Delay Risk Identification & Assessment For Residential Project Using AHP-RII Methodology

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Abstract: *Residential projects are describes as being very large scale large-scale, long span, and high financial involvement. Due to long duration many delays take place during the execution processes. But if the delays are identified and assessed and optimized in detail cost and time overruns, various lawsuits and contract termination can be reduced. Five main delay factors were identified and further divided in various sub factors after going through the literature survey and by conduction personnel meeting key personnel of the industry. Using AHP –RII analytic hierarchy process (AHP) and Relative Importance Index (RII) a questionnaire was conducted for qualitatively and quantitatively by severity and frequency of occurrence of delay factors respectively. This study provides the most important factors, which are as follows: 1) Lack of on time Payment; (3) Rework as per client requirement (4) Ineffective project planning and scheduling; (5) Shortage of equipment; (6) to obtain permission from Government body; (7) Slowness in Decision; and (8) Frequent change in sub-contractor. The research have found that applied AHP-RII methodology together is very is proficient of assessing the risk which can be helpful for the decision makers to take conscious decision to remove unexpected delays in project*

Keywords: Analytic hierarchy process, Severity, Frequency of occurrence, Relative importance index

1. INTRODUCTION

From past five decades the civil industry of India is acting as an engine for the development of the and has been a very important source of initial input for the socio-economic development of the country. After agriculture civil industry is the second largest sector which contributes for 6%-9% in terms of the GDP, every year 8 to 10% growth is observed per year. USD 50 billion in year 2008 were invested with a consistent increment in further decades also. In providing employment also the sector is devoting a lot, around 31.46 million jobs were provided along with 1.25 million technical jobs in 2008–2009. According to government record, thereby resulting in an annual addition of around 2.5 million jobs to the existing stock with approximately 125,000 new engineering jobs being added annually. Issues such as less productivity, less mechanization and lack of technically qualified employee's damages the industry.

From last five years the value of the civil industry has been increases to another level. The practice of incompatible performance is increasing much faster. Performances of all the projecting are facing downfall in terms of cost time, quality. Therefore main area of investigation is to find the intrinsic factor which contributes towards this factor. Poor performance is shown by almost 40% of ongoing projects. Comparative study with other country have shown that India is presenting most unexpected worst schedule performance when compared with the countries like China, Thailand, Japan. It is also found that highest schedule overrun is shown by which 55% is. The MOSPI latest report have shown that among 951 project 309 have shown cost overrun & 474 are going behind the schedule. MOSPI has reported that "Of the total reported cost increase of USD 12.4 billion, USD 8.4 billion is on 466 delayed projects". Inappropriate planning, and financial management, land

acquisition, poor coordination between parties were some of the reasons of the problem. Causes and factors affecting the schedule and cost study is published by many. Its Application Indian construction context still remains unexplored. There is a urgent requirement evaluate the other aspects that cause the delays, analyse and understand the effects, Collaborate them into factors.

1.1 Definition of Delay

Construction delay was 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." Delay was also defined as an "activity which required duration to perform or complete task of the contract with additional days of work".

2. Scope of Work

Since every Construction project are unique in nature, the criticality of factors associated with it also varies from project and parties to the contract. To measure the factor influencing Delay, the responses from the field personnel were considered. The main objective of the research is limited to exploring the most critical factors of delay in residential project. Therefore, the findings of the same are not completely applicable in the infrastructure and other special construction projects. The main focus of this research was confined to the residential construction project, with an in-depth analysis of the delay risk factors and their qualitative and quantitative analysis.

3. Research Gap

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. Almost all the risk assessments model are having the combination of the quantitative and qualitative data. Both of this techniques are independently no suitable or sufficient for the analysis of risks. So, AHP-RII is method is recommended which involve both quantitative and qualitative data analysis.

4. Objectives

1) To examine the major causes of delays in Residential construction project.
2) To examine the delay in terms of severity & frequency of occurrence by making a multilevel model.
3) To assess the qualitative and quantitative risk
4) To evaluate and rank & suggest corrective action to reduce impact of Delay factor.

5. Delay risk assessment Methodology

5.1 Risk Assessment

The idea of the risk is very different as per different point of view, approach experience, field of expertise. An unpredictable activity which if occurs, will leave its positive or negative impact on some of the objective of the project in terms of time, money schedule, resources, quality, Probability of occurrence and impact on project was identified of the risk. The output of these analysis will give a holistic quantum of the risk in terms of its severity and occurrence frequency, using Eq. (1).

Risk = Severity of delay factor * Frequency of occurrence of delay factor Eq (1)

Identifying risk is the first step in risk analysis; it tell about the most important type of risk and it's characteristic. If we want to avoid the undesirable problems than identification of risk must be done much before time. The method of locating, recognizing & describing risk is.Analysis of risk is the next stage of the assessment. In this stage a thorough study of available data is done and it is also observed that what is the severity of the effect and how frequently the event is occurring, For this wide variety of mathematical techniques can be used. There is one concept of semi- quantitative analysis, this analysis collaborates the mathematical information from quantitative data and subjective information from qualitative data. The inherent traits of the risk are analysed using qualitative analysis and prioritizes risks based on agreed characteristics. The effect of each risk is evaluated and its probability of occurrence is also identified. The most valuable advantage of quantitative risk assessment is that it gives a measurement of the value of impacts, which further can be used for the analysis. One of the important bottle neck numerical ranges used is that the measurement may be unclear. The project uncertainty is minimized, this one of the advantage of this method and also provides the quantitative risk assessment.

5.2. Proposed risk assessment methodology

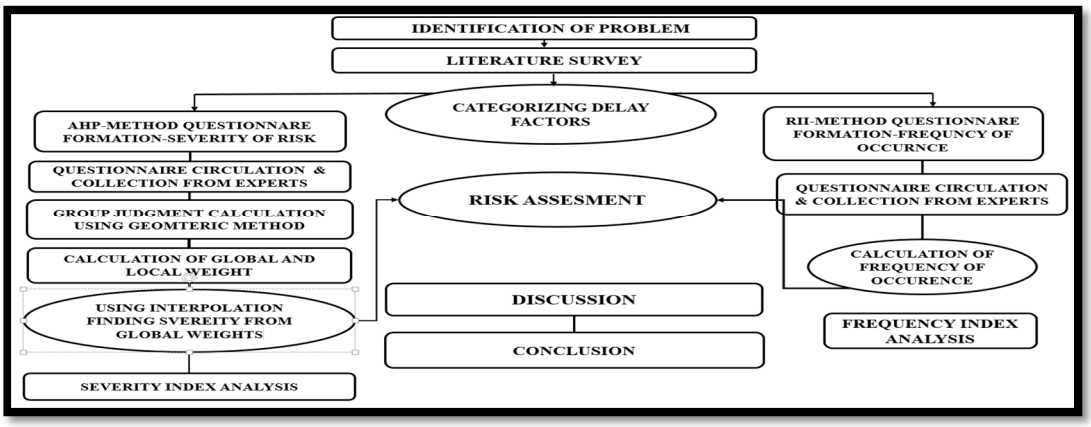

Fig: 1 risk assessment framework

Firstly, residential construction delay factors in different levels were identified by literature survey and having communication with key personnel of the industry representing various stakeholders, project manager, general manager, engineers involved in the residential project. Second stage was to design a proper questionnaire survey to collect data from experts using AHP for finding the severity & RII for the data related to frequency of occurrences.

5.3 Expert survey

On the basis of decided goals a proper questionnaire format was designed after studying all the factors causing delay. All the opinions of the experts were collected by circulating this questionnaire among the key personnel's of the industry. The questionnaire is classified into three sections which are as follows:

Section A: Experts Profile

Section B: Expert opinion.

Section C: Expert judgment on different levels of delay factors for frequency of occurrence index.

Used AHP scale was of the range 1-9, on the basis of this scale a pairwise questionnaire matrix was developed to find the severity of the risk factor. The detail table is given below for the same. Experts were asked the question that was which factor is much influential and how strongly it is over others with respect to the objective. The importance of factors is categorized as follows: equally important (1), moderately importance (3), strongly importance (5), very strongly importance (7), and absolutely importance (9).

Relative information index (RII) method was used in second stage for finding the frequency of occurrence, with a scale of 1-5. The frequency of occurrence is categorized as follows: very low (1), low (2), average (3), high (4), and very high (5).

The last section of the questionnaire was related to the basic details of the experts, regarding their educational background, years of experience & their designation in the firm. One brief example was also explained in the questionnaire to avoid any kind of misunderstanding because of complexity of the AHP questionnaire as it was difficult to understand up to some extent.

5.4 Collaborative risk assessment methodology

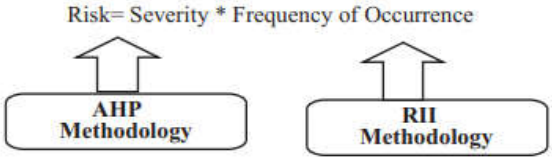

Fig: 2 collaborative risk assessment methodology of AHP and RII

5.5 Severity through AHP methodology

T.L Saaty developed the analytical hierarchy process in Saaty in 1980 which is also unknown as the Saaty method. AHP is one of the most effective MCDM method for decision making. For developing the preferences in a very organized way AHP is needed to divide the decision making process in following stages. In very initial stage, the key problem is defined, and the scope of the problem is determined. In second stage a well-organized hierarchy model was developed with the goal in the top and then their corresponding levels of factors and sub factors. In the mathematical calculation for AHP

initially all the individual judgement were converted to group judgment using geometric mean method. After this the relative weight-age was found for each factor with corresponding factor of the upper level. Criteria weigh was found, they consistency of the matrix was checked by converting the matrix to normalized matrix. Than for every single element local & global weight priority was calculated. Next step was to check the consistency of the responses. CR is the ratio and frequency of occurrence value.

Intensity of importance	Definition	Explanation
1	Equal Importance	Two risk contribute equally to the objective
3	Moderate Importance	One risk is slightly important than other other risk
5	Strong Importance	One risk is strongly important than other activity
7	Very strong Importance	One risk is very strongly important than other risk
9	Extreme Importance	One risk is extremely important than other risk

Table No.1-Scale for pairwise comparison

6. Frequency of occurrence through RII methodology

For finding the frequency of occurrence the RII method was used, below given formula is used for the calculation. For giving rank to the cause of delay based on frequency of occurrence as identified by the experts, below given formula is used. The relative frequency index formula is shown in Eq. (2).

F.I: Σaini/AN Eq(2)

Where ai is the constant referring the weighting given to each response (1 for very low up to 5 for very high), ni is the frequency of the response, A is the highest weight 5, and N is the total number of responses. The highest frequency is shown by the factor having largest RII value.

Scale	Frequency of occurrence
1	Very low
2	Low
3	Average
4	High
5	Very High

Table No.2-Scale for Frequency of occurrence

7. RESULTS

7.1 Severity index

All the local & global weight are shown in table no Table No. 3 for each factor and sub factors of delay. Ranking of each factor also shown Table No.3. Multiplication of local weight of main factor & sub factor gives the global weight of the sub factors.

7.2 Frequency index

Once the severity was calculated through AHP & frequency of occurrence was also found using RII .Table No.4 shows the ranking of frequency of occurrence of each factor of each level with accordance with the goal of the developed model hierarchy in this research

7.3 Risk index

The mathematical risk ranking for the delay are shown in the Table No-5. Multiplication severity & and frequency of occurrence was used to calculate the risk after the calculation of severity and frequency of occurrence.

7.4 Expert Participants

A total of 25 questionnaires were sent to residential construction key personnel & experts who are currently engaged in the projects. The consistency ratio of the 4 responses were greater than 0.10, because of which only 21 response were used for the further study. Fig.3 shows the attributes of the experts for this study.

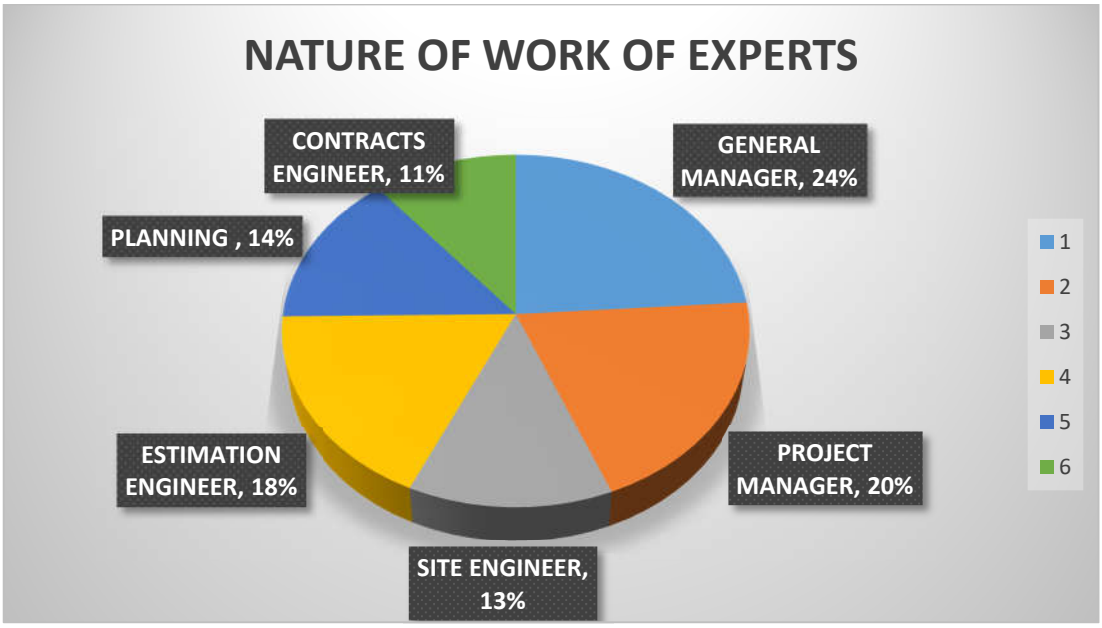

Fig: 3 Characteristics of experts

MAIN FACTOR	LOCAL WEIGHT	SUB FACTOR	LOCAL WEIGHT	GLOBAL WEIGHT	SEVERITY	RANK

Client related	0.204	Lack of on time payment	0.229	0.0467	0.106	8
		Slowness in decision	0.09	0.018	0.047	17
		Changes in planning	0.06	0.012	0.034	20
		Additional work	0.429	0.088	0.193	5
		Delay in approval of drawing	0.169	0.034	0.081	10
		Orientation of building	0.02	0.004	0.016	26
Contractor related	0.115	Ineffective project planning and scheduling	0.183	0.021	0.052	13
		Frequent change in sub-contractor	0.298	0.034	0.080	11
		Inappropriate construction method	0.113	0.013	0.035	18
		Rework due to error	0.410	0.047	0.107	7
		Poor communication and coordination with the parties	0.073	0.008	0.025	23
		Incompetent project team	0.081	0.0094	0.028	21
		Shortage of resources and equipment	0.762	0.088	0.193	4
		Poor workmanship	0.080	0.00919	0.027	22
Consultant	0.07	Late in reviewing and approving drawing and design	0.271	0.019	0.048	16
		Poor coordination with the parties	0.099	0.007	0.022	24
		Delay to raise and finalize RA bill	0.282	0.020	0.049	14
		Delay in inspection and testing	0.049	0.003	0.015	27
		Delay to approve changes in drawing	0.276	0.019	0.049	15
		Conflicts between consultant and designer	0.024	0.002	0.011	29
Architectural & Design related factors	0.05	Delay in provision of drawing	0.137	0.007	0.022	25
		Delay in site inspection	0.043	0.002	0.012	28
		Misunderstanding of owner requirement	0.059	0.218	0.468	2
		Unclear details in drawing	0.513	0.026	0.062	12
		Complexity of design	0.247	0.012	0.034	19
Other factor	0.59	GST Impact	0.208	0.123	0.267	3
		Accident during construction	0.061	0.036	0.083	9
		To obtain permission government body	0.635	0.375	0.799	1
		Delay in provision of water and electricity	0.097	0.057	0.128	6

Table No-3 Severity of delay factors with rank.

FACTORS	FREQUENCY	SUB FACTORS	FREQUNCY	RANK
Client related	0.605	Lack of on time payment	0.676	1
		Slowness in decision	0.438	22
		Changes in planning	0.457	19
		Additional work	0.438	22
		Delay in approval of drawing	0.352	28
		Orientation of building	0.429	26
Contractor related	0.905	Ineffective project planning and scheduling	0.724	4
		Frequent change in sub-contractor	0.457	19
		Inappropriate construction method	0.600	7
		Rework due to error	0.448	21
		Poor communication and coordination with the parties	0.467	17
		Incompetent project team	0.524	12
		Shortage of resources and equipment	0.743	3
		Poor workmanship	0.638	6
Consultant	0.505	Late in reviewing and approving drawing and design	0.562	8
		Poor coordination with the parties	0.438	22
		Delay to raise and finalize RA bill	0.305	29
		Delay in inspection and testing	0.552	10
		Delay to approve changes in drawing	0.495	14
		Conflicts between consultant and designer	0.400	27
Architectural & Design related factors	0.467	Delay in provision of drawing	0.562	8
		Delay in site inspection	0.438	22
		Misunderstanding of owner requirement	0.467	17
		Unclear details in drawing	0.552	10
		Complexity of design	0.495	14
Other factor	0.657	GST Impact	0.514	13
		Accident during construction	0.486	16
		To obtain permission government body	0.886	1
		Delay in provision of water and electricity	0.876	2

Table No-4- Frequency of Occurrence for delay factors with rank.

MAIN FACTOR	RISK	SUB FACTOR	RISK	RANK

Client related	0.438	Lack of on time payment	0.72	1
		Slowness in decision	0.020	17
		Changes in planning	0.015	20
		Additional work	0.084	6
		Delay in approval of drawing	0.028	13
		Orientation of building	0.007	27
Contractor related	0.25	Ineffective project planning and scheduling	0.038	10
		Frequent change in sub-contractor	0.037	11
		Inappropriate construction method	0.021	16
		Rework due to error	0.048	8
		Poor communication and coordination with the parties	0.012	24
		Incompetent project team	0.014	22
		Shortage of resources and equipment	0.143	3
		Poor workmanship	0.017	18
Consultant	0.153	Late in reviewing and approving drawing and design	0.027	14
		Poor coordination with the parties	0.010	25
		Delay to raise and finalize RA bill	0.015	21
		Delay in inspection and testing	0.008	26
		Delay to approve changes in drawing	0.024	15
		Conflicts between consultant and designer	0.004	29
Architectural & Design related factors	0.113	Delay in provision of drawing	0.012	23
		Delay in site inspection	0.005	28
		Misunderstanding of owner requirement	0.218	7
		Unclear details in drawing	0.034	12
		Complexity of design	0.017	19
Other factor	1.25	GST Impact	0.137	4
		Accident during construction	0.040	9
		To obtain permission government body	0.708	2
		Delay in provision of water and electricity	0.112	5

Table No-5- Risk index of schedule delay factors with rank.

7.CONCLUSION

As shown in Table5, “Other factors” is ranked first (1.25), followed by Client related (0.438), contractor related (0.25), Consultant related (0.15), Architectural & design related (0.13). According to numerical risk ranking, the first top 10 sub-factors are Lack of on time payment (0.72), To obtain permission from government body (0.708), Shortage of resources and equipment (0.143), GST Impact (0.137), Delay in provision of water and electricity (0.112), Additional work (0.084), Rework due to error (0.048), Accident during construction (0.040), Ineffective project planning and scheduling (0.038).e of the recommendation to decrease impact of the delay factor studied and run project smoothly are as follows:

1. As per the study it is found that due to Lack of timely payment completion time of project get affected so date & stages wise payment schedule must be attached with work orders of all activities.

2. For Delays related to government agencies a separate department legal department must setup by the companies which will keep continuous track on all government related approval much before time assuming that delay will definitely occur.
3. For delays related to resources, look heads can be prepared which can work as dashboard. Using this look head we can track the future requirement of material and equipment & can arrange resources in time if there is shortage.
4. For delay related GST more cash payments must done.
5. Scope of work must be clearly defined in the contract document so that there are less chances of additional work.
6. For delays due to Misunderstanding of owners requirement regular weekly review meeting must be arranged with the technical team.
7. For delays due to rework a proper plan out must be done, use check list, provide periodic training onsite.
8. Incentives scheme programs must be geared towards rewarding labour, who outperform and exceed pre-determined benchmark, especially those who are linked with critical activities in order to encourage and motivate labour. This will leads to complete task within given period.

In project management process the risk assessment is one of the strongest method for decision making decision it becomes more effective when judgment is given good experienced industry experts. When any project gets delayed and we do the diagnoses, it becomes difficult to locate exactly where the delay has occurred. This kind of analysis will help to locate where it has happened immediately, this location of delay can help project manager to act on it faster before project go ahead. If delays is optimized automatically quality control will be applied to site with respect to schedule optimization. If delays is optimized automatically quality control will be applied to site with respect to schedule optimization.

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