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Factors Causing Delay and Methodology of Ranking for Residential Projects

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***Abstract:*— One of the most common problems in the construction project presently are delays. Delays of a construction project can be defined as the late completion of works as compared to the planned schedule or contract schedule. Projects can be delayed due to number of reasons that may be due to the client, the contractor, acts of God, or a third party. They may occur early or later in the project development. Delays can be minimized only when their cause are identified. The objective of this study was to identify the major causes of delays, the effects of delays, finding importance of each delay factors by Relative Importance and Importance Index method and methods /recommendations of minimizing delays in Residential Construction project. This study was carried out based on literature review and a questionnaire survey. A total of seventy delay factors with nine major groups were identified. The Importance to each seventy factors and nine major groups were found. The major causes which affected the overall residential projects are: External Factors, Contractor Factors, Material Factors, Owner Factors, Design Factors, Equipment Factors, Consultant Factors, Labor Factors and Project Related Delay Factors.**

The thesis presents the results of a questionnaire survey conducted to identify and evaluate the relative importance and Importance Index of the significant factors contributing to delay. Respondents of this survey included personnel from owners, consultants and contractors involved in project.

Controlling and monitoring should be established to enhance project performance in order to minimize or avoid delay in construction projects. The findings of this study was to help the owners / stakeholders to act on critical causes and further try to reduce those barriers on their projects.

Keywords:— Residential Construction delays, Delay Causes, Effect of Delays, Relative Importance Index (R.I.I) and Importance Index (I.I).

I. INTRODUCTION

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer work period, higher material costs through inflation, and due to labor cost increases.

Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources. These sources include the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations. However, it is rarely happen that a project is completed within the specified time.

Delay is a situation when the contractor, consultant, and client jointly or severally contribute to the non-completion of the project within the original or the stipulated or agreed contract period. Delays give rise to disruption of work and loss of productivity, late completion of project, increased time related cost, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to minimize the possibility of delay occurrence or identify it at early stages.

Delays and cost overruns have significant implications from economic as well as political point of view. Due to delays in project implementation, the people and the economy have to wait for the provisions of public goods and services longer than is necessary. Thus, delays limit the growth potential of the economy. Similarly, cost overruns reduce competitiveness of the economy.

II. AIM AND OBJECTIVES

Aim of the study is to identify, rank and recommend the major causes of delay in the Residential Projects.

The main objectives of this study include the following:

1. To identify the factors / reasons causing the delays in Residential Projects.
2. To identify the effects of delays caused by the various Residential Projects.
3. To test the importance of the causes of delay by Relative Importance Index and Importance Index methods and rank it suitably.
4. To identify and suggest the methods of minimizing these factors causing delay.

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III. PREVIOUS STUDIES OF LITERATURES

One of the most important problems in the construction industry is delay. Delays can be occurring in every construction project and the size of these delays differently from project to other project. Some projects are only a few days behind the schedule and some are delayed over a year. So it is important and necessary to define the actual causes of delay in order to minimize and avoid these delays factors in any construction project.

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 theses 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 work team 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.

Albert P. C. Chan, et al (2004) aimed to develop a conceptual framework on critical success factors. Seven major journals in the construction field are chosen to review the previous works on project success. Five major groups of independent variables, namely project-related factors, project procedures, project management actions, human related factors, and external environment are identified as crucial to project success. Further study on the key performance indicators is needed to identify the causal relationships between critical success factors and key performance indicators. The causal relationships, once identified, will be a useful piece of information to implement a project successfully.

Greeshma B Suresh, et al (2015) researched work attempts to identify, investigate, and rank factors perceived to affect delays in the construction projects with respect to their relative importance. The top 10 major causes of construction delays in construction industry are Shortage of construction materials, Effect of subsurface conditions and natural disaster, Delay in material delivery, Low productivity of labors, Rework due to errors, Late procurement of materials, Unqualified workforce, Low productivity and efficiency of equipment, Delay in quality control, Poor site management and supervision, Poor communication between parties & Lack of high technology

Ibrahim Mahamid, et al (2012) conducted the study to investigate the time performance of road construction projects in the West Bank in Palestine to identify the causes of delay and their severity according to contractors and consultants through a questionnaire survey. A total of 52 causes of delay were identified during the research. The survey concluded that the top five severe delay causes are political situation, award project to lowest bid price, progress payment delay by owner, and shortage of equipment.

Jesper Kranker Larsen, et al (2016) analyzed the factors that project managers experience as having the greatest effect on time, cost, and quality. Factors were ranked using the relative importance index. From the findings it was determined that the most influential factor for time is unsettled or lack of project funding; for cost, errors in consultant material; and for quality, errors in construction work. The main conclusion of this research is that project schedule, budget, and quality level are affected in significantly different ways.

IV. PROBLEM STATEMENT

Construction is a dynamic, competitive, ever changing and challenging industry. Construction projects can be delayed for a large number of reasons. Differences categories of delays and different types of delays found on construction projects. Delays can be minimized when their causes are identified. Since the problems are rather contextual, the studies need to focus on specific geographical area, country or region. Many Residential construction projects have faced various problems and delay of time is one of the major problems. It is generally said that the contract language is considered difficult to comprehend and they are therefore a major source of disputes.

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V. IDENTIFICATION OF DELAY FACTORS

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources.

There are many factors that contributed to causes of delays in construction project. The study sought the views of owners, consultants, and contractors on the relative importance and Importance Index Method of the factors that cause delays in building construction projects. The study showed that there are total of nine main/major groups in that total of Seventy (70) delay factors which have been identified. Categorization of such delay factors are as follows:

1. Material related delay factors.
2. Labour related delay factors.
3. Equipment related delay factors.
4. Design related delay factors.
5. Consultant related delay factors.
6. Contractor related delay factors.
7. Owner Related delay factors.
8. Project Related delay factors.
9. External Related delay factors.

For these causes of delays the causes and its effect is shown by fish bone diagram as below:

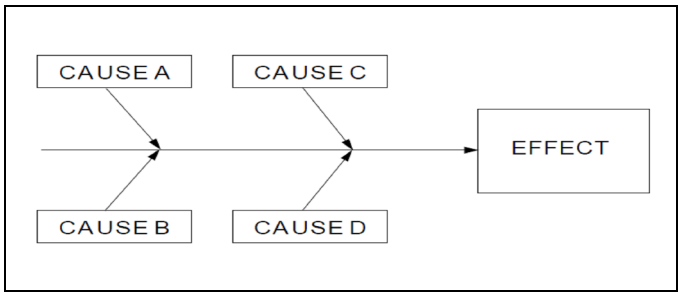

Figure: 1 Fish bone/Ishikawa Diagram Example

Types of Delay

There are four basic ways to categorize type of delays as follows:

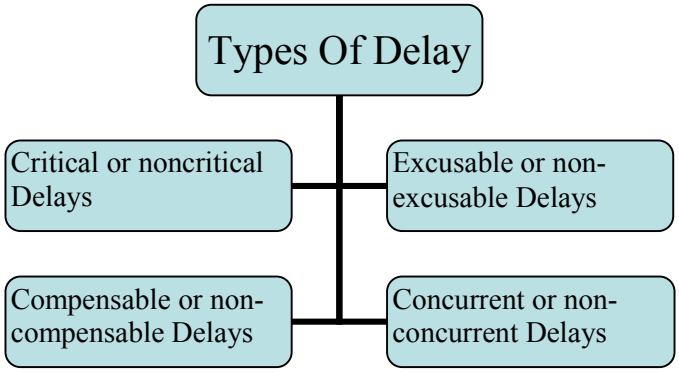

Figure 2: Types of Delays

1. Critical or noncritical
2. Excusable or non-excusable
3. Compensable or non-compensable
4. Concurrent or non-concurrent

VI. METHODOLOGY

1. Primary Data:

Questionnaire survey carried out from Interviews and Site Visits to get in-depth information.

2. Secondary Data:

Review of literature carried out through local & international papers, books, internet etc.

Questionnaires prepared based on factors identified from various literatures.

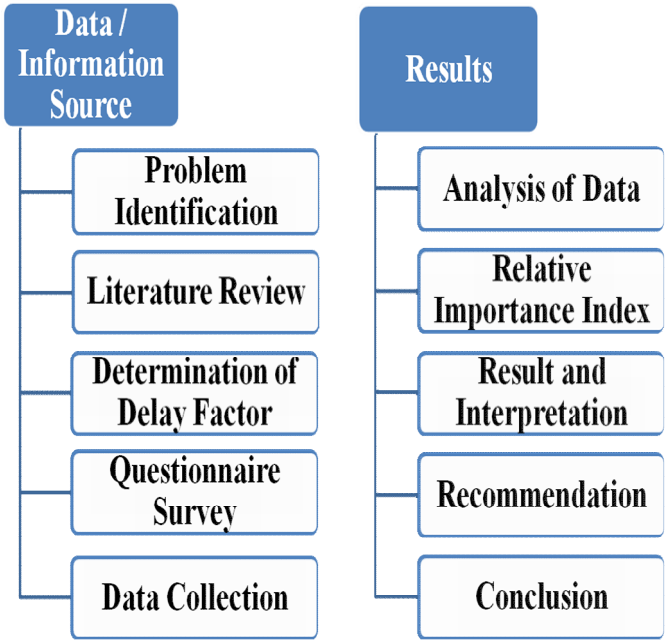

Figure 3: Data Collection and Result Flowchart

6.1 Data Analysis

To analyze data various researchers used the research instrument which was developed using a variety of measures that were adopted from extant literature and a number of new measures developed for this research project .The instruments used in the field survey questionnaires were five Point Likert-scales. The questionnaire was carefully designed to allow the respondents to provide the significant and occurrence of the delay in construction projects based on their experience. The sample consisted of engineering professionals working in three major construction stakeholders: owner, consultant and contractor. No any logical or mathematical process for sampling was employed in this study.

The data analysis work is done by the reference of surveyed questionnaires of different organization collected. The total of 26 different Questionnaires from different Residential Projects are collected and analyzed. The questionnaire test is done through Cronbach's alpha test then the ranking of delays are done accordingly through Relative Importance Index and Importance Index Method.

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6.1.1 Questionnaire Preparation

The delays caused in many of the research papers have been found out and actual condition of sites may lead to make the perfect Preparation of Questionnaire. The research paper as previously seen explains details about the delays and gives the weight age to the causes by giving mean values. This will further help us to priorities these factors according to their impact on cost and time.

Likert scale is used form scaling of ranks given by each respondent. A Likert scale but more commonly pronounced is a psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research, such that the term is often used interchangeably with rating scale.

These are categorized as follows:-

Slightly significant delays factor	-	1
Moderately significant delay factor	-	2
Very significant delay factor	-	3
Moderately significant delay factor	-	4
Extremely significant delay factor	-	5

6.1.2 Cronbach's Alpha for Reliability Statistics

"Cronbach's (alpha) α" is a function of the number of items in a test, it is the average covariance between item-pairs, and the variance of the total score. In statistics, Cronbach's alpha is used as a estimate of the reliability of a psychometric test. Here this test is done to check the Questionnaires. It shows the accuracy of each question. There liability of an instrument is the degree of consistency which measures the attribute; it is supposed to be measuring. Reliability can be quoted with the stability, Consistency, or dependability of a measuring tool. The test is repeated to the same sample of people two occasions and then compares the scores obtained by computing a reliability coefficient.

Cronbach's Coefficient Alpha test can be applied to the scouting sample in order to measure the consistency of the questionnaire. This method is used to measure their liability of the questionnaire between each group and the mean of the whole groups of the questionnaire. Alpha typically varies between 0 and 1. The closer the Alpha is to1, the greater the internal consistency of items in the instrument being assumed. Cronbach's Alpha can be written as a function of the number of test items and the average inter-correlation among the items, this formula is referred from literature paper of Prakash Rao-(2014) and is given by,

$$\alpha = \frac{K*C}{V + (K-1)\,C}.$$

Where,
K = Highest rank to each number of item
C = average inter-item covariance among the items
V = average variance ib items

6.1.3 Relative Importance Index (RII)

The Relative Importance Index (RII) ranking method had been applied to determine the ranks of the different delay causes. RII was used for the analysis because it best fits the purpose of this study. From the ranking assigned to each cause of delays, it is able to identify the most critical delay factors in the construction industry. The RII has been used in many domains to evaluate the comparative importance of a single item to others. Relative Importance Index or weight is a type of relative importance analyses. RII aids in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables.

The equation stated below was used to compute the relative importance index for all the causes. (RII) for each factor is referred from Journal Paper of Desai Megha-(2013) and is given as follows:

$$\mathbf{RII} = \frac{\sum \mathbf{W}}{\mathbf{A} * \mathbf{N}}$$

Where,

W = Weightage given to each factor (ranging from 1 to 5)
A is 5 (the highest weight) and
N is the Total number of Respondents

The RII value had a range from 0 to 1 (0 not inclusive), the higher the value of RII indicates that the more important was the delay factor to the Construction industry.

6.1.4 Importance Index (I)

The other method of finding the importance of affects of these delay factors is Importance Index Method. The method is different from Relative Importance Method but the results of both the methods are similar to each other. The method and Formula used for both the methods are different. The value of Importance Index is in Percentage and ranges from 1 to 100% as in case of Relative Importance Index it ranges from 0 to 1. Highest is the value of Importance Index greater is the affected delay on sites. In the graphs below Importance Index value is shown in percentage value.

The collected data was analyzed using an importance index. In this method the total responses from the entire questionnaire are collected together and multiply it by the frequency of respondent to the different ranges of ranking and found its result. The importance index was computed from the literature paper of Abd El-Razek-(2008).

The formula for Importance Index is given by,

$$\boldsymbol{I} = \frac{\sum \mathrm{ai} * \mathrm{xi}}{5}$$

Where,
I = importance index
ai= constant expressing the weight of the 4th response,
xi = frequency of the 4t h response given as a percentage of the total responses for each cause

VII. Result of the Study

The result of this study includes the Relative Importance Index value, Importance Index Value and Ranking of all considered delay Factors

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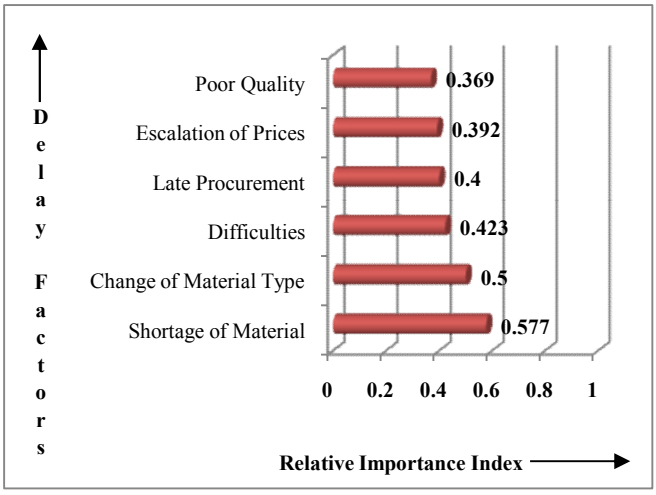
Table 1: RII & II values for Material Related Delay Factors.

Sr.No	Description of Delay Factor	RII	RII In (%)	II Value	Rank
1.	Shortage of Material	0.577	21.68	57.69	1
2.	Change of Material Type	0.5	18.79	50.01	2
3.	Difficulties	0.423	15.9	42.31	3
4.	Late Procurement	0.4	15.03	40	4
5.	Escalation of Prices	0.392	14.73	39.23	5
6.	Poor Quality	0.369	13.87	33.08	6



Graph 1: RII value versus Delay Factor of Material Related Delays.

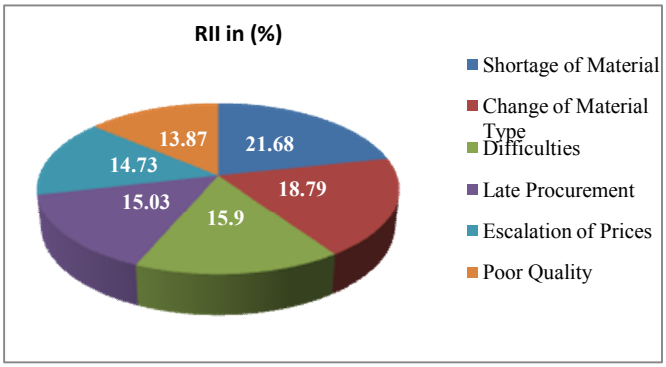
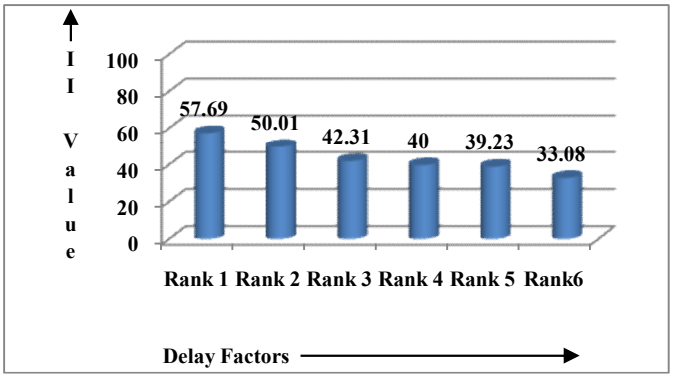


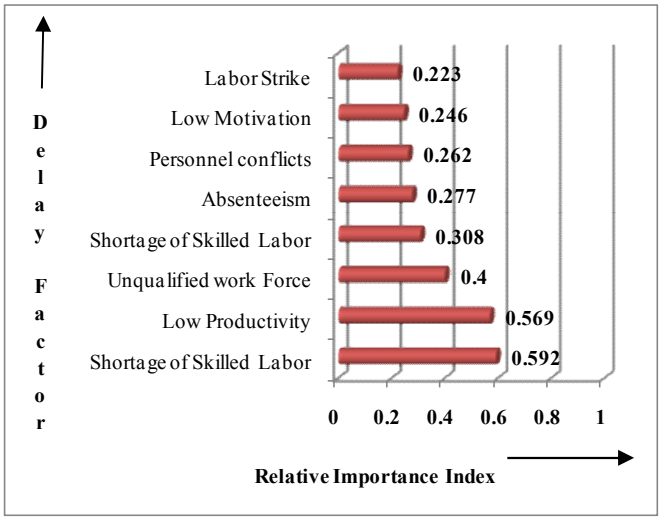
Figure 4: RII value by Percentage presentation of Material Related Delay.



Graph 2: II value versus Delay Factors Related to Material

Table 2: shows RII & II values for Labour Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Shortage of Skilled Labours.	0.592	20.58	60.07	1
2.	Low productivity level of labors.	0.569	19.78	57.7	2
3.	Unqualified workforce.	0.4	13.90	40	3
4.	Shortage of Unskilled Labours.	0.308	10.70	30.77	4
5.	Absenteeism.	0.277	9.63	27.7	5
6.	Personnel conflicts among labors.	0.262	9.11	26.15	6
7.	Low Motivation and morale of labor.	0.246	8.55	24.62	7
8.	Labour Strike or blockage of political parties or other organization at local or national level.	0.223	7.75	20	8



Graph 3: RII value versus Delay Factors Related to Labour.

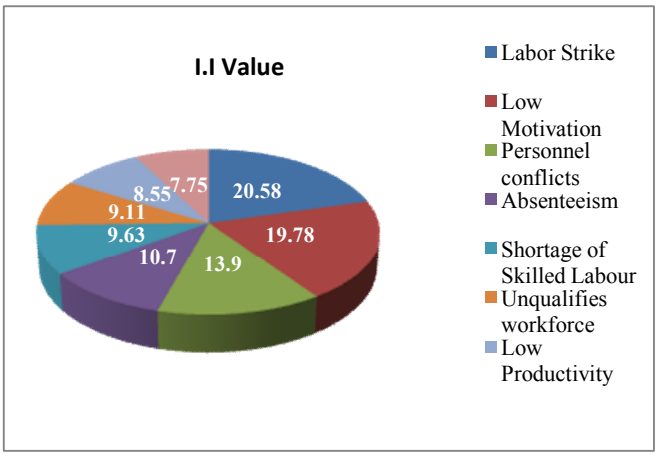


Figure 5: II value by Percentage presentation of Labor Related Delay

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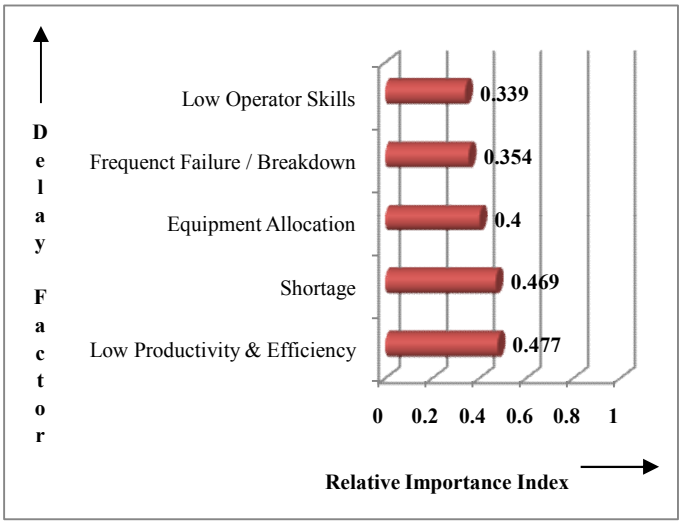
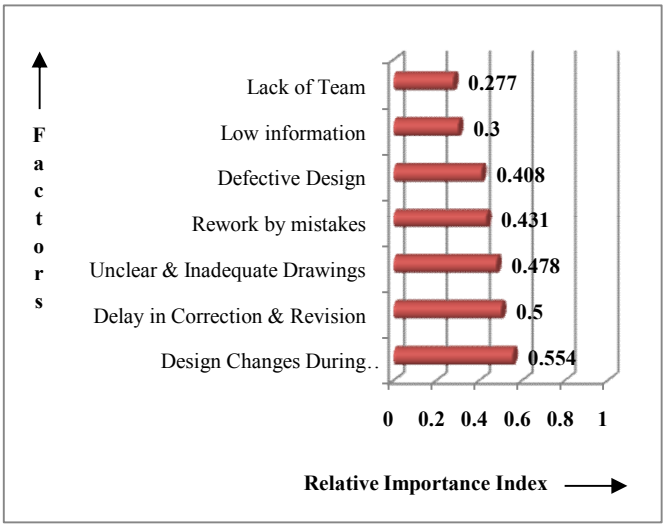
Table 3: shows RII & II values for Equipment Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Low productivity and efficiency of equipments.	0.477	23.39	47.69	1
2.	Shortage of Equipments.	0.469	23	46.92	2
3.	Equipment allocation problem.	0.400	19.62	40	3
4.	Frequent Failure or Breakdown of Equipments.	0.354	17.36	35.39	4
5.	Low level of Equipments – operator skills.	0.339	16.63	33.85	5



Graph 4: RII value versus Delay Factors Related to Equipments.



Graph 5: RII versus Delay Factors Related to Design

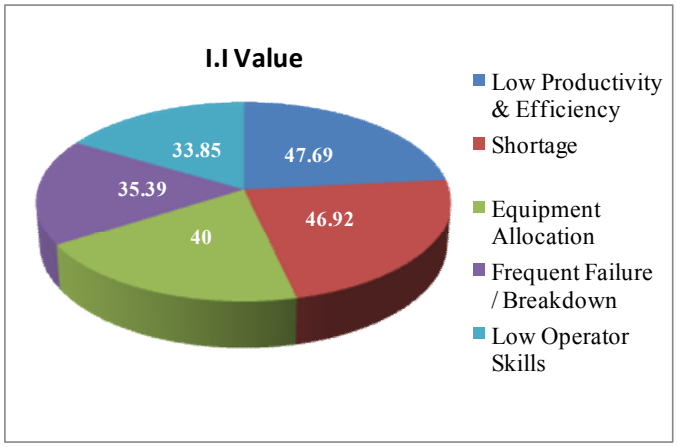


Figure 6: II value by Percentage presentation of Equipment Related Delay

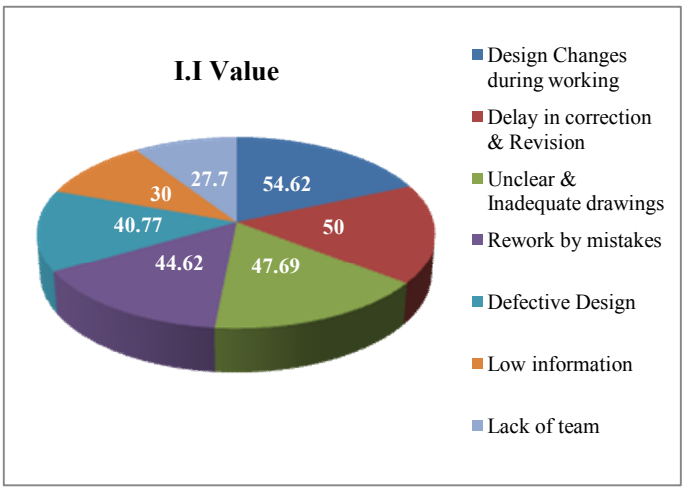


Figure 7: II value by Percentage presentation of Design Related Delay

Table 4: RII & II values for Design Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Design changes by owner his agents or engineer during construction.	0.554	18.7 9	54.62	1
2.	Delay in giving corrections and revisions of designs and instructions.	0.5	16.96	50	2
3.	Unclear and inadequate details in drawings.	0.478	16.21	47.69	3
4.	Excessive Rework due to errors/ mistakes/ incomplete design documents.	0.431	14.62	44.62	4
5.	Defective Design made by Designers.	0.408	13.84	40.77	5
6.	Insufficient data collection and survey before making drawings.	0.3	10.81	30	6
7.	Lack of Design team experience in construction projects.	0.277	9.4	27.7	7

Table 5.5: RII & II values for Consultant Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Delay in performing inspection and testing.	0.446	20.13	44.62	1
2.	Delay due to Strict Checking and Supervisions.	0.439	19.81	43.85	2

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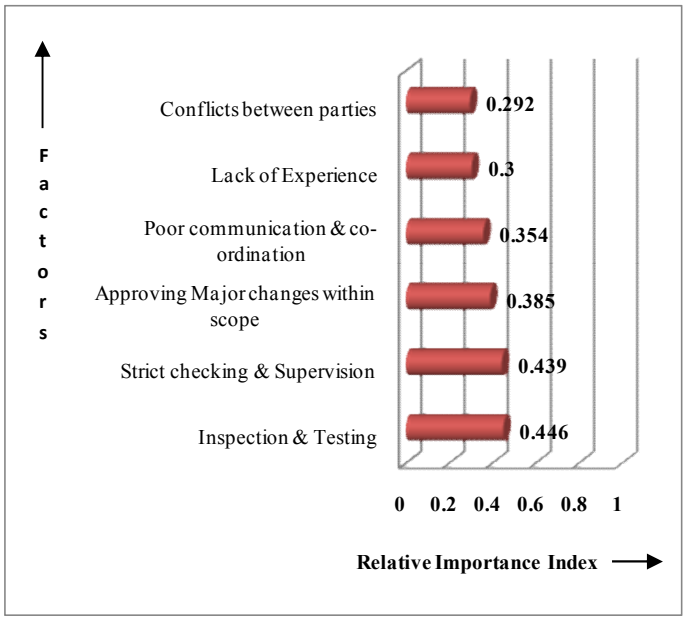
3.	Delay in approving major changes in change of scope of work.	0.385	17.37	38.47	3
4.	Poor Communication and Co-ordination between owners and contractors.	0.354	15.98	36.15	4
5.	Lack of Consultants experience.	0.3	13.54	30	5
6.	Conflicts between contractors and design engineers.	0.292	13.17	29.24	6



Graph 6: RII value versus Delay Factors Related to Consultant.

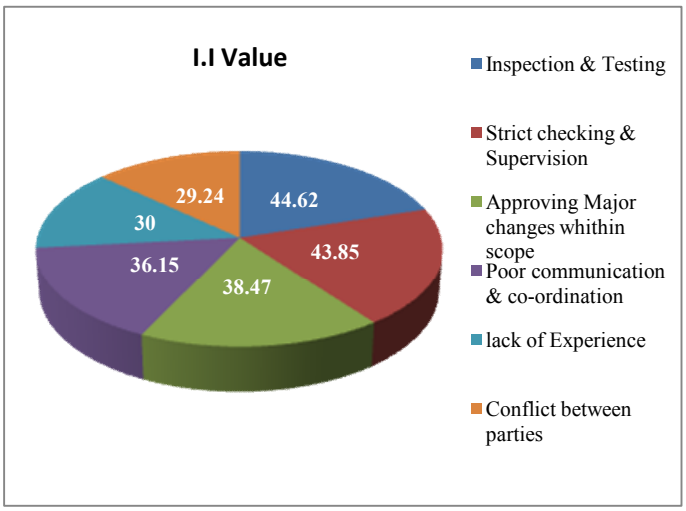
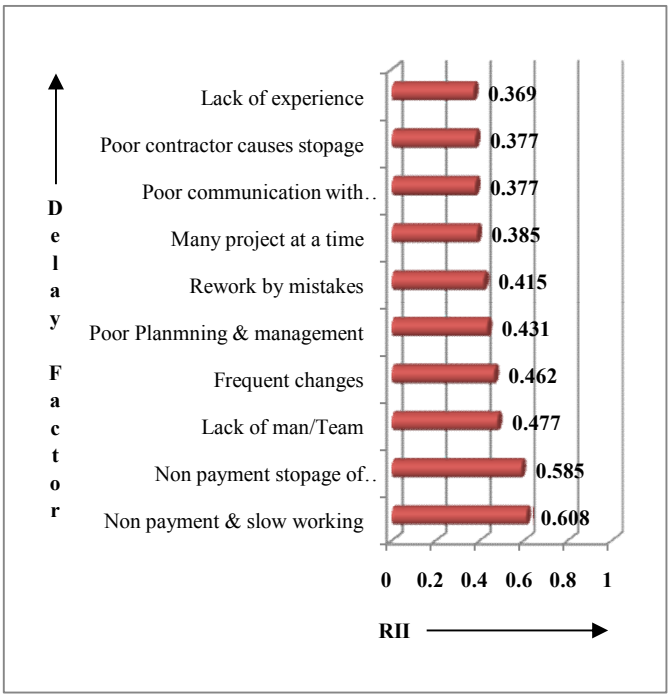


Figure 8: II value by Percentage presentation of Consultant Related Delay

Table 6: RII & II values for Contractor Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Nonpayment to sub-contractors causes less interest and slow working on project	0.608	13.55	60.77	1
2.	Nonpayment to suppliers causing stoppage to material delivery.	0.585	13.04	59.24	2
3.	Lack of man power or team to complete the project.	0.477	10.63	46.92	3
4.	Frequent changes of Sub-contractors.	0.462	10.3	46.16	4
5.	Poor site planning, management, scheduling and supervision.	0.431	9.61	43.08	5
6.	Rework due to mistakes or improper construction methods.	0.415	9.25	41.54	6
7.	Taking too many projects at a time causes delay.	0.385	8.58	38.46	7
8.	Poor communication and co-ordination between senior authorities.	0.377	8.40	37.7	8
9.	Poor quality of sub-contractor work provoked to stop the work.	0.377	8.40	37.69	9
10.	Lack of Experience.	0.369	8.24	36.92	10



Graph 7: RII value versus Delay Factors Related to Contractor.

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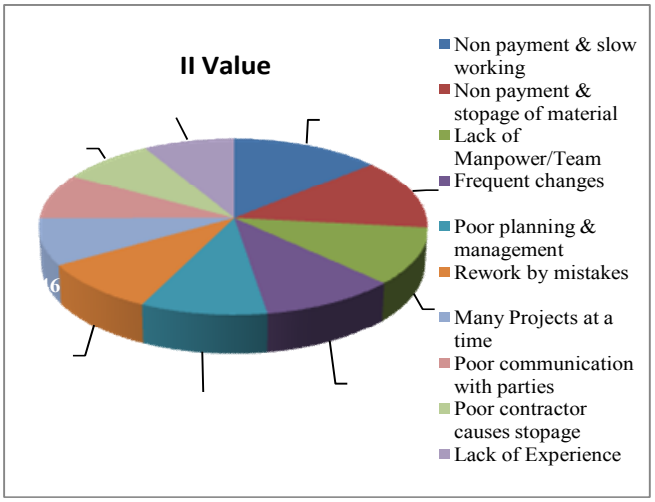
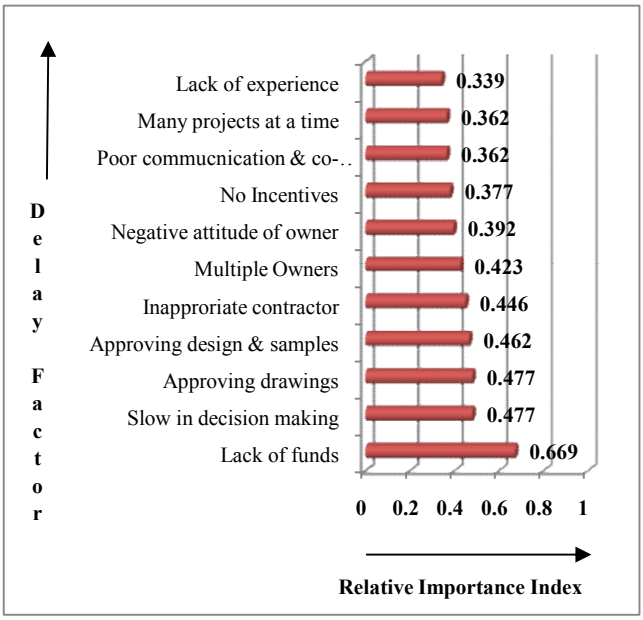


Figure 9: II value by Percentage presentation of Contractor Related Delay

Table 7: RII & II values for Owner Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Lack of Funds.	0.669	13.98	69.23	1
2.	Delay due to slow in decision making.	0.477	9.97	47.69	2
3.	Delay in approving drawings, design and samples.	0.477	9.97	47.7	3
4.	Delay in approving drawings and samples.	0.462	9.65	46.15	4
5.	Selecting inappropriate contractors.	0.446	9.32	44.62	5
6.	Multiple Owners of Projects.	0.423	8.84	42.31	6
7.	Negative attitude of owner or owner's representatives causes slow responses from staff.	0.392	8.19	39.23	7
8.	Unavailability of incentives for contractors/ staff for finishing work ahead of schedules.	0.377	7.88	37.69	8
9.	Poor communication and co-ordination between other parties.	0.362	7.56	36.15	9
10.	Delay due to many projects at a time.	0.362	7.56	36.15	10
11.	Lack of Experience in Construction Projects.	0.339	7.08	33.85	11



Graph 8: RII value versus Delay Factors Related to Owner.

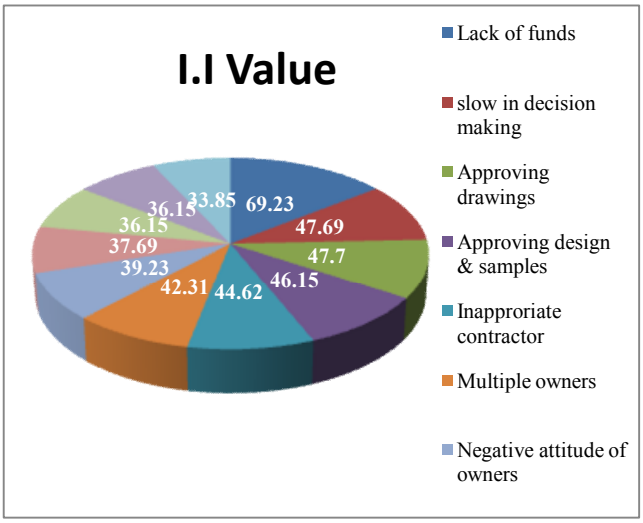


Figure 10: II value by Percentage presentation of Owner Related Delay

Table 8: RII & II values for Project Related Delay Factors.

Sr. No	Description of Delay Factor	R.I.I Value	RII (%)	I.I Value	Rank
1.	Original Contract Duration is too short.	0.392	41.44	40	1
2.	Legal Disputes between various parties / participants.	0.285	30.13	28.47	2
3.	Ineffective delay penalties.	0.269	28.43	26.93	3

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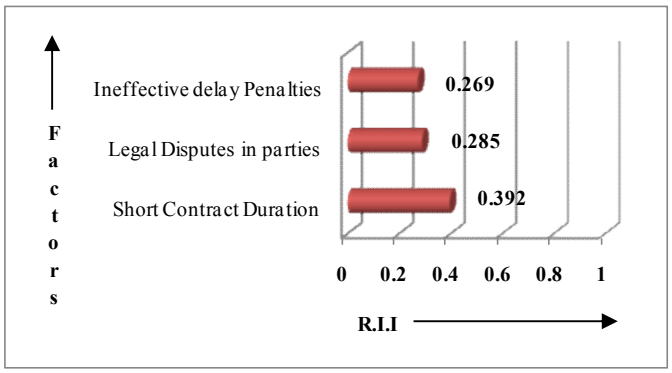


Graph 9: RII value versus Delay Factors Related to Project.

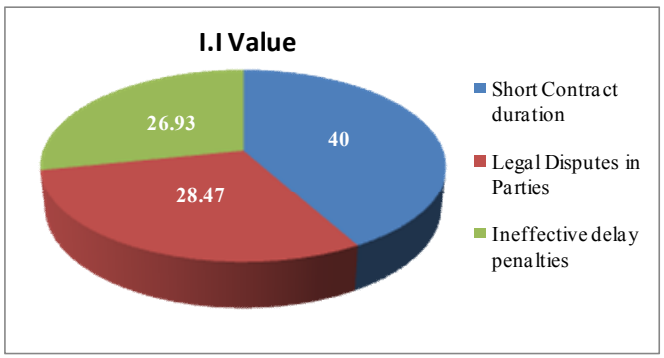
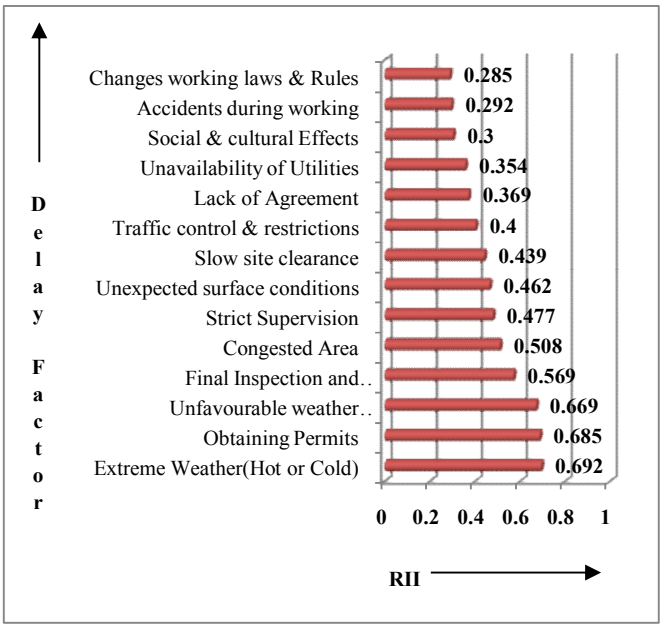


Figure 11: II value by Percentage presentation of Project Related Delay

Table 9: RII & II values for External Related Delay Factors.

Sr. No	Description of Delay Factor	RII Value	RII (%)	II Value	Rank
1.	Extreme weather (Hot, Cold) and unusual Rain, typhoon floods, landslides and earthquakes.	0.692	10.65	69.23	1
2.	Delay in obtaining permits from authorities/ municipality.	0.685	10.54	68.53	2
3.	Unfavorable weather conditions.	0.669	10.29	66.92	3
4.	Delay in performing final inspections and certification of work from clients and consultants.	0.569	8.75	56.92	4
5.	Congested area of working or material storing.	0.508	7.81	50	5
6.	Strict supervisions from senior authorities.	0.477	7.34	47.69	6
7.	Unexpected surface and subsurface conditions (soil, hard rock, high water table etc.)	0.462	7.11	46.15	7
8.	Slow site clearance.	0.439	6.75	43.85	8
9.	Traffic control and restrictions at job site.	0.4	6.15	40	9
10.	Lack of agreement between design, specifications and building code.	0.369	5.68	36.93	10
11.	Unavailability of utilities in site.	0.354	5.45	36.15	11
12.	Effects of social and cultural factors.	0.3	4.62	30.77	12
13.	Accidents during construction.	0.292	4.49	29.23	13
14.	Changes in Rules and Laws\ of working.	0.285	4.37	28.46	14



Graph10: RII value versus Delay Factors Related to External Delays.

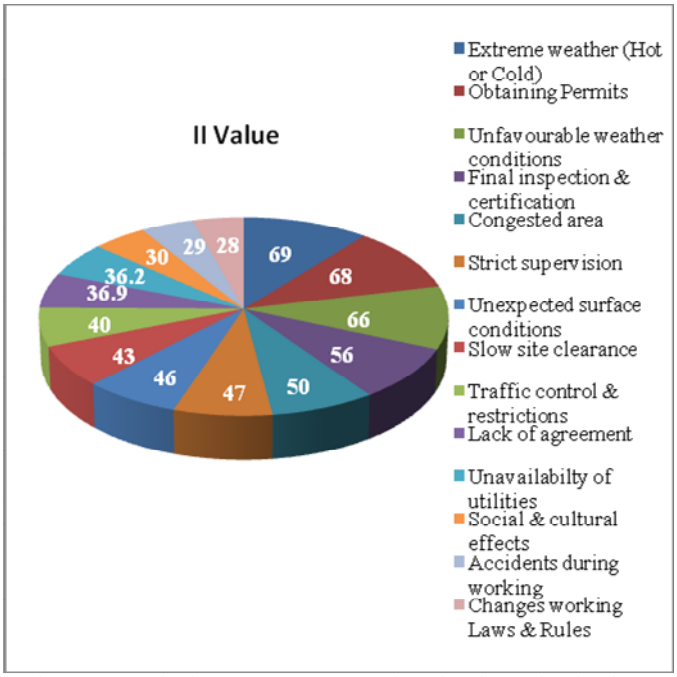


Figure 12: II value by Percentage presentation of Project Related Delay.

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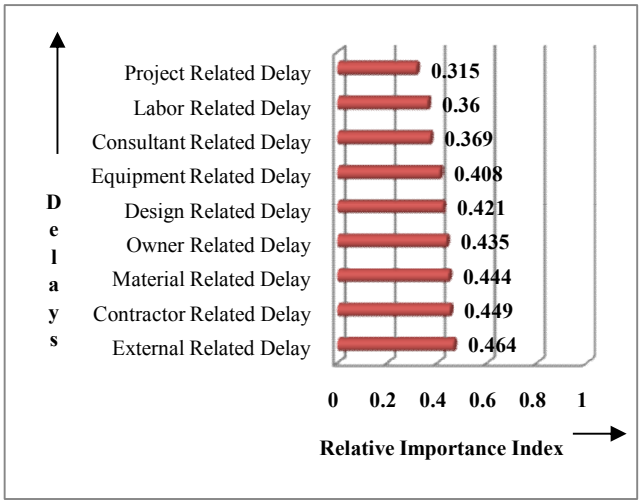
Table 10: RII & II values for Major Nine Factors.

Sr. No	Description of Delay Factor	RII Value	RII (%)	I I Value	Rank
1.	External Related Delays	0.464	13	46.49	1
2.	Contractor Related Delays	0.449	12.58	44.85	2
3.	Material Related Delays	0.444	12.44	43.72	3
4.	Owner Related Delays	0.435	11.87	43.69	4
5.	Design Related Delays	0.421	11.80	42.2	5
6.	Equipment Related Delays	0.408	11.43	40.77	6
7.	Consultant Related Delays	0.369	10.34	37.06	7
8.	Labor Related Delays	0.360	10.9	35.88	8
9.	Project Related Delays	0.315	8.83	31.80	9



Graph 11: RII value versus Delay of Nine Major Factors

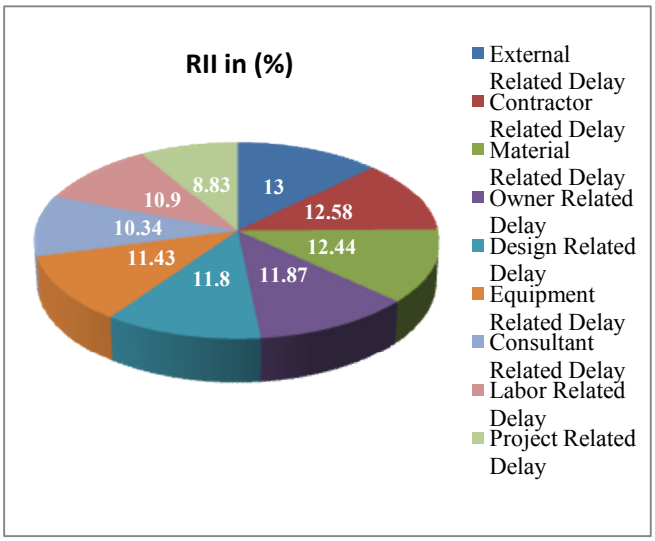
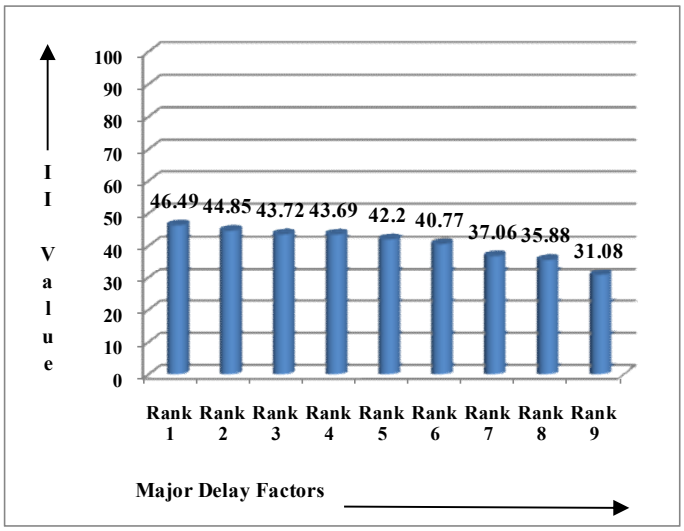


Figure 13: RII value by Percentage presentation of Major Nine Delay Factors.



Graph 12: Importance Index versus All Nine Major Delay Factors.

VIII. CONCLUSION AND RECCOMENDATIONS

8.1 Conclusion

From the above results the conclusion may be given as follows:

1. The factors caused by various Residential construction industries is somewhat same to every projects, the delays which may occur may mainly due to Contractor, Owner and Consultant.
2. In this above study the delay factors were divides into nine major groups and 70 delay factors were identified from literature surveys and Practical sites conditions.
3. The data collected from 26 different Residential Construction sites were collected and two methods were applied for finding its importance namely: Relative Importance and Importance Index method and ranked coordinately as per results found by these methods.
4. The result by theses two methods gives percentage wise distribution to each major delay factors. The result of these delay factors effected by percentage wise distribution by Importance Index Method is given as; External Factors 46.49%, Contractor Factors 44.85%, Material Factors 43.72%, Owner Factors 43.69%, Design Factors 42.2%, Equipment Factors 40.77%, Consultant Factors 37.06%, Labour Factors 35.88% and Project Related Delay Factors 31.80% and the result by Relative Importance Method is given by; External Factors 0.464, Contractor Factors 0.449, Material Factors 0.444, Owner Factors 0.435, Design Factors 0.421, Equipment Factors 0.408, Consultant Factors 0.369, Labour Factors 0.360 and Project Related Delay Factors 0.315. As the value of Relative Importance Index value ranges from 0 to 1 whereas Importance Index value ranges from 0 to 100 %.

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8.2 Recommendations to Minimize Delays

8.2.1 General

1. Most of the time administrative works take longer time than expected in obtaining any permits, NOC or certificates
2. Monthly meeting of sub-contractor, client should be done.
3. Contractors should be aware in preparing planning, monitoring and scheduling programs.
4. Make separate material procurement department.
5. Make Material testing department separate for good quality
6. The use of many subcontractors may lead to a high risk of delays.
7. Unskilled or Uneducated workers may lead to inefficient work and cause accidents during construction and that may have impacts on quality of work.
8. Owners or senior authorities should make decisions quickly so as to prevent projects from being delayed and successful completion in time and in Planned Value.
9. Proper communication and coordination with various parties is a major factor in the timely completion of the project each phase of construction.
10. The workers or staff will be more effective if there are enough numbers of engineers, planning managers, technicians, and foremen, so the responsibilities would be shared between all of them.
11. Design and Drawings should be clear
12. Construction projects for subsurface conditions should necessary involve the assessment of site surface (and subsurface) conditions to select the best methods for construction.
13. The updating of technology utilization and new construction equipments should be used.
14. Application of dewatering pumps working throughout the rainy season.
15. Site management and supervision should be done correctly by the respective representatives.
16. Proper Planning of building and designing should be implemented accurately

8.2.2 Methods to reduce down construction delays.

The delays occurred in Residential Project can be minimized by these various methods are given below:

- Sound Implementation Planning
- Better Formulation and Appraisal of Projects.
- Advance Action
- Clearances
- Assurance of Funds Resources
- Better Contract Management, Penalties and Incentives
- Monitoring

8.2.3 Minimizing Techniques of Construction Delays

The main Tools used for the reduction in time and easy to use can be use to prevent delay are:

- Brainstorming
- Fishbone Diagrams
- Project critical path analysis
- Gantt charts

LIMITATIONS

The study is limited to a sample interview for Residential projects, which could vary for infrastructure projects. A study of infrastructure projects could give quite a different picture. Some limitations are subject to geographical location of the site throughout the India. Moreover, there is usually reluctance from the part of the project authorities to reveal the data. More number of samples would give a clearer picture as the there was less number of resources available in city. The projects are of small scale there would be more number of delays for big township projects which can identify more significant delays.

FUTURE SCOPE

1. By the help of this thesis one can understand the various causes of delay and its effect which can be more or less on the project.
2. The study of Commercial and Infrastructure projects may give different delay views which could be resolved by different methods.
3. More research to be done on various construction project sites to identify complex factors causing delay and find solutions to it.
4. By elaborate study and considering more numbers of case studies one can make this thesis more accurate results.

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