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ANALYSIS OF VARIOUS PARAMETERS THAT AFFECT THE DELAY PROCESS IN RESIDENTIAL BUILDINGS THROUGH THE RII METHOD

Mrunmai Kashid, Student of Civil Engineering. Dept. of Master's in Construction Management, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune.
Email- kashidmrunmai17@gmail.com
Dr. K.B.Gurani, Assistant Professor, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021.
Email- kvgurani@gmail.com
Prof. V.O. Biradar, P.G. Coordinator, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021
Dr. D.B. Jasutkar, Head of The Department, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021

ABSTRACT:
Residential projects are complex, large-scale endeavors prone to delays due to their long duration and high investment. Identifying and assessing these delays can help mitigate cost and time overruns, disputes, and contract terminations. Our study categorized delay factors into three levels, with seven primary factors: economic, socio-political, contractual, resource-related, technical, organizational, and natural hazards. Through a literature review, expert interviews, and a questionnaire survey, we identified the top five delay factors: technical, financial, contractual, socio-political, and natural hazards. Using Relative Importance Index (RII) methods, we prioritized the top sub-factors, including fund risk, unforeseen ground conditions, and design changes. This RII approach effectively assesses delay risks, enabling better project management.

INTRODUCTION:

The construction industry is a vital sector in India's economy, second only to agriculture, and plays a significant role in the country's social and economic development. Construction projects have improved living standards in both rural and urban areas. However, delays are a common issue in the industry, affecting project timelines and budgets. Delays can be defined as time overruns beyond the agreed-upon completion date, and can be classified into excusable (unforeseen circumstances) and non-excusable (contractor's responsibility) categories. The success of a construction project depends on completing it on time, within budget, and meeting quality standards.

Construction delays happen when projects run behind schedule, exceeding the planned completion date. This can lead to financial losses for owners and increased costs for contractors. Timely project completion is crucial for efficiency, but construction projects are vulnerable to various unpredictable factors, including performance issues, resource constraints, environmental factors, and contractual disputes

OBJECTIVE:

The main objective of this study is to identify the major causes of delays of building construction projects using a case study in Pune city. Accordingly, possible ways of minimizing them are suggested. It is noted that the clients, consultants, and contractors don't give importance to evaluate the time delay at the end of project. The specific objectives of the study are as follows:

To identify delay factors in construction projects.

To rank the delay factors according to the importance level on delays in project.

To find the tools to analyze and evaluate the delay factors in construction buildings
To provide recommendations to control delay during construction phase.

PROBLEM STATEMENT:

The most valuable and challenging task for the managers, architects, engineers and contractors has become the successful completion of construction projects within the specified time. How to accomplish that task is an issue that should be solved. 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.

Factor influencing delay in construction work have been considered very common in developing countries like India, the delay has been ignored to some extent. Thus the present research is aimed at evaluating the various critical factors which are influencing Delay in residential construction project in and providing suitable solutions to decrease impact of delay due to which project probably completed within stipulated time. Most construction project risk analysis problems contain a mixture of quantitative and qualitative data. Qualitative and quantitative risk assessment techniques are independently inadequate for the analysis of risks. So, AHP-RII is methods are suggested which involve both quantitative and qualitative data analysis. The increasing complexity of construction projects has imposed substantial uncertainty and subjectivity on the risk analysis method. Most construction project risk analysis problems contain a mixture of quantitative and qualitative data. Qualitative and quantitative risk assessment techniques are independently inadequate for the analysis of risks. So, some other risk analysis methods are suggested which involve both quantitative and qualitative data. The fuzzy risk analysis method, analytic hierarchy process method, technique for order preference by similarity to ideal solution, and fuzzy technique for order preference by similarity to ideal solution can deal with combined qualitative and quantitative risk analysis.

METHODOLOGY :

A critical review of literature in order to understand the concept of Time delay on building construction projects.
Review of past studies
Study of published books
Study of published papers
Understanding the causes of Time delay with available literature and its impact on completion of project so far.
Conducting site visits and having interactions with the respective people regarding the main influencing factors causing time delay.
Collection of data of the selected Residential Construction Building using Questionnaire Survey by Likert's Scale Method.
Analysis of the obtained data by Relative Importance Index Method.
Ranking of each influencing factor and thereby finding the top influencing factors in each stage of construction.
Representing the results obtained from the analysis using graphs.
Recommendation of possible solutions to avoid time delay.

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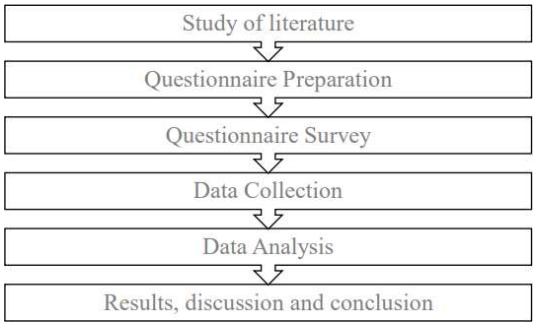


Fig 1.1. Flowchart of Methodology

DATA ANALYSIS

From the literature review we identified 7 main influencing factors causing for delays and total 54 sub factors. Then the data collection was carried out through questionnaire amongst the various parties like Contractors, Clients, Consultants involved in handling construction projects. The questionnaires were distributed to clients, consultants and contractors of selected 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. Significance of major influencing factors causing construction time delay was identified in the questionnaire survey. Respondents were asked to rank the factors with 5 pointers

Likert scale as:

1. Rarely
2. Sometimes
3. Average
4. Very frequently
5. Mostly

a. Analysis of questionnaire by using Likert's scale :

Likert's scale is a technique developed by Dr. Rensis Likert, a sociologist. Likert scale is a psychometric response scale primarily used in questionnaire to obtain participant's preference or degree of agreement with a statement or set of statements. Likert scales are a non-comparative scaling technique and unidimensional in nature. Respondents are asked to indicate their level of agreement with a given statement by way of ordinal scale.

Likert's scale is used because it is easy to construct, high reliable scale, and also it is easy to read for the participants.

RII was used for ranking the factors, the investigated factors and their RII scores are represented. The results of the study revealed that among the 54 factors.

RII calculation is used to determine relative significance and for ranking the factors affecting delay in construction projects.

RII is given as;

$$RII = \frac{\sum_{i=1}^{4} W * X}{A * N} \quad \ldots\ldots\ldots\ldots\ldots \text{equation(1)}$$

Where, RII = Relative Importance Index
W = Weighting given to each factor by respondents and its ranges from 1-5
X = Frequency of it response given for each factor A =Highest weight (i.e. 5 in case) N = Total no. of participants.

LITERATURE REVIEW:

Desai Megha, et al [2013] studied the delay factors and catego0rised it in nine major groups as: Project, owner, contractor, Consultant, Design, Material, Equipment, Labour and External related delay factors depending on their nature and occurrence on practical situations on projects. The study was done through questionnaire survey of many Residential Projects across India and found its ranking through Relative Importance Index and Importance Index consisting of Frequency and Severity Index and finally the recommendations for these delay factors are covered.

Nirmal Kumar Acharyat, et al [2006] surveyed that the instrument was distributed in construction fields to obtain construction professionals experience that how much the instrumented delay causes have been affecting the timely completion of the projects. The Four categories of Owner, Contractor, Project and Third Party related delays were adopted for this study. The mean score values and ranking is done to different delay factors.

P .M. Pethkar, et al [2015] studied time and cost overruns as the most important factors responsible for abandonment and contractor's failure. Although the Indian construction industry has gained far more importance in recent times because of opening up of Indian markets and the arrival of megaprojects for infrastructure development. Delay gives increase to disturbance of work and loss of productivity, late completion of project increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of progress to reduce the possibility of delay occurrence. Delays often results in time overrun, disputes, litigation, and complete abandonment of projects.

Sadi A. Assaf, et al [1995] studied main causes of delay in large building projects in Saudi Arabia and their relative importance and Importance Index. A survey was made which includes 56 causes of delay, and the respondents were asked to indicate their degree of importance. The level of importance of the causes and groups were measured and ranked by their importance index for contractors, owners and Architectural Engineering's. It was found that contractors, Architectural Engineering's, and owners generally agree on the ranking of the individual delay factors.

K .L. Ravishankar, S. et al (2014) studied the total of seventeen groups of total 50 factors of delay was considered. The results was based on questionnaire survey and the most important causes of delay was shortage of skilled and unskilled labor, design changes, fluctuation of prices, high waiting time for availability of workteam and rework due to errors affected the construction project. The methodology contains the time and cost overrun also its mean score, ranking of all the delay factors.

Danso and Antwi (2012) evaluate the factors influencing time and cost overruns of the telecom tower construction projects in Ghana. They found 15 major factorsinfluencing time overruns and 14 major factors causing cost overruns in telecom tower construction projects in Ghana. Danso and Antwi (2012) also revealed that telecom tower construction projects executed between 1992 and 2011 experienced as much as 82%time overrun.

DISCUSSION:

Overview of data collection:

A total of thirty-five (35) sets of questionnaires were sent to the selected construction company (Clients, Consultants and Contractor) located in Pune. Out of 35, Thirty (30) 85.71 %

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

completed sets were received back. Following section discusses analysis of given by respondents from survey.

DEMOGRAPHICS OF RESPONDENTS :

Demography of the respondents was assessed to see the factual data of respondents involved in the data collection. It included the percentage of respondents, respondents working position in the Organization and the working experience of the respondents.

PERCENTAGE OF RESPONDENTS:

The respondents represented three categories of the personnel such as, Contractors, site engineer Consultants, project manager, other. These findings are presented in figure 1.2

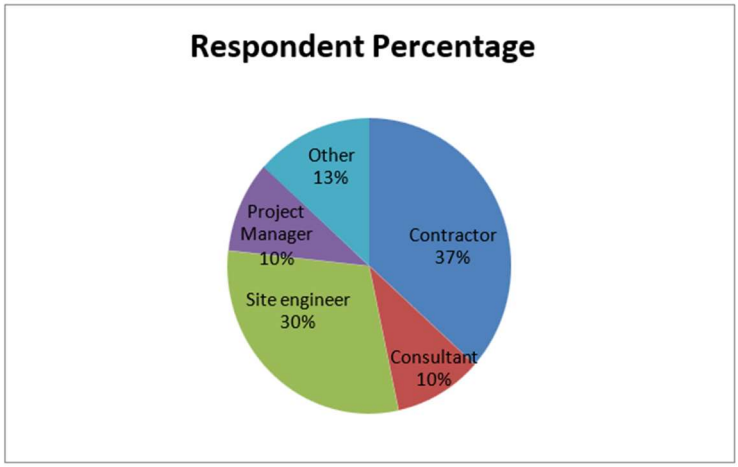


Fig. 1.2 Respondent Percentage

ANALYSIS OF OWNER CONTRIBUTED FACTORS

	FACTORS	R	S	A	VF	M	TOTAL	RII	RANK
		1	2	3	4	5			
A	OWNER								
1	Delay to furnish and deliver site	7	17	6	0	0	30	0.787	5
2	Delay in progress of payment	6	8	3	10	3	301	1.147	1
3	Poor bidding process	19	11	0	0	0	30	0.547	8
4	Delay in approval of drawings	6	9	9	2	4	30	1.053	2
5	Suspension of work by owner	17	6	4	3	0	30	0.707	6
6	changes in order during construction	3	12	12	0	3	30	1.040	3
7	Non adherence to contract conditions	10	13	4	3	0	30	0.800	4
8	Use of costly Material / poor market survey	17	7	3	3	0	30	0.693	7

Table 1.3 Analysis of owner contributed factors

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

ANALYSIS OF CONTRACTOR CONTRIBUTED FACTORS

B	CONTRACTOR	1	2	3	4	5	TOTAL	RII	RANK
1	Inaccurate estimate of cost and time	9	15	4	0	2	30	0.813	4
2	Difficult in Financing project	5	8	15	0	2	30	1.013	1
3	Improper site Planning	18	4	8	0	0	30	0.667	9
4	Error in contract documents/ schedule	16	10	4	0	0	30	0.640	10
5	Poor communication and co-ordination	12	10	6	2	0	30	0.773	6
6	Lack of Experience	17	8	5	0	0	30	0.640	10
7	Rework due to errors during constructions	11	16	3	0	0	30	0.693	7
8	Primitive technologies used	17	7	6	0	0	30	0.653	8
9	Conflict between contractors and other parties	7	15	5	3	0	30	0.853	2
10	Inadequate Safety measures	17	6	0	5	2	30	0.787	5
11	Lack of supervision	8	14	5	3	0	30	0.840	3

Table 1.4. Analysis of Contractor contributed factors

ANALYSIS OF CONSULTANT CONTRIBUTED FACTORS

C	CONSULTANT	1	2	3	4	5	TOTAL	RII	RANK
1	Faculty design	20	8	0	2	0	30	0.587	7
2	Un-use of advanced engineering design software	17	8	5	0	0	30	0.640	6
3	Delay in producing Design documents	16	7	0	3	4	30	0.827	4
4	Insufficient data Collection and survey before design	9	15	0	4	2	30	0.867	3
5	Redesigning	6	16	3	3	2	30	0.920	2
6	Delay in approval major changes in scope of work	9	8	7	3	3	30	0.973	1
7	Inadequate experience of consultant	11	16	3	0	0	30	0.693	5

Table 1.5. Analysis of Consultant contributed factors

ANALYSIS OF MATERIAL CONTRIBUTED FACTORS :

D	MATERIAL	1	2	3	4	5	TOTAL	RII	RANK
1	Shortage of construction material in market	9	11	4	3	3	30	0.933	2

2	Delay in material delivery	5	15	5	3	2	30	0.960	1
3	Damage of Stored material while they are needed urgently	14	12	2	2	0	30	0.693	7
4	Delay in Manufacturing special building materials like precast modules	15	10	5	0	0	30	0.667	8
5	Quality problem with procured material	9	18	0	3	0	30	0.760	4
6	Change in material type during construction	15	7	5	3	0	30	0.747	5
7	Procuring undesired or unwanted material instead	16	8	3	3	0	30	0.707	6
8	Improper Management of material	10	13	2	3	2	30	0.853	3

Table 1.6. Analysis of material contributed factors

DATA ANALYSIS OF EQUIPMENT CONTRIBUTED FACTORS

E	**EQUIPMENT**	**1**	**2**	**3**	**4**	**5**	**TOTAL**	**RII**	**RANK**
1	Shortage of equipment	15	9	4	2	0	30	0.707	5
2	Difficulty in transporting equipment	9	15	2	2	2	30	0.840	3
3	Wrong kind of equipment	18	10	2	0	0	30	0.587	6
4	equipment Breakdown	14	8	6	2	0	30	0.747	4
5	Unavailability of Special equipment	16	6	0	4	4	30	0.853	1
6	Low productivity level of equipment	9	14	4	0	3	30	0.853	2

Table 1.7. Analysis of equipment contributed factors

DATA ANALYSIS OF LABOR CONTRIBUTED FACTORS

F	**LABOUR**	**1**	**2**	**3**	**4**	**5**	**TOTAL**	**RII**	**RANK**
1	Working permit of labours	16	6	4	2	2	30	0.773	6
2	shortage of labours	5	13	6	3	3	30	1.013	1
3	High labour wages	8	7	13	0	2	30	0.947	3
4	Labor safety problems	16	5	5	2	2	30	0.787	5
5	Low productivity level of labours	8	5	13	2	2	30	1.000	2
6	Labour health problems while working in hazardous conditions	7	17	4	2	0	30	0.813	4

Table 1.8. Analysis of labor contributed factors

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

DATA ANALYSIS OF EXTERNAL FACTORS :

G	EXTERNAL	1	2	3	4	5	TOTAL	RII	RANK
1	Effect of subsurface and ground condition factors	12	9	7	2	0	30	0.787	4
2	Weather effect on construction activities	3	8	13	3	3	30	1.133	1
3	Accidents during construction	20	7	3	0	0	30	0.573	8
4	location of site/ lack of proper access	9	19	0	2	0	30	0.733	5
5	Change in government regulations and laws	18	8	2	2	0	30	0.640	7
6	Political and other external influences	13	7	6	4	0	30	0.813	3
7	Theft of material	9	13	6	2	0	30	0.813	3
8	Flood	10	17	3	0	0	30	0.707	6
9	Cyclone	21	7	2	0	0	30	0.547	9
10	Pandemic (covid 19)	6	5	12	4	3	30	1.107	2
11	Earthquake and other	24	6	0	0	0	30	0.480	10

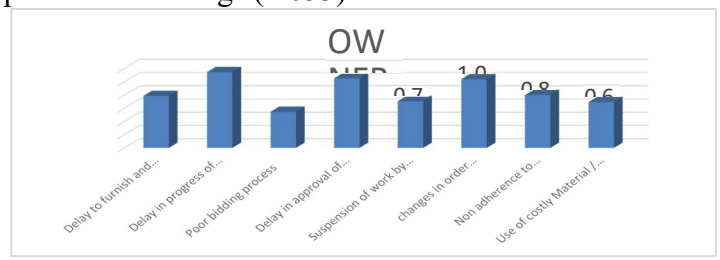
Table 1.9. Analysis of external factors

DISCUSSION OF RESULT

Based on the ranking, Figure 4.3. shows the top three most influencing factors caused for delay from owner related survey-

Delay in progress of payment (1.147)

Delay in approval of drawings (1.053)

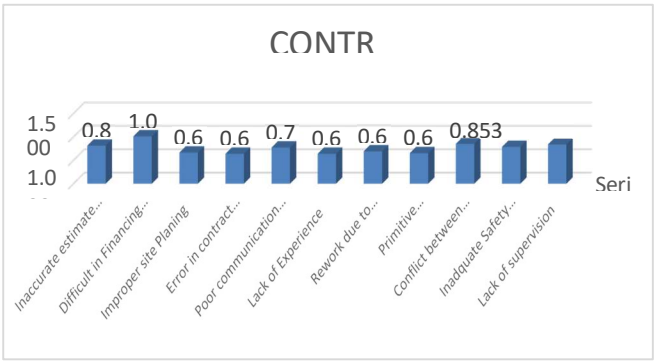


Based on the ranking, Figure 4.4. shows the top three most influencing factors caused for contractor related delay-

Difficult in Financing project (1.013)

Conflict between contractors and other parties (0.853)

a. Lack of supervision (0.840)



Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

Fig2.0. RII of contractor contributed factors

Based on the ranking, Figure 4.5. shows the top three most influencing factors caused for consultant related delay-

Delay in approval major changes in scope of work (0.973)

Redesigning (0.920)

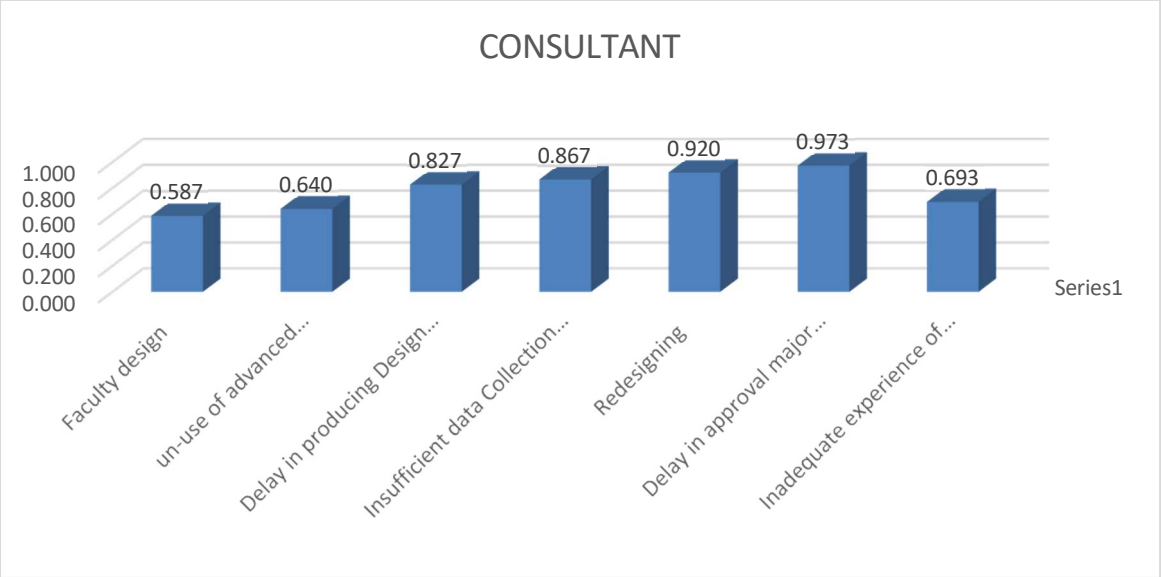


Fig.2.1. RII of contractor contributed factors

Based on the ranking, Figure 4.6. shows the top two most influencing factors caused for material related delay-

a. Delay in material delivery (0.960)

b. Shortage of construction material in market (0.933)

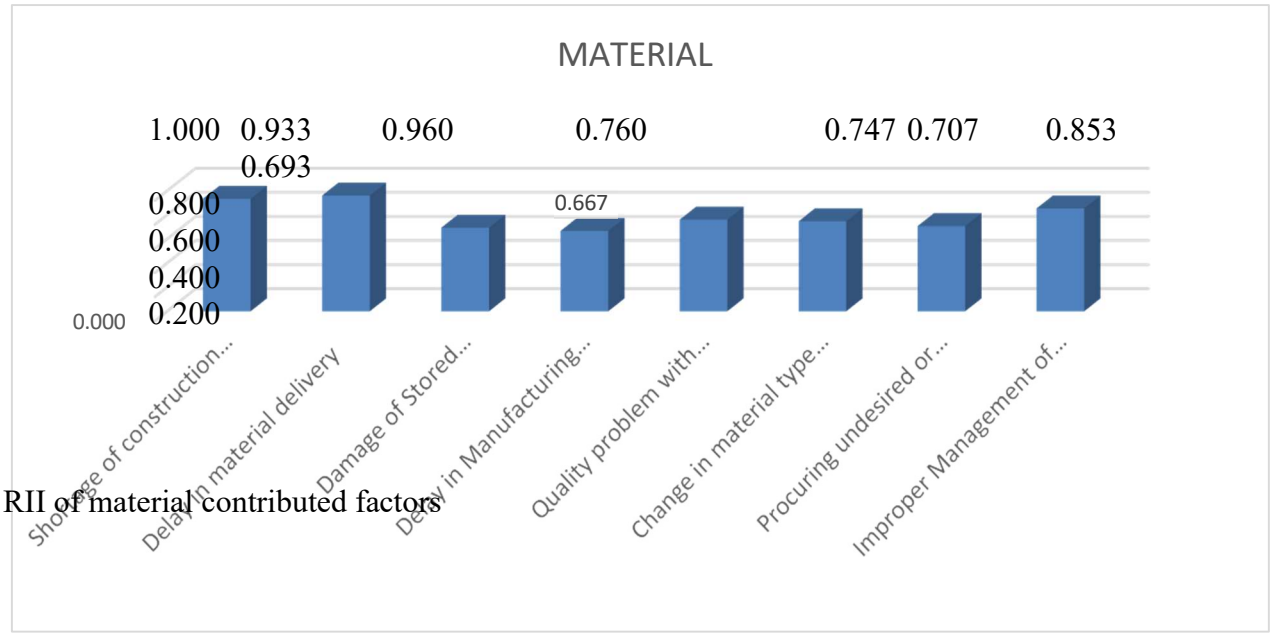


Fig.2.2. RII of material contributed factors

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

Based on the ranking, Figure 4.7. shows the top three most influencing factors caused for equipment related delay-
Unavailability of Special equipment (0.853)
Low productivity level of equipment (0.853)
Difficulty in transporting equipment (0.840)

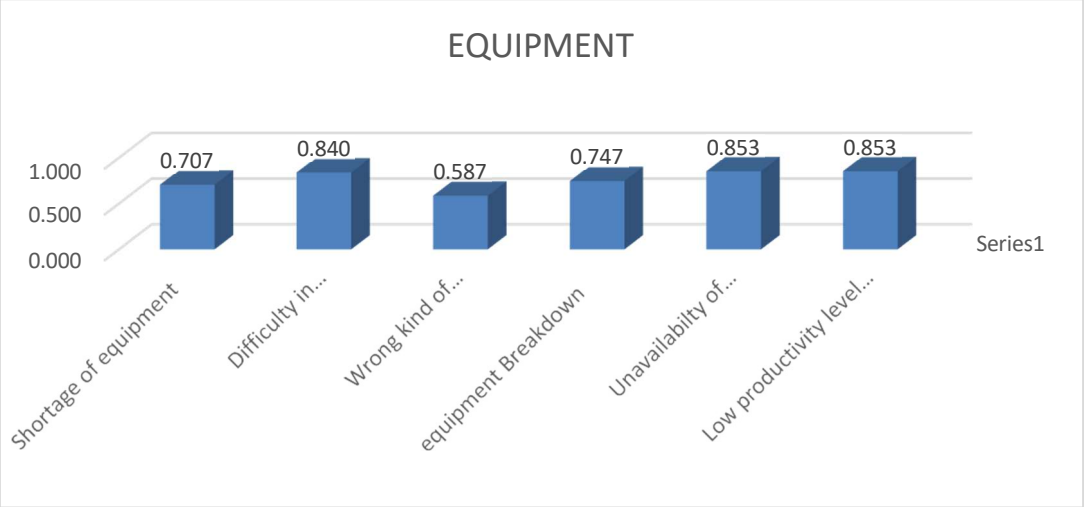


Fig.2.3. RII of equipment contributed factors
Based on the ranking, Figure 4.8. shows the top two most influencing factors caused for labour related delay-

a. shortage of labors (1.013)
b. Low productivity level of labors (1.000)

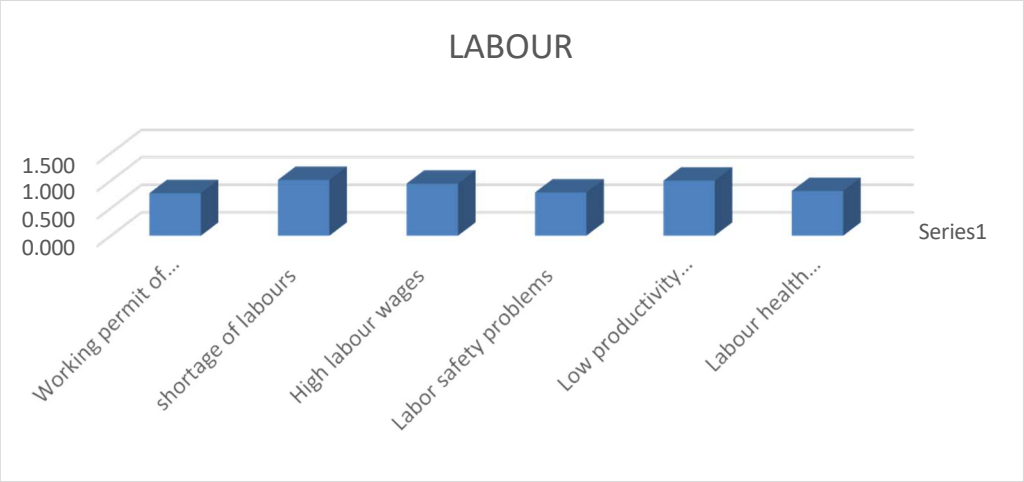


Fig.2.4. RII of labor contributed factors

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 5, No.2, May : 2025

Based on the ranking, Figure 4.4.7 shows the top two most influencing factors caused for external delay Weather effect on construction activities (1.107)ss

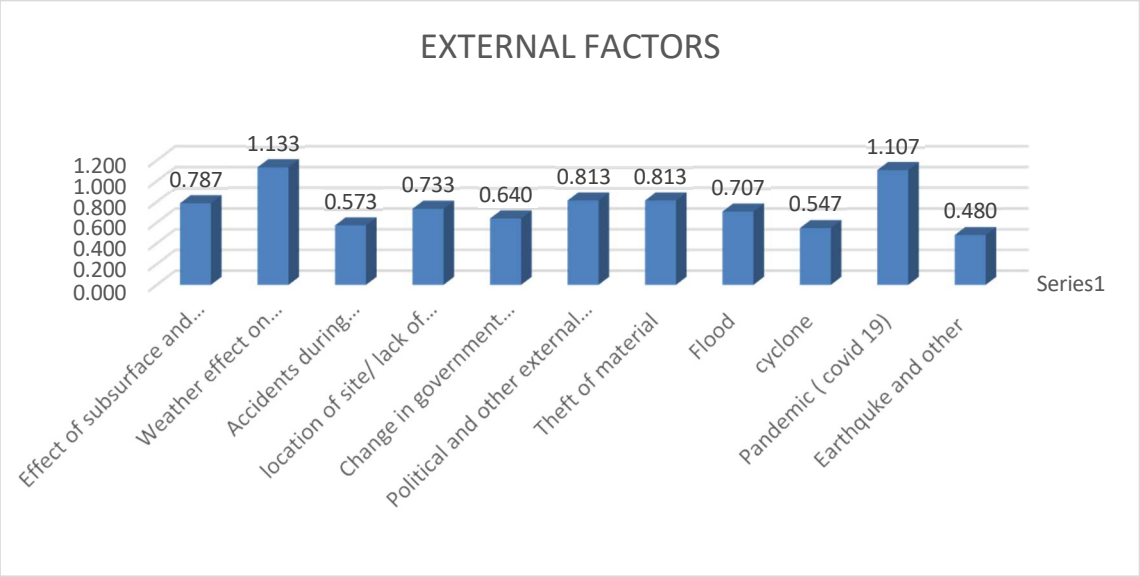


Fig.2.5. RII of External factors

CONCLUSION:

1. This study is conducted through questionnaire survey for finding factors which causes delay in construction projects in Kolhapur. Out of 35 sets,30 sets are received. Data were analyzed by R.I.I method for finding most affected factor by giving rank to them.
2. This study identified 7 most important factors; they are further divided into 54 factors:

a) Owner related
b) Contractor related
c) Consultant related
d) Material related
e) Equipment related
f) Labor related
g) Other external related (E.g.: Act of God)

3. Management needs to focus on sound planning. It won't be possible to execute construction project within the desirable schedule and cost without sound implementation of planning
4. Most of the projects in Pune are delayed due to improper management of man-power resources by contractors. From 1st factor such that owner related factor we have found out that, progressive payment is most affecting factor as compared to other factors therefore management needs to provide proper management of finance.
5. Every activity as per planning and scheduling of contractor must be recorded by the project manager and the sign of contractor should be taken.
6. We need to use good quality materials which gives good strength and long life.
7. From 5th factor (i.e. equipment related delay factor) we have found out that, equipment breakdown affects more as compared to other equipment related factors.

8. For that, we need to follow manufacturers guidelines properly, company needs to provide training to relevant employees, prevent overworking of machines, work on preventive maintenance.
9. From 6th factor (i.e. labors related factor) we have found out that, shortage of labours affect more as compared to other labour related factors. For that, we need to provide attractive salary and training to the labours.
10. In Pune region, there was flood in 2019, 2020 and 2021. And due to pandemic whole construction industry was disturbed. For that we need to claim risk assessment and insurance coverage.
present and future generations.

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