TO STUDY OF FACTORS AFFECTING RISK IN CONSTRUCTION OF SLUM REHABILITATION PROJECT AND IDENTIFY MITIGATION STRATEGIES

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***Abstract*: One of the greatest challenges that India faces according to census 2011 is increasing population and urbanization. Population as per census 2011 is 1200 million making India the second most populate country of globe, after china. Rapid urbanization is direct result of rocketing population. One of the most chronic and intense problem of urban life is slums. Slums exist in almost every metropolitan city of the globe. And so to overcome that, the trend of involving private sector in affordable housing segment is observed globally. In India, it has been mainstreamed through the Pradhan Mantri Awas Yojana (PMAY) under which one component deals with in-situ slum rehabilitation through the public–private partnership (PPP) mode in which the private sector brings in finance and skills to construct housing while the public sector provides land. Slum population makes positive contribution to the city economy by active participation in productive activities. For the better and fast sustainable development of these projects, it is needed for the companies, which engaged in these development projects to identify the risks involved in the projects and usefulness of mitigation strategies for the risks identified. This is the reason why this topic has selected to derive the probability and severity involved in the risks and best mitigation strategy for those risks in the slum rehabilitation projects by the companies which has been working under the PMAY by government of Gujarat. The findings, suggestions and conclusion of the study helps the government, private investors and financial institutions for identifying risks, properly allocating them and manage the projects in best possible way. It would also guide the stakeholders in selecting the best option for mitigating the effects of risks.**

Index Terms: Slum Rehabilitation, PMAY, risk identification, mitigation strategies.

I. INTRIDUCTION

In Project planning, if it is to be efficiently implemented, requires making a number of decisions that have their finale in the smooth running of construction work. This is possible thanks to examining a project from its many aspects and angles, also in terms of likelihood of adverse situations (i.e., risk factors). The risk, as a factor adversely affecting the project, is weighed at the first stage of the investment process, namely at the stage of winning contract through tender.

In view of the situation in the construction industry, where the main aim is to minimize the costs of construction work, as well as to gradually decrease the prices for construction work, procuring an offer for construction work is very difficult. On the one hand, a construction company tries to maximize the profit. The following question rises – at what level risk should be taken in case of a particular contract in order to win the tender and to secure funding for risks which are very difficult to assess. In the course of project implementation, different situations may occur which, at first glance, may seem unfavorable but, in consequence, may bring financial savings due to the changes of construction techniques, work scope or changes in organization.

Construction companies usually analyse most common risk factors, and especially those with potential major impact on construction. The method of verification depends on the company's experience in the industry.

The aim of this study is to present the results of research on risk factors impacting on construction projects. The research will be done by performing risk analysis and determine the factors affecting successful risk management.

II. OBJECTIVES OF THE STUDY

- To study & determine the risk factors that affect objectives of construction of slum rehabilitation projects.
- To identify stakeholders involved in slum rehabilitation projects and to interact with them to analyse determined risk factors affecting slum rehabilitation projects.
- To suggest strategies to reduce/minimize to risk in slum rehabilitation projects.

III. RESEARCH METHODOLOGY

- **Literature review:** Literature reviews based on the topic were collected. These were used as a base for the project. From the literatures collected the methodology and processes were studied.

- **Data collection**: Data Collection was done by questionnaire survey and expert opinion. After identification of factors from literatures and opinions of experts, Questionnaire was prepared for the associated personnel in construction companies other stakeholders for identifying their views and preferences.

- **Data analysis**: It is important to recognise the degree to how much the respondent's rate the possibility of the various parameters based on their own experience and knowledge. After collection of data from the survey it was analysed to identify the most affecting risk factors.

IV. DATA COLLECTION

After identification of factors from literatures and opinions of experts, Questionnaire is prepared for the associated personnel in construction Contractor companies for identifying their views and preferences.

- **Part 1:** Personal information of survey respondent like Name, Organization, Designation, Experience.

- **Part 2:** Various Risk factors will be listed out in survey form. In this section attendee had to give the probability and Severity value on Likert scale of 1 to 5 to identify the most critical risk factors.

APPROACH AND METHODOLOGY:

➢ From the various literatures review it has been learnt that there are many issues regarding project delay, cost overrun and poor quality work in various construction projects. These issues are found more likely to be in large scale projects like Construction of Slum rehabilitations.

➢ So for accomplishment of the objective, questionnaire survey form was made in which respondents will have to give rating to the various factors list down in it according to Likert scale specifies in it. The five point scale which ranges for Probability, from 1(Rare) to the 5(most likely) and for Severity, from 1(Rare) to the 5(extreme) is used and by Risk Matrix method and most critical risk factors which affects the project will be identified. And for AHP method the ratio scales are derived from the principal Eigen Vectors and the consistency index is derived from the principal Eigen Value. The output of the AHP is ranked indicating the overall preference for each of the decision choices, which eventually help the decision maker to select the best option.

Sr. No.	Name of Risk Factor	Risk Description
1	Estimating error	Might result in cost and time overruns.
2	Project approval and permits	Issues regarding permissions/approvals from client
3	Planning & design risk	Project specifications must be clearly defined in the planning stage itself.
4	Change in laws and policies	Changes in government regulations and laws
5	Risk of financing	Contractor's financial difficulties
6	Fluctuation in inflation	Will result in increased prices of raw materials, labor services, etc.
7	Fluctuation in interest rate	Might result in cost overruns.
8	Local public interference and disputes	Beneficiary interruptions
9	Non availibility of Material and labour fo	Might result in time overruns.
10	Inappropriate construction methods	Re-work will be done if not followed proper method
11	Operation and maintenance risk	Operations includes all of the processes needed to construct, Maintenance includes the physical side of operations like making repairs, painting, etc.
12	Government Corruption	Corruption resulting in non-transparent decision making and unfavorable outcomes.
13	Political disturbance	Might result in time overruns.
14	Environmental risks	A risk which can environmentally-driven impact on the construction associated with the current or planned schedule
15	Health and Safety risks	Person may be harmed or suffers adverse health effects if exposed to a hazard

Table 1 List of Risk Factors in Questionnaire form

QUIESTIONNAIRE DESIGN

➢ The questionnaire survey was done to determine the judgment of various respondents from the construction industry.

➢ The result from questionnaire would be used to improve the ability of all Contractors to identify the most affecting critical risk factors and choose the appropriate mitigation strategies to overcome the risks and challenges during construction.

The questionnaire form has the three segments:

- Declaration of objective of questionnaire is for the study purpose only with some details of project work.
- Details of respondents like Name, Name of the Firm, Designation, Experience.
- 15 factors were enlisted for data analysis and evaluation.

V. DATA VALIDATION

- The questionnaire survey form, with 15 factors which were developed from various literature to best fit with nature of construction industry was discussed with the guide who requested to validate the data by knowledge experts and local construction practitioners.
- Validation of questionnaire was done by distributing the data to experts for verification by the emails. And data of questionnaire, was checked for reliability, language implications, and add or remove more factors and information if possible. From the remarks given by the experts about the changes in questionnaire and factors were considered.

VI. DATA ANALYSIS

- It is important to recognise the degree to how much the respondent's rate the possibility and Severity of the various parameters based on their own experience, Perspective and knowledge. After collection of data from the survey it was analysed to identify the most affecting risk factors.
- Data analysis was based on the data which is collected from the physical questionnaire form filled by various respondents.
- For the analysis of data, Risk matrix method was used and the data analysed in Microsoft excel.

1. RISK MATRIX METHOD:

- A risk matrix is a matrix that is used during risk assessment to define the level of risk by considering the category of probability or likelihood against the category of consequence severity. This is a simple mechanism to increase visibility of risks and assist management decision making. In practice, the risk matrix was a useful approach where either the probability or the harm severity cannot be estimated with accuracy and precision.

Risk Rating = Probability x Severity

- Probability is the measure of the chance for an uncertain event will occur. Exposure in terms of time, proximity and repetition. It is expressed in terms of percentage.
- Severity is the degree of impact of damage or loss caused due to the uncertain event.

Based on responses received, presented in tables below, have prepared different matrices to define level of risk by considering probability & severity effects for all types of risks. For this purpose values of probability and severity was filled in 5x5 matrix table and grouped values gained were divided in four risk frequencies low, medium, high and extreme.

1. Estimating error

Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	3	0	0	0	1	4
3	3	2	5	2	0	12
2	0	5	1	3	2	11
1	0	2	2	4	0	8
Total	6	9	8	9	3	35

Risk Raiting	
P5	0
P4	36
P3	96
P2	99
P1	24

Risk Frequency		
Green	6	Low
Yellow	21	Medium
Orange	2	High
Red	6	Extreme

2. Project approval and permits

Probability	Severity					Total
	5	4	3	2	1	
5	0	2	1	0	0	3
4	0	2	5	9	2	18
3	0	2	1	5	5	13
2	0	0	0	1	0	1
1	0	0	0	0	0	0
Total	0	6	7	15	7	35

Risk Raiting	
P5	0
P4	108
P3	91
P2	15
P1	0

Risk Frequency		
Green	5	Low
Yellow	18	Medium
Orange	10	High
Red	2	Extreme

3. Planning & design risk						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	0	0	1	1	0	2
3	1	4	0	2	1	8
2	0	2	3	4	7	16
1	0	0	0	4	5	9
Total	1	6	4	11	13	35

Risk Raiting	
P5	0
P4	12
P3	32
P2	176
P1	117

Risk Frequency		
Green	17	Low
Yellow	12	Medium
Orange	5	High
Red	1	Extreme

4. Change in laws and policies						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	1	2	0	1	0	4
3	3	4	4	6	0	17
2	0	2	1	2	4	9
1	0	0	0	1	4	5
Total	4	8	5	10	8	35

Risk Raiting	
P5	0
P4	32
P3	85
P2	90
P1	40

Risk Frequency		
Green	9	Low
Yellow	16	Medium
Orange	6	High
Red	4	Extreme

7. Fluctuation in interest rate						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	0	2	1	1	0	4
3	0	1	0	4	2	7
2	0	0	4	6	6	16
1	0	0	1	0	7	8
Total	0	3	6	11	15	35

Risk Raiting	
P5	0
P4	12
P3	42
P2	176
P1	120

Risk Frequency		
Green	15	Low
Yellow	16	Medium
Orange	4	High
Red	0	Extreme

8. Local public interference and disputes						
Probability	Severity					Total
	5	4	3	2	1	
5	0	2	1	0	0	3
4	0	2	8	3	0	13
3	0	4	4	4	0	12
2	0	2	1	1	2	6
1	0	0	0	1	0	1
Total	0	10	14	9	2	35

Risk Raiting	
P5	0
P4	130
P3	168
P2	54
P1	2

Risk Frequency		
Green	3	Low
Yellow	15	Medium
Orange	15	High
Red	2	Extreme

9. Non availibility of Material and labour force						
Probability	Severity					Total
	5	4	3	2	1	
5	0	1	0	1	0	2
4	0	3	3	3	0	9
3	0	5	1	12	0	18
2	0	1	1	2	2	6
1	0	0	0	0	0	0
Total	0	10	5	18	2	35

Risk Raiting	
P5	0
P4	90
P3	90
P2	108
P1	0

Risk Frequency		
Green	2	Low
Yellow	20	Medium
Orange	12	High
Red	1	Extreme

10. Inappropriate construction methods						
Probability	Severity					Total
	5	4	3	2	1	
5	0	1	0	1	0	2
4	0	2	0	1	0	3
3	0	1	2	3	0	6
2	0	1	2	6	7	16
1	0	0	0	2	6	8
Total	0	5	4	13	13	35

Risk Raiting	
P5	0
P4	15
P3	24
P2	208
P1	104

Risk Frequency		
Green	15	Low
Yellow	15	Medium
Orange	4	High
Red	1	Extreme

11. Operation and maintenance risk						
Probability	Severity					Total
	5	4	3	2	1	
5	2	7	5	0	0	14
4	2	10	4	1	0	17
3	1	0	1	1	0	3
2	0	0	1	0	0	1
1	0	0	0	0	0	0
Total	5	17	11	2	0	35

Risk Raiting	
P5	70
P4	289
P3	33
P2	2
P1	0

Risk Frequency		
Green	0	Low
Yellow	4	Medium
Orange	19	High
Red	12	Extreme

12. Government Corruption						
Probability	Severity					Total
	5	4	3	2	1	
5	2	0	0	0	0	2
4	1	1	0	0	0	2
3	0	0	0	6	1	7
2	0	0	1	6	12	19
1	0	0	0	1	4	5
Total	3	1	1	13	17	35

Risk Raiting	
P5	6
P4	2
P3	7
P2	247
P1	85

Risk Frequency		
Green	18	Low
Yellow	13	Medium
Orange	1	High
Red	3	Extreme

13. Political disturbance						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	1	0	1	0	0	2
3	0	1	2	4	1	8
2	0	0	3	3	12	18
1	0	0	0	3	4	7
Total	1	1	6	10	17	35

Risk Raiting	
P5	0
P4	2
P3	48
P2	180
P1	119

Risk Frequency		
Green	20	Low
Yellow	12	Medium
Orange	2	High
Red	1	Extreme

14. Environmental risks						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	3	1	1	0	0	5
3	0	3	3	5	0	11
2	0	8	2	3	1	14
1	1	1	0	2	1	5
Total	4	13	6	10	2	35

Risk Raiting	
P5	0
P4	65
P3	66
P2	140
P1	10

Risk Frequency		
Green	4	Low
Yellow	22	Medium
Orange	6	High
Red	3	Extreme

15. Health and Safety risks						
Probability	Severity					Total
	5	4	3	2	1	
5	0	0	0	0	0	0
4	1	1	1	1	0	4
3	0	1	0	2	2	5
2	0	0	2	5	16	23
1	0	0	0	1	2	3
Total	1	2	3	9	20	35

Risk Raiting	
P5	0
P4	8
P3	15
P2	207
P1	60

Risk Frequency		
Green	21	Low
Yellow	10	Medium
Orange	3	High
Red	1	Extreme

Based on matrices shown in tables above, most frequent risks are identified and are shown in the Results below.

VII. CONCLUSION

After conducting the research work to identify the most significant risk factors which contributes Slum Rehabilitation Projects, are concluded from the analysis and results are as follow: Based on the research analysis we can say that every risk factors selected for the study has its own impact on the construction of this type of project, but there are some factors which contributes and affect the project more significantly as per the experience and perspective of the different stakeholders of the construction industry, are analysed and results are as below.:

Based on matrices shown in tables above in data analysis, following table is derived for frequency of the occurrences of the risk.

Table 2- Risk Frequency of each Factors

No.	Types of risks	Risk frequency			
		Low	Medium	High	Extreme
1	Estimating error	6 (17%)	21 (60%)	2 (06%)	6 (17%)
2	Project approval and permits	5 (14%)	18 (51%)	10 (29%)	2 (06%)
3	Planning & design risk	17 (49%)	12 (34%)	5 (14%)	1 (03%)
4	Change in laws and policies	9 (26%)	16 (46%)	6 (17%)	4 (11%)
5	Risk of financing	0	5 (14%)	12 (34%)	18 (51%)
6	Fluctuation in Inflation	3 (09%)	2 (06%)	14 (40%)	16 (46%)
7	Fluctuation in interest rate	15 (43%)	16 (48%)	4 (12%)	0
8	Local public interference and disputes	3 (09%)	15 (43%)	15 (43%)	2 (06%)
9	Non availibility of Material and labour force	2 (06%)	20 (57%)	12 (34%)	1 (03%)
10	Inappropriate construction methods	15 (43%)	15 (43%)	4 (12%)	1 (03%)
11	Operation and maintenance risk	0	4 (12%)	19 (54%)	12 (34%)
12	Government Corruption	18 (51%)	13 (37%)	1 (03%)	3 (09%)
13	Political disturbance	20 (57%)	12 (34%)	2 (06%)	1 (03%)
14	Environmental risks	4 (11%)	22 (63%)	6 (17%)	3 (09%)
15	Health and Safety risks	21 (60%)	10 (29%)	3 (09%)	1 (03%)

On the basis of the ranks given by the respondents, extreme level risks are identifies as below which requires to put more attention and immediate actions need to be taken to mitigate the effects of such risks. Effective control system is required to identify and to implement.

1. Risk of Financing (18)
2. Fluctuation in Inflation (16)

There are 2 other risks which are in the high frequency level says immediate action must be taken to isolate, eliminate, substitute the risk and to implement effective risk controls named as follows:

1. Operation and Maintenance Risk (19)
2. Local Public Interference and Disputes (15)

Almost 50% of the risks i.e. 8 risks of selected 15 risks falls in medium type of risk category, which requires reasonable and practical steps to minimize the risk effects.

1. Estimating error
2. Project approval and permits
3. Change in laws and policies
4. Fluctuation in interest rate
5. Local public interference and disputes
6. Non availability of Material and labour force
7. Inappropriate construction methods
8. Environmental risks

There are only five risks, which are under low frequency category. The risks can be ignored, as they usually do not create any significant problem. Below is the list:

1. Planning & design risk
2. Inappropriate construction methods
3. Government Corruption
4. Political disturbance
5. Health and Safety risks

VIII. RECOMMENDATIONS AND MITIGATION STRATEGIES

By tools used for analyzing data, it can be useful for the management to use them sophisticated. By this simple and easy method manager can find these type of factors on the site which can reduce wastages on site.

The following recommendations are drawn as per the identified results from the survey:

No.	Risk	Mitigation Strategies
1	Risk of Financing	• Risk of financing can be reduced by regularizing delay in project approvals, monitoring fluctuating traffic and third party delay/ violation. • Foreign exchange fluctuation is required to be controlled by reducing borrowings from the foreign sources and debt service risks.
2	Fluctuation in Inflation	• Use of Inflation caps and floors to reduce risk • Apply and maintain Flexible price formula to meet traffic revenue deficiency Make Constructive Investment
3	Operation and Maintenance Risk	• Operation and maintenance risk can be reduced by regularizing demand risk, putting proper monitoring over interest rated and foreign exchange rates as well as reducing the effect of delay in construction.
4	Local Public Interference and Disputes	• Maintaining detailed documentation and approval letters regarding to project activities can help to reduce public interferences and Hire competent and experienced personnel to handle the situation of local public interference. • Use construction disputes resolve methods like Negotiation, Mediation, Arbitration, Expert determination etc.

- Choose suitable and competent work force for the special works on site like experienced Supervisors, Foremen, Site engineers, project managers, Quality managers, Safety engineers etc. for prevention of using inappropriate construction method.
- Appropriate planning and scheduling software should be used to improve execution of work on time.
- Contractors and engineers should be empowered and encouraged for decision making for betterment of the project.
- Maintaining detailed documentation before and after according to activities can help in submitting reports and getting approval on time for further works, As well as examine and use the political connections of your local partners to get approvals on time.
- Various material management techniques should be implement on site by project manager can reduce over/below ordering of materials as well as deterioration of unused stocked materials.
- Regularly maintenance of power tools and machineries can certainly reduce breakdowns and failure during construction.

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