and organizational measures, which can be used as a checklist to improve the monitoring of construction project.	• Conflicts due to partnership of project • Inflexibility of consultant towards changes in design • Corrupt practices of officers
Lo et al., 2006 [19].	The authors analyse construction delays in Hong-Kong civil engineering projects using rank agreement factor (RAF), Percentage Agreement (PA), and Percentage Disagreement (PD), to explain the differences in perception of respondents on the significance of delay.	• Type of project bidding and selection of competent sub-contractor • Ineffective site management of project • Shortage of labours
Odeh & Battaineh, 2002 [21].	The paper identifies important causes of delays in construction projects with the traditional type of contract, from the viewpoint of contractors and consultants in Jordan.	• Changes in government regulations • Customization due to demands from customer

III Methodology

Considering the high uncertainty related to variables associated with the construction industry, a questionnaire approach has been adopted which proved helpful in analyzing facts and concluding the results. A questionnaire survey was carried out in India involving professional stakeholders viz. contractors, consultants, and developers each of which has played crucial roles in their particular projects and had contributed to the industry in some way or the other. The profession and its respondents being surveyed have been kept heterogeneous to account for the big picture of the civil industry [13].

A. Preparation of Questionnaire

Construction delays and its substantial research and literature review available for study, are classified into delay groups, and sub classified into a number of causes. Some of these causes are adopted in this paper while considering the Indian scenario and its stakeholders perspective. This was achieved by personal interaction with stakeholder to check the extent of association of the adopted causes for this study with the current scenario Indian construction sector. The selected causes were chosen by reviewing international books and papers. Subsequently, with more personal interviews the attributes, along with the questionnaire, honed with time. For this research, the questionnaire was divided into eight major groups with a total of 44 delay attributes. Every attribute mentioned targets a particular component in the construction field like finance, work-Force, etc. Each attribute, a sub-point to its respective component, tackles the range of scope that every component offers. The respondents were required to rate each attribute mentioned in the questionnaire on a five-point Likert Scale separately for two variables (viz. Severity and Frequency). Distribution for these are given as; Importance: 5-Extreme, 4-Great, 3-Moderate, 2-Considerable, 1- Little, and, for Frequency: 5-Always, 4-Mostly, 3-Often, 2-Sometimes, 1-Rare [23]. The weightage (%) accounted in RII test, and FI test concerning Likert Scale was:

The questionnaires were distributed and collected majorly via personal interviews. The respondents in locations which were non-viable due to time or accessibility constraint were in touch via e-mails. The results thus obtained by the survey as per the responses were given by stakeholders were used to perform Descriptive Analysis. Such an analysis is used to rank the causes of delays as per the acquired responses [13]. Ambiguity is a by-default property of such obtained results and gives no precise understanding. To overcome this, advanced statistical analysis is essential and has been carried out.

TABLE II
Relative Importance Index Scaling

Terminology	Severity (%)	Likert Scale
Little	0-10	1
Considerable	10-30	2
Moderate	30-60	3
Great	60-90	4
Extreme	90-100	5

TABLE III
Frequency Index Scaling

Terminology	Likelihood (%)	Likert Scale
Rare	0-10	1
Sometimes	10-30	2
Often	30-60	3
Mostly	60-90	4
Always	90-100	5

B. Respondents Profile

Respondents were chosen with heterogeneity according to their profession, and key roles played in the construction

industry and a particular project respectively. The experience was the main criteria while selecting any stakeholder as a well-suited respondent [18]. Experience of such respondents varied from Construction Managers to the owner himself. Along with experience, educational qualification was also maintained as a criterion. Questionnaires were floated to experts who were leaders in their field. With a response rate of 67%, 100 responses were obtained out of the circulated 150 questionnaires.

TABLE IV.
Respondent's Profile

Experience (Years)	Contractor	Consultant	Developer	Total
5 - 10	13	9	9	31
11-15	5	11	5	21
16-20	9	9	4	22
>20	6	9	11	26
Total	33	38	29	100

C. Relative Importance Index

Relative importance helps to understand the influence of each factor on the variable comparatively when two or more independent factors affect a dependent variable. Responses from every individual were considered to rank the causes of delays relevant to the Indian Construction Industry.

$$RII = \frac{(1 \times X_1) + (2 \times X_2) + (3 \times X_3) + (4 \times X_4) + (5 \times X_5)}{5 \times (\sum^{5}_{i=1} X_i)}$$

Where,
RII= Relative Index ($0 \leq RII \leq 1$)
X_1 = number of respondents for little importance,
X_2 = number of respondents for considerable importance,
X_3 = number of respondents for moderate importance,
X_4 = number of respondents for great importance,
X_5 = number of respondents for extreme importance

D. Frequency Index

This index explains the extent of frequency an attribute can attain as per the response was given by the Stakeholders. Further, this FI is essential to calculate the Importance Index [6] [9]. This index ranges from 0 to 1. Proximity to 1, shows high frequency of the particular cause to which FI is calculated, and vice versa

$$FI = \frac{(1 \times X_1) + (2 \times X_2) + (3 \times X_3) + (4 \times X_4) + (5 \times X_5)}{5 \times (\sum^{5}_{i=1} X_i)}$$

Where,
FI= Frequency Index ($0 \leq FI \leq 1$)
X_1 = number of respondents for Rare occurring,
X_2 = number of respondents for Sometimes occurring,
X_3= number of respondents for Often occurring,
X_4 = number of respondents for Mostly occurring,
X_5 = number of respondents for Always occurring.

E. Importance Index

$$II = RII \times FI$$

Where,
II= Importance Index ($0 \leq II \leq 1$)
RII= Relative Index ($0 \leq RII \leq 1$)
FI= Frequency Index ($0 \leq FI \leq 1$)

The results obtained from this Importance Index helps to rank the attributes in an ascending order giving the top-ranked attribute to be the most impactful while the lowest ranked attribute as the least impactful.(refer Table VI).

F. Spearman Rank Correlation

To analyze any relationship in between any selected attributes, Spearman Rank Correlation is used [15]. IBM SPSS software featured this calculation of Spearman's Correlation and was utilized in this research.

G. Principal Component Analysis

Principal Component Analysis is used mainly to reduce a data set to a more manageable size while maintaining as much of the original necessary information as possible [11] [12]. Primarily, adequacy of the surveyed data was successfully carried out using Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity [15]. Amongst the 44 attributes mentioned, 23 were found to be significantly important based on correlation. These 23 attributes were further analyzed using Principal Component Analysis. Here, the analysis derives linear components by decomposing the original sample data. The first component provides as much of the variability in the data as possible, and each component after that accounts for as much of the remaining variance as possible. This analysis is most concerned with finding out the linear components and establishing the capability of a particular variable to contribute its respective component [15].

IV. Results and Discussion

A. Importance Index

Analysis has been carried out on the attributes mentioned in the questionnaire according to the Importance Index Method. The obtained values has been ranked in descending order (refer Table VI).

B. Principal Component Analysis

Principal Component Analysis is used to give concise factors that represent the various correlated attributes. Eight Components (factors) explaining a variance of 67% was inferred from the obtained result from IBM SPSS software (refer Table VII). Components extracted from Principal Component Analysis are as follows –

TABLE V
Attributes and their corresponding Groups

Group	Code	Attributes
Developer and his Team related problems	C1	Conflicts due to partnership of the project
	C2	Type of project bidding and selection of competent sub-contractor
	C3	Delay in approving major changes in the scope of work by developer/interior designer/customer
	C4	Delay in selection and procurement of materials due to diverse market by developer/customer
	C5	Poor qualification of the Developers own technical team
Sub-contractor related problems	C6	Delay in site mobilization (Initial Setup) and beginning of work [ex. labour colony, electricity, and plumbing connections, transportation of equipment on site]
	C7	Improper scheduling (unforeseen conditions, per day productivity of labours)
	C8	Ineffective site management of project
	C9	Ineffective supervision of project
	C10	Improper construction methods used by contractor (ex. traditional mixing of concrete instead of RM
	C11	Rework due to improper construction
	C12	Frequent changes of sub-contractors because of their ineffectual work
Consultant related problems	C13	Late in providing design documents by consultant
	C14	Unclear and inadequate details in drawings
	C15	Misunderstanding of owner's requirements by design engineer
	C16	Delays in performing inspection and testing by consultant
	C17	Inflexibility (rigidity) of consultant towards changes in design
Materials and Equipment related problems	C18	Shortage of construction materials in market
	C19	Delay in delivery of constructional materials on site
	C20	Quality problem with procured material
	C21	Shortage of equipment and equipment failure
	C22	Low productivity and efficiency of equipment
Labour related problems	C23	Shortage of labours
	C24	Unqualified & low productivity level of labours
	C25	Personal conflicts among labours & labour groups
	C26	Lack of incentive(bonus) from contractor
Project related problem	C27	Legal disputes b/w various parties (Owner, Contractor, Consultant, etc.)
	C28	Problem with neighbors
	C29	Lack of effective communication and coordination with project stakeholders
	C30	Issues on recruiting, attaining, and promoting experienced project team
	C31	Customization due to demands from customer (finishing items like tiles, fittings, etc.)
External factors	C32	Corrupt practices of officers
	C33	National insecurities (terrorism, civil war, curfew, strikes, etc.)
	C34	Natural disasters (flood, landslides, etc.)
	C35	Effect of social and cultural factors (festivals, traditions, mishaps, etc.)
	C36	Accident during construction (ex. labour safety problems, labour injuries due to crane etc.)
	C37	Changes in government regulations and laws
	C38	Changes in prices of materials and equipment
	C39	Change in political powers
Finance/Accounts/Billing related problems	C40	Delay in clearance of bills and respective payments from developer
	C41	Delay in disbursement from investors/financial institutions
	C42	Delay in provision of daily wages of labours from sub-contractor
	C43	Delay from customer (direct/loans) for payment to developer
	C44	Economic slowdown

TABLE VI
Ranking of attributes

Code	Importance Index	Rank
C23	0.4054	1
C18	0.3886	2
C24	0.3713	3
C7	0.3527	4
C40	0.3441	5
C43	0.3347	6
C8	0.3275	7
C41	0.3255	8
C9	0.3247	9
C16	0.314	10
C13	0.3009	11
C6	0.2904	12
C5	0.2773	13
C32	0.2746	14
C31	0.2701	15
C2	0.2689	16
C4	0.2689	17
C44	0.2671	18
C19	0.2657	19
C10	0.2642	20
C12	0.2586	21
C27	0.2467	22
C38	0.2421	23
C42	0.2415	24
C35	0.2371	25
C14	0.2293	26
C30	0.2269	27
C11	0.2243	28
C16	0.2137	29
C20	0.2103	30
C37	0.2069	31
C28	0.2062	32
C1	0.2045	33
C29	0.2018	34
C22	0.1964	35
C26	0.1923	36
C17	0.1915	37
C15	0.1887	38
C21	0.1856	39
C25	0.1574	40
C34	0.1477	41
C36	0.144	42
C39	0.1354	43
C33	0.1047	44

1. *Improper cash flow –*

The first factor named 'Improper cash flow' explains 25.565% of total variance of the linear component (factor) and contains four attributes. The first attribute, Delay in disbursement from investors is due to lack of capital investment from investor which leads to disturbance in cash flow. The second attribute, Delay from a customer for payment to the developer is also a cash flow issue. Accounting for the large building projects, normally construction is done in phases, and after completion of each phase, the developer gets payment in the form of pre-booking of property by the customer which generate the cash flow in the project. At times the customer delays the payment which leads issues in cash flow. Third attribute, Delay in the provision of daily wages from sub-contractor to labours can happen due to various reasons such as untimely payment by the developer to the contractor. Also, contractors delay the payment as profit margin earned by them is not up to their expectations. Fourth attribute, Delay in clearance of bills and respective payments from developers has been explained in the third attribute.

2. *Labour related problems –*

The second factor named 'Labour related problems' explains 7.77% of total variance of the linear component (factor) and contains three attributes. The first attribute, personal conflicts among labour and labour group is due to lack of co-ordination amongst them as well as improper planning, handling, and distribution of workforce by project management. This adversely affects the overall length of the project. The second attribute, Lack of incentives or bonus from contractor affects the productivity of labours, indirectly ascends towards delay. If the contractor gives timely payment with proper incentives then, labours may work more productively, and the project may complete in time. Third attribute, Effect of social and cultural factors have an enormous impact on the project duration in Indian industry. Considering the cultural and social diversity, and its associated breaks/leaves taken by labours hampers the length of the project.

3. Improper planning –

The third factor named '*Improper planning'* explains 6.905% of total variance of the linear component (factor) and contains four attributes. The first attribute, *Late in providing* design *documents by the consultant* is due poor coordination between execution team and design team. It may also happen due to delay in approval of design documents or drawings by the client. The second attribute, *Inadequate and unclear details in the drawing* are due to improper monitoring and management of documents by the respective document controller (of consultant/client/contractor). Planning department at times erroneously pre-estimates the number and quantity of labour and materials respectively required for a particular activity. These lacks of estimation direct towards third attribute, *Shortage of labours* and fourth attribute, *Shortage of construction materials in the market.*

4. *Problems due to material and equipment –*

The fourth factor named '*Problems due to material and equipment*' explains 6.412% of total variance of the linear component (factor) and contains two attributes. The first attribute, *Low productivity and efficiency of the equipment* is due irregular machinery maintenance. The second attribute, *Delay in the delivery of construction material* on the site is due improper material management which is the responsibility of Store Officials. This attribute can also occur due to the transportation issue, shortage of material in market or reluctance of vendors.

TABLE VII
Component extracted from Principal Component Analysis

Factor Name	Code	Factor Loading	% Variance
Improper cash flow	C41	0.731	25.565
	C43	0.698	
	C42	0.627	
	C40	0.6	
Labour related problems	C25	0.819	7.77
	C26	0.715	
	C35	0.664	
Improper planning	C13	0.674	6.905
	C14	0.648	
	C23	0.613	
	C18	0.567	
Problems due to material and equipment	C22	0.729	6.712
	C19	0.722	
Incompetent project staff	C10	0.687	5.709
	C5	0.638	
	C6	0.628	
Conflict of interest amongst stakeholders	C17	0.742	5.363
	C27	0.678	
	C1	0.613	
Inimical external influences	C39	0.765	4.667
	C37	0.751	
Undefined project scope	C3	0.754	4.318
	C30	0.654	

5. *Incompetent project staff –*

The fifth factor named '*Incompetent project staff*' explains 5.709% of total variance of the linear component (factor) and contains three attributes. Evidently, qualification and productivity of staff decide the fate of the project. The first attribute, *Improper construction methods used by the contractor* is mainly due to the unqualified project team. The second attribute, *Poor qualification of technical team* is due to improper delegating of staff by Human Resource department. Third attribute, *Delay in site mobilization* mostly occurs in accordance with the first attribute.

6. *Conflict of interest amongst stakeholders –*

The sixth factor named 'Conflict of interest amongst stakeholders' explains 5.363% of total variance of the linear component (factor) and contains three attributes. The first attribute as *Inflexibility* towards *changes in design* is due to conflict of interest amongst consultant and contractor. It is the responsibility of the project manager to explain the consultant about various unaccounted practical difficulties faced at the site and thus the need for change. Similarly, it is also necessary to explain to the contractor the particular design made by the consultant and its vitality due to its presence. Second and third attribute, *Legal disputes between various parties* and *Conflicts due to the partnership* of the project respectively happens due to lack of communication which results in clashes among stakeholders.

7. *Inimical external influences*

The seventh factor named '*Inimical external influences*' explains 4.667% of total variance of the linear component (factor) and contains two attributes. The first attribute, *changes in political power* hampers the ongoing and upcoming government construction projects specifically due to conflict of interest. Delays of such projects are highly unpredictable in the Indian scenario. The second attribute, *Changes in government regulations and law* directly affects every stage of the project, from planning to the final execution.

8. *Undefined project scope –*

The eighth factor named '*Undefined project scope*' explains 4.318% of total variance of the linear component (factor) and contains two attributes. The first attribute, *Delay in approving major changes in the scope of work* by *stakeholder* is due to lack of clarity of project scope. Successful recruiting and managing of the project team highly depend on well-defined project scope, hence the second attribute, *Issues on recruiting attaining and promoting experienced project team*.

C. Correlation Analysis

Inferring from the result and discussion of Importance Index and Principal Component Analysis, finance issues and labor issues were found to be critically predominant as compared to the other groups and components. Correlation Analysis was carried out on these two groups giving the extent of agreement amongst stakeholders in terms of Spearman's method of correlation (refer Table VIII and IX).

For cash flow related delays (refer Table VIII), it is seen that none of the parties agree amongst each other. Generally, money flows from top-level hierarchy to bottom level hierarchy. Delays at any level lead to successive delays in later levels, thus affecting the project duration. On

the other hand, all stakeholders agree that most of the delays are due to the labour related problems (refer Table IX).

TABLE VIII
Result for Finance/Billing/Accounts related Delays

Causes	Developer	Contractor	Consultant	Spearman's rho
C40	0.28532	0.35750	0.37449	contractor and consultant – 0.3 developer and contractor – 0.4 developer and consultant – 0.5
C41	0.32403	0.27803	0.39374	
C42	0.22730	0.21962	0.29410	
C43	0.35767	0.33125	0.33185	
C44	0.43681	0.34017	0.38853	

TABLE IX
Result of Labours related Delays

Causes	Developer	Contractor	Consultant	Spearman's rho
C23	0.36823	0.43091	0.40000	contractor and consultant – 1.0 developer and contractor – 0.8 developer and consultant – 0.8
C24	0.40709	0.35711	0.34935	
C25	0.13612	0.16438	0.16834	
C26	0.16669	0.18727	0.23045	

D. Mathematical Validity of Factor Analysis

Once the factors have been finalized, a key question arises that needs to be answered as to whether the target dimensions have been explained by the attributes in each factor collectively [12]. If attributes outline the factor finalized, it is implicit that attributes to some extent should correlate among themselves, but it can't be a perfect correlation [13]. IBM SPSS software is used to calculate the extent of correlation among attributes. It is observed that the values of Pearson bivariate correlations are greater than 0.4 in most of the cases among different attributes in all the factors. [13].

- Reliability Analysis

Cronbach's alpha test has been performed to confirm the construct of the model over time. It has been carried out on entire data as well as attributes in each factor. Cα can attain any value between 0 and 1, where a higher value denotes the greater internal consistency and vice versa.

The value of Cα has been inflated by a large number of variables. Thus no set interpretation would help to assume an acceptable limit for the same [24]. The value of Cα for all attributes calculated is 0.852 which is considered to be good.

V. CONCLUSION

A total of 100 professionals from construction industry were involved in this research and had given their expert opinion in the form of responses to the questionnaire survey. Analysis of the causes from the questionnaire showed that Financial issues, Labour issues, and Planning issues as critical factors of construction delays.

The above concluded critical factors were found to explain the maximum variance according to the Principal Component Analysis, of which, Improper cash flow, i.e., financial issue explained the highest variance (25.565%). This component includes following attributes of delay viz., *Delay in disbursement from investors, Delay from a customer for payment to developer, Delay in the provision of daily wages from sub-contractor to labours and, Delay in clearance of bills and respective payments from developers*.

First six top-ranked causes from Importance Index have been considered, which point towards the above concluded critical factors like Labour issues were explained by the 1st and 3rd ranked causes; *Shortage of labours* and *Unqualified & low productivity level of labours* were the causes respectively. Planning issues were explained by 2nd and 4th ranked causes; *Shortage of construction materials in the market* and *Improper scheduling* were the causes respectively. Finally, financial issues were described by 5th and 6th ranked causes; *Delay in clearance of bills and respective payments from developer* and *Delay from a customer for payment to developer* were the causes respectively.

Correlation Analysis was conducted on the attributes in a group-wise manner to check the extent of agreement amongst stakeholders (developers, contractors, and consultants). Correlation Analysis for the above concluded critical factors has also been carried out. Table VIII, which shows the correlation for the group finance/billing/accounts related delays, i.e., financial issues, concludes a lack of agreement between any stakeholders. This shows the retractable perspective of Stakeholders when financial matters are considered. The Table IX, which indicates the correlation for the group labour related delays, i.e., labour issues, concludes a substantial agreement among stakeholders. This shows a predominance of labour issues in construction delays.

Finally, this research has identified the hurdles that affect the Indian construction industry extensively. Research findings and conclusions, however, are useful to other developing countries as they may face the similar problem. Furthermore, the international literature displayed generic similarities that may benefit exhaustive comparative analysis worldwide. To study these project delays profoundly, future research needs approaches that include Casual Modelling. This would provide insight of the interrelatedness and complex interactions among the delay factors.

VI. LIMITATION

Although the study concludes with tangible results regarding the construction delays, the limitations that abide them should also be accounted for in this research. First, the study was carried out for construction industry restricted to Indian residential construction projects only. Although the methodology used in this research is standard, the result thus obtained cannot be generalized worldwide due to the dynamic nature of the industry. Second, the sample size that was analyzed is 100, which is considered to be on the smaller side to carry out statistical analysis. Third, the ranking of factors deduced from analysis in this research is relative to each other exclusively and is statistically significant; however, there is a possibility that exact ranking may not be statistically significant. Fourth, the response of the professionals having experience of 5 to 10 years may vary slightly as opposed to that of the response given by experts having experience more than 10 years. Even though the former may have great qualifications relevant to the Industry, the latter practically are more exposed to the construction field as they have managed numerous projects. Finally, this study attempts to see the residential construction as a big picture, but, further classification such as small and large scale projects will definitely produce more specific results.

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