

RISK IDENTIFICATION AND MANAGEMENT IN CONSTRUCTION PROJECTS

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Abstract

No construction project is risk free whether if it is building projects, or any other type of construction projects. For successful completion of the project, managing of risks factor is mandatory. It is very difficult to remove all the risks by managers but this risk can be minimized by monitoring regularly. Main aim of this study to identify that effects cost, time, delay and quality of the projects, to evaluate the rating of risk and also to evaluate the significant risk factors among all other risk factors. In this study, an approach of qualitative method is used. Thirty risk factors are established after studying different research paper and subsequently Risk analysis sheets are circulated among the twenty project of a Construction company out of which twelve project of a construction company has responded. Rate of response is 60%, which may be considered to be fair for data analysis. While for data analysis, the methods used are: Survey response are analyzed using Probability/impact risk rating matrix in which Risk analyze as 'low', 'medium', 'high' and 'extreme' by colour coding; Risk significance index (RSI) matrix; Risk Index Score method and Pareto analysis. This result identify twenty major factors in which extreme risk factors inherent in construction project are financial risk followed by late approval of drawing, communication gap in top to lower management, non availability of skilled worker, increase labour cost and material prize. Pareto chart (80-20 Rule) focus on the major risk factors which poses extreme risk level involved in construction project. The result shows that 80% risk manage by mitigating twenty risk factors involved in construction project. These twenty risk factors are responsible for negative impact associated to cost, time, delay and poor quality of work.

Keywords: Risk management, Risk factors, Risk identification, Risk analysis, Risk index score and Pareto analysis

1. INTRODUCTION

The aim of this study is to identify the major risks that are caused in various construction projects. The general methodology of this study based largely on the survey questionnaire and interviews which are collected from various sources. Project management is the implementation of awareness; skills, method and approach to project activities in order handle the risk management. Any issue that is caused due to risk management affects the cost and time of the project. The project management knowledge area describes project management awareness and exercise in term of its component processes. Risk management is the process of identifying, analyzing and responding the project risk.

Construction projects are always risks orientated that raise from number of sources. Risk is uncertainty, which affects the cost, time, delay and quality of the projects. Most of the management desire low risk, which causes probability of success, profit or some other form of gain. Also natural disasters, affect many people. Risks cannot be avoided, but can be minimized.

2. NEED FOR RISK MANAGEMENT

Risk is very common in construction project. Risk causes loss, damage and also affects the cost, time, delay and quality of the projects. Thus, the need of risk management is

compulsory. The significant risk factors must be keep in mind to eliminate the risk in future and keep safe project site, safe environment, good quality and timely completion of the projects without effecting cost of the project

3. RESEARCH OBJECTIVE

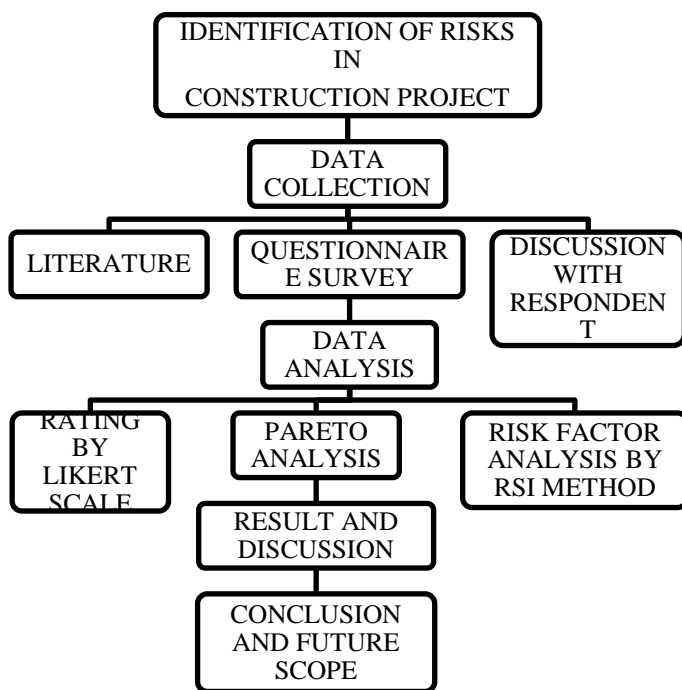
Here aim of this study will be focuses on the major risk factors that affect the construction project. Based on the literature, survey questionnaire and interviews which are collected from various sources, the objective of the project is formulated as:

- 1 To identify the major and common risks factors which cause adverse impact related with the construction project.
- 2 To develop a new methodology to examine Risk Factors by using economic techniques.
- 3 To instruct how to use method for finding risk factors.
- 4 To specify risk significance index score of the factors and to signify the rank of risk factors according to their importance.
- 5 To construct a Pareto diagram which helps in identifying the top causes for the risks related with the construction project.
- 6 To spread awareness among the management to use risk management techniques in the construction project.
- 7 To propose a model for avoiding risk factors in construction project.

4. LIMITATION OF THE RESEARCH

- 1 The data collected are limited to the year 2016 and 2017 Only. The research is limited to only India in which the respondents are randomly being selected and the factors varied with the size of project.
- 2 The respondent’s opinions are use only for research purposes. Respondents are not disclosed in this report.
- 3 It is very difficult to remove all the risks but this risk can be minimized by monitoring the construction project regularly.
- 4 It is impossible to mitigate the all risk factors that affect risk management but I try my best to explain the scope of my study and make report more appropriate.

5. METHODOLOGY



6. RISK FACTOR ANALYSIS

Many Researchers was adopted risk significance index (RSI) for analysis of data and ranking major risk factors by using Risk index score. The same method is adopted in this study. Each respondent is asked to give opinion on the risk that affects the construction projects. For this Risk analysis sheets are circulated to each respondent as probability of risk occurrence (α) and if the risk occurs, what is the degree of impact of risk (β).

$$(RSI)_{ij} = (\alpha)_{ij} \times (\beta)_{ij}$$

(RSI) ij = Risk significance index assessed for risk i by respondent j

α_{ij} = Probability of occurrence of risk i assessed by respondent j

β_{ij} = Degree of impact of risk i assessed by respondent j

To calculate Risk significance index, the five point scales for α and β , will be converted into numerical Conversion. Risk significance index value is determined by using matrix as given in Table 1.

After calculating risk significance index of all responses, the average score of each risk is to determined, this average score is called risk index score and is used for ranking the risks. A 5-point Likert scale for probability, where 1 “Very small”, 2 “Small”, 3 “Neutral”, 4 “Large”, and 5 “Very large”. also for impact, where 1 “Very low”, 2 “Low”, 3 “Neutral”, 4 “High”, and 5 “Very high”.

Table-1: Calculation sheet for numerical Conversion of respondent’s response

		β		Degree of impact					
				Rating scale by Likert					
α				1	2	3	4	5	
				Numerical conversion					
				0.2	0.4	0.6	0.8	1.0	
Probability	Rating scale by Likert	Numerical conversion	5	1.0	0.20	0.40	0.60	0.80	1.00
			4	0.8	0.16	0.32	0.48	0.64	0.80
			3	0.6	0.12	0.24	0.36	0.48	0.60
			2	0.4	0.08	0.16	0.24	0.32	0.40
			1	0.2	0.04	0.08	0.12	0.16	0.20

The formula used for the calculation of risk index score are mention below:

$$(RIS)_i = \sum_{j=1}^N (RSI)_{ij} \div (N)$$

N= number of respondents

7. PARETO ANALYSIS (80-20 RULE)

The aim of the Pareto chart is to find out most significant factors among set of factors. As a thumb rule, the Pareto Principle states that 80% of the risk occurs in construction project by 20% of the causes. The application of the Pareto analysis in risk management allows management to focus on those risks that have the most impact on the project.

After obtaining Relative index score for each factor, cumulative index and cumulative percentage of each factor is also determined. Thereafter draw the Pareto diagram in which Relative index score are taken on primary axis and it is indicated by bar diagram in descending order also cumulative percentage of relative index are taken on secondary axis and it is indicated by line diagram in ascending order and also factors are taken on horizontal axis. Based on Pareto diagram interpret the result.

8. DATA ANALYSIS AND DISCUSSION

8.1 Data Analysis

Thirty risk factors are established and Risk analysis sheets are circulated among the twenty project of a Construction company out of which twelve project of a construction company has been responded. Based on the feedback from

twelve respondents, data analysis as per response of respondent are followed:

- 1 After receiving feedback from twelve respondents (based on Likert scale i.e. 1-5 scale). One respondent sample is shown in Table 2. Afterwards responses of respondent will be converted into numerical scale by using Table 1.

Table -2: One respondent Sample Feedback sheet

Risk Factors	Probability level of risk occurrences(α)	Degree of impact if the risk occurs(β)
	Rating scale by likert	Rating scale by likert
Financial Reasons	5	5
Late approvals drawings and NSR items	5	4
Project delay	5	5
Cash flow problems of client	4	4
Security problems	5	4
Loss due to changes of government	3	4
Variation in market price	5	5
Hike of labour cost	4	4
Hike of materials price	4	5
Changes of Drawings	4	4
Unfairness in tendering	5	5
Hike in site overheads	3	4
Poor planning and budgeting	5	3
Errors in design drawings	3	3
Materials shortage	5	4
Shortage of skilled manpower	4	5
Equipment failure	4	4
Water and electricity problem	5	3
Issue of legal judgment	3	4
Storage of poor quality material	4	4
Competition with other projects	3	3
Accidents on site	5	5
Poor planning for project location	3	4
Execution of construction work	4	3
Communication problem from top to lower management	4	4
Non availability of effective equipment	4	5
Surrounding local body	5	5
Environmental issue	5	4
Demanding the project before Schedule	3	3
Transfer of the project to other contractor	5	4

- 2 Afterwards, the Risk significance index (RSI) for each factors are determined by using matrix shown in Table 1
- 3 Afterward Risk significance Index of all twelve respondents are determined thereafter based on Risk Significance Index of all twelve respondents, averaging scores i.e. Risk Index Score is determined by using risk index score formula. Calculation is shown in Table 4
- 4 Based on Risk Index Score, ranking of risk factors is rearranged from extreme risk to low risk. It is shown in Table 5.
- 5 Draw a bar chart based on ranking of risk as shown in Figure 2.
- 6 Respondent's response matrix on financial risk based on Relative Significance Index: - Based on the feedback from twelve respondents in which seven respondents analyzed as Extreme risk, one respondent analyzed as High risk, two respondents analyzed as Medium risk and two respondents analyzed as Low risk. Respondent's response on financial risk in matrix is shown in Table 3. And corresponding bar chart is shown in Figure.1

Table-3: Respondent’s response matrix on financial risk

LIKEHOOD	IMPACT				
	Very low-1	Low-2	Neutral-3	High-4	Very High-5
Very Large-5				R8,R12	R1,R10
Large-4			R6	R4,R7	R2
Neutral-3		R3,R9			
Small-2	R5	R11			
Very small-1					

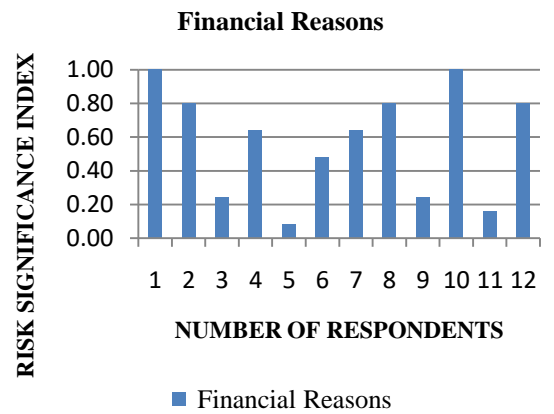


Fig-1: Respondent’s response on Financial Risk

Low risk (L)	Medium risk (M)	High Risk (H)	Extreme risk (E)
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Preferred Acceptable
 Undesirable Unacceptable

Table-4: Risk index calculation sheet

S. No.	Risk Factors / Respondents	1	2	3	4	5	6	7	8	9	10	11	12	Total	Risk Index Score (Mean)
1	Financial Reasons	1.00	0.80	0.24	0.64	0.08	0.48	0.64	0.80	0.24	1.00	0.16	0.80	6.88	0.573
2	Late approvals drawings and NSR items	0.80	0.60	0.12	0.60	0.48	0.64	0.80	0.60	0.48	0.12	0.48	0.80	6.52	0.543
3	Project delay	1.00	0.48	0.36	0.24	0.36	0.04	0.48	0.04	0.48	0.32	0.16	0.64	4.60	0.383
4	Cash flow problems of client	0.64	0.36	0.60	0.36	0.64	0.32	0.24	0.80	0.36	0.48	0.64	0.80	6.24	0.520
5	Security problems	0.08	0.24	0.16	0.08	0.08	0.12	0.36	0.24	0.16	0.24	0.16	0.16	2.08	0.173
6	Loss due to changes of government	0.48	0.24	0.36	0.24	0.36	0.08	0.48	0.16	0.48	0.32	0.16	0.64	4.00	0.333
7	Variation in market price	1.00	0.24	0.24	0.16	0.24	0.32	0.48	0.16	0.32	0.32	0.12	0.32	3.92	0.327
8	Hike of labour cost	0.64	0.48	0.36	0.24	0.48	0.36	0.48	0.12	0.64	0.32	0.16	0.64	4.92	0.410
9	Hike of materials price	0.80	0.48	0.36	0.48	0.48	0.08	0.48	0.08	0.64	0.32	0.08	0.64	4.92	0.410

10	Changes of drawings	0.64	0.08	0.16	0.08	0.04	0.12	0.08	0.08	0.12	0.08	0.36	0.24	2.08	0.173
11	Unfairness in tendering	1.00	0.12	0.60	0.24	0.36	0.32	0.24	0.64	0.48	0.48	0.80	0.64	5.92	0.493
12	Hike in site overheads	0.48	0.08	0.12	0.12	0.08	0.16	0.32	0.48	0.08	0.04	0.04	0.04	2.04	0.170
13	Poor planning and budgeting	0.48	0.32	0.24	0.16	0.24	0.32	0.48	0.16	0.32	0.32	0.12	0.32	3.48	0.290
14	Errors in design drawings	0.36	0.48	0.16	0.08	0.04	0.12	0.08	0.08	0.12	0.08	0.36	0.24	2.20	0.183
15	Materials shortage	0.80	0.24	0.16	0.08	0.12	0.04	0.12	0.08	0.08	0.08	0.36	0.24	2.40	0.200
16	Shortage of skilled manpower	0.80	1.00	0.36	0.24	0.48	0.36	0.48	0.12	0.32	0.32	0.16	0.64	5.28	0.440
17	Equipment failure	0.64	0.16	0.16	0.12	0.04	0.12	0.12	0.08	0.12	0.12	0.08	0.24	2.00	0.167
18	water and electricity problem	0.60	0.24	0.12	0.12	0.08	0.16	0.32	0.48	0.08	0.04	0.04	0.04	2.32	0.193
19	Issue of legal judgement	0.48	0.24	0.08	0.12	0.12	0.16	0.04	0.48	0.08	0.32	0.04	0.04	2.20	0.183
20	Storage of poor quality material	0.64	0.24	0.12	0.08	0.08	0.16	0.32	0.48	0.12	0.04	0.04	0.04	2.36	0.197
21	Competition with projects	0.36	0.12	0.32	0.16	0.24	0.32	0.32	0.16	0.24	0.32	0.12	0.32	3.00	0.250
22	Accidents on site	1.00	0.80	0.36	0.48	0.08	0.32	0.08	0.04	0.16	0.12	0.32	0.24	4.00	0.333
23	Poor planning of project location	0.48	0.16	0.24	0.12	0.36	0.32	0.08	0.04	0.16	0.12	0.32	0.24	2.64	0.220
24	Execution of construction work	0.48	0.36	0.12	0.12	0.08	0.16	0.32	0.48	0.08	0.04	0.04	0.04	2.32	0.193
25	Communication problem from top to lower management	0.64	0.48	0.36	0.36	0.64	0.36	0.48	0.64	0.64	0.32	0.24	0.64	5.80	0.483
26	Non availability of effective equipment	0.80	0.48	0.36	0.24	0.48	0.08	0.48	0.08	0.64	0.32	0.16	0.64	4.76	0.397
27	Surrounding local body	0.12	0.08	0.04	0.04	0.08	0.08	0.08	0.24	0.20	0.36	0.04	0.80	2.16	0.180

28	Environmental issue	0.80	0.36	0.04	0.16	0.36	0.40	0.36	0.36	0.08	0.08	0.04	0.08	3.12	0.260
29	Demanding the project before schedule	0.36	0.32	0.24	0.16	0.24	0.32	0.48	0.16	0.32	0.32	0.12	0.32	3.36	0.280
30	Transfer of the project to other contractor	0.80	0.80	0.36	0.16	0.48	0.16	0.48	0.64	0.64	0.32	0.16	0.64	5.64	0.470

Table-5: Ranking of Risk Sheet

S. No.	Risk Factors	Risk Index Score(Mean)	Rank
1	Financial Reasons	0.573	1
2	Late approvals drawings and NSR items	0.543	2
3	Cash flow problems of client	0.520	3
4	Unfairness in tendering	0.493	4
5	Communication problem from top to lower management	0.483	5
6	Transfer of the project to other contractor	0.470	6
7	Shortage of skilled manpower	0.440	7
8	Hike of labour cost	0.410	8
9	Hike of materials price	0.410	8
10	Non availability of effective equipment	0.397	9
11	Project delay	0.383	10
12	Loss due to changes of government	0.333	11
13	Accidents on site	0.333	11
14	Variation in market price	0.327	12
15	Poor planning and budgeting	0.290	13
16	Demanding the project before schedule	0.280	14
17	Environmental issue	0.260	15
18	Competition with projects	0.250	16
19	Poor planning in project location	0.220	17
20	Materials shortage	0.200	17
21	Storage of poor quality material	0.197	18
22	water and electricity problem	0.193	19
23	Execution of construction work	0.193	19
24	Errors in design drawings	0.183	20
25	Issue of legal judgement	0.183	20
26	Surrounding local body	0.180	21
27	Changes of drawings	0.173	22
28	Security problems	0.173	22
29	Hike in site overheads	0.170	23
30	Equipment failure	0.167	24

7 After obtaining Risk Index Score of each factor, cumulative index score and cumulative percentage of each factor is determined by using Pareto Analysis (80 – 20 Rule). Calculation is shown in Table 6.

8 Draw a Pareto chart .It is shown in Figure-3

Table 6: Pareto analysis calculation sheet

S. No.	Risk Factors	Risk Index Score(Mean)	Cumulative index score	Cumulative %
1	Financial Reasons	0.573	0.573	6.08%
2	Late approvals drawings and NSR items	0.543	1.117	11.84%
3	Cash flow problems of client	0.520	1.637	17.36%
4	Unfairness in tendering	0.493	2.130	22.59%
5	Communication problem from top to lower management	0.483	2.613	27.71%
6	Transfer of the project to other contractor	0.470	3.083	32.70%
7	Shortage of skilled manpower	0.440	3.523	37.36%
8	Hike of labour cost	0.410	3.933	41.71%
9	Hike of materials price	0.410	4.343	46.06%
10	Non availability of effective equipment	0.397	4.740	50.27%
11	Project delay	0.383	5.123	54.33%
12	Loss due to changes of government	0.333	5.457	57.86%
13	Accidents on site	0.333	5.790	61.40%
14	Variation in market price	0.327	6.117	64.86%
15	Poor planning and budgeting	0.290	6.407	67.94%
16	Demanding the project before Schedule	0.280	6.687	70.91%
17	Environmental issue	0.260	6.947	73.67%
18	Competition with projects	0.250	7.197	76.32%
19	Poor planning in project location	0.220	7.417	78.65%
20	Materials shortage	0.200	7.617	80.77%
21	Storage of poor quality material	0.197	7.813	82.86%
22	Water and electricity problem	0.193	8.007	84.91%
23	Execution of construction work	0.193	8.200	86.96%
24	Errors in design drawings	0.183	8.383	88.90%
25	Issue of legal judgement	0.183	8.567	90.84%
26	Surrounding local body	0.180	8.747	92.75%
27	Changes of drawings	0.173	8.920	94.59%
28	Security problems	0.173	9.093	96.43%
29	Hike in site overheads	0.170	9.263	98.23%
30	Equipment failure	0.167	9.430	100.00%
	Total	9.430		

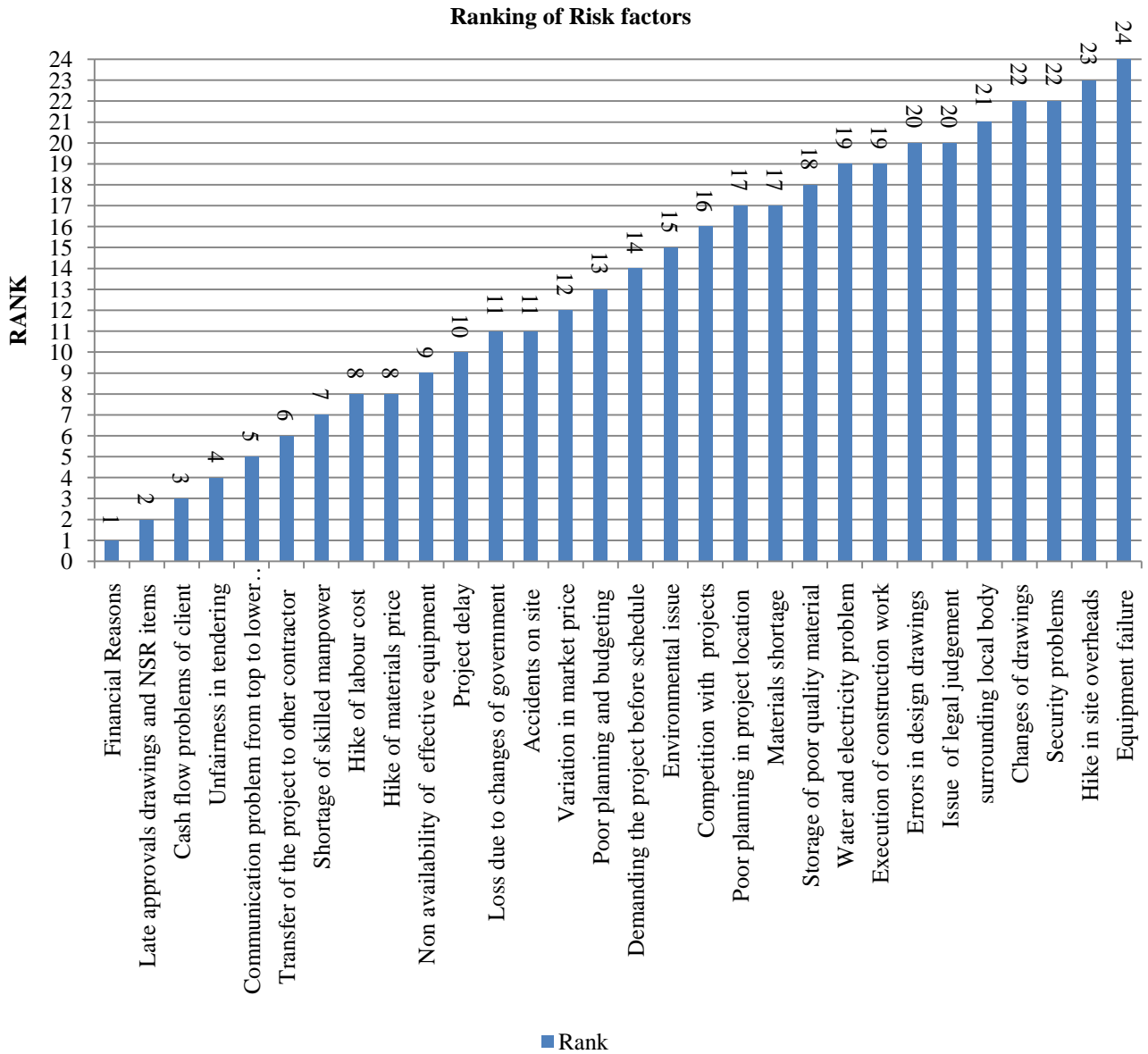


Fig-2: Ranking of Risks

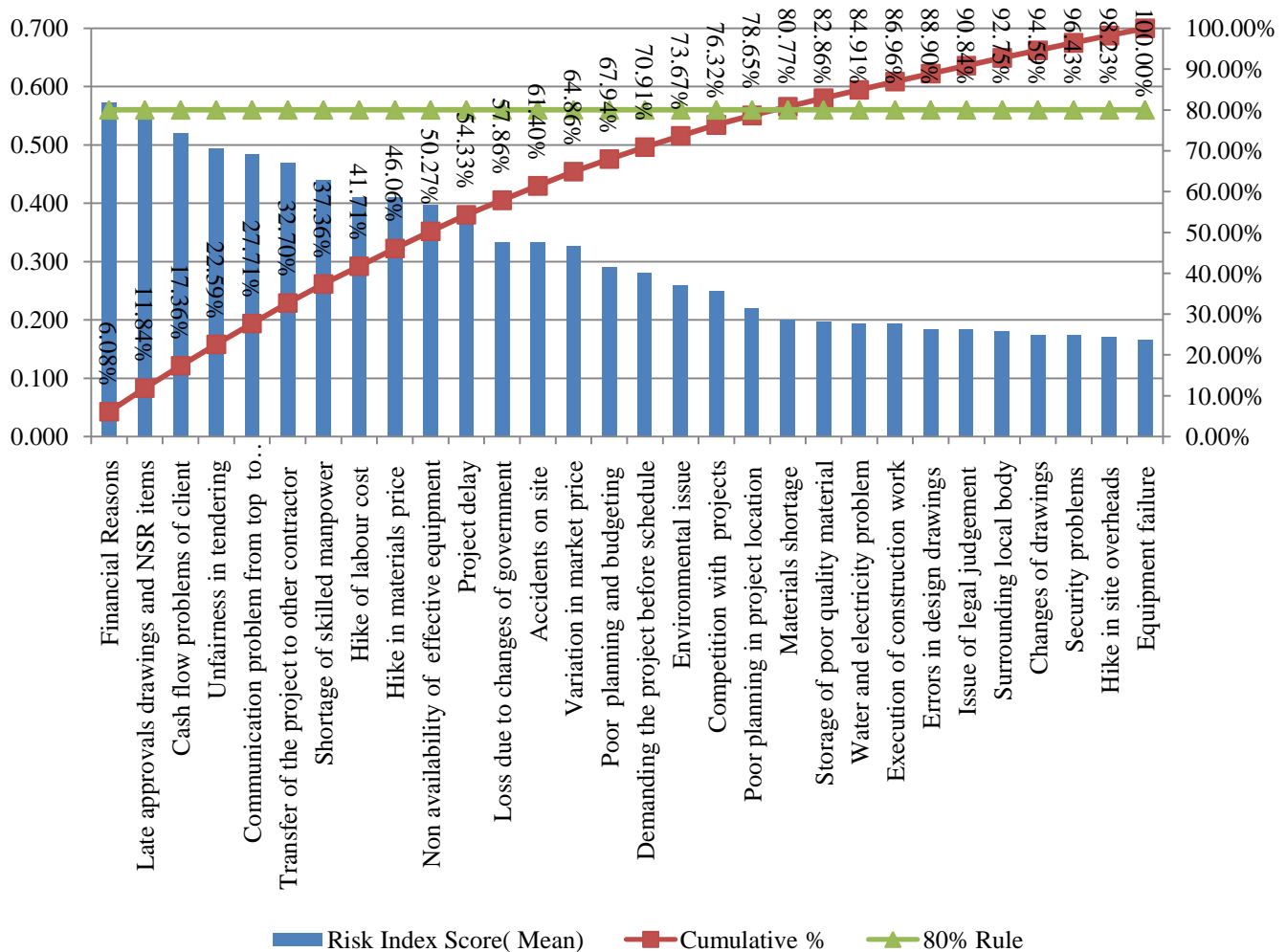


Fig-3: Pareto Chart

8.2 Result and Discussion

Thirty risk factors are established after studying different research paper and subsequently Risk analysis sheets are circulated among the twenty project of a Construction company out of which twelve project of a construction company has responded. Rate of response is 60%, which may be considered to be fair for data analysis. Based on the feedback from twelve respondents, after data analysis as per response of respondent the following findings have been mentioned in detail.

This results identify twenty major factors in which extreme risk factors inherent in construction project are financial risk has higher risk index score (0.573), followed by late approval of drawings and NSR items(0.543), Cash flow problems of client (0.520), Unfairness in tendering (0.493), Communication problem from top to lower management (0.483), transfer of the project to other contractor (0.470), Shortage of skilled manpowers (0.440), Hike of labour cost (0.410), Hike in materials price (0.410) than other risk. So financial reason has extreme level of risk than other risk factors, subsequently it stands in ranking one which means financial reason is unacceptable in

construction project followed by other risk factors also. Ranking the level of risk according to their risk index score.

Pareto chart (80-20 Rule) focus on the major risk factors which poses extreme risk level involved in construction project. The result shows that 80% risk manage by mitigating twenty risk factors involved in construction project. These twenty risk factors are responsible for negative impact associated to cost, time, delay and poor quality of work. From the Pareto chart risk factor can be easily understand how to identify and mitigate the risk.

9. CONCLUSION AND FUTURE SCOPE

9.1 Conclusion of Research

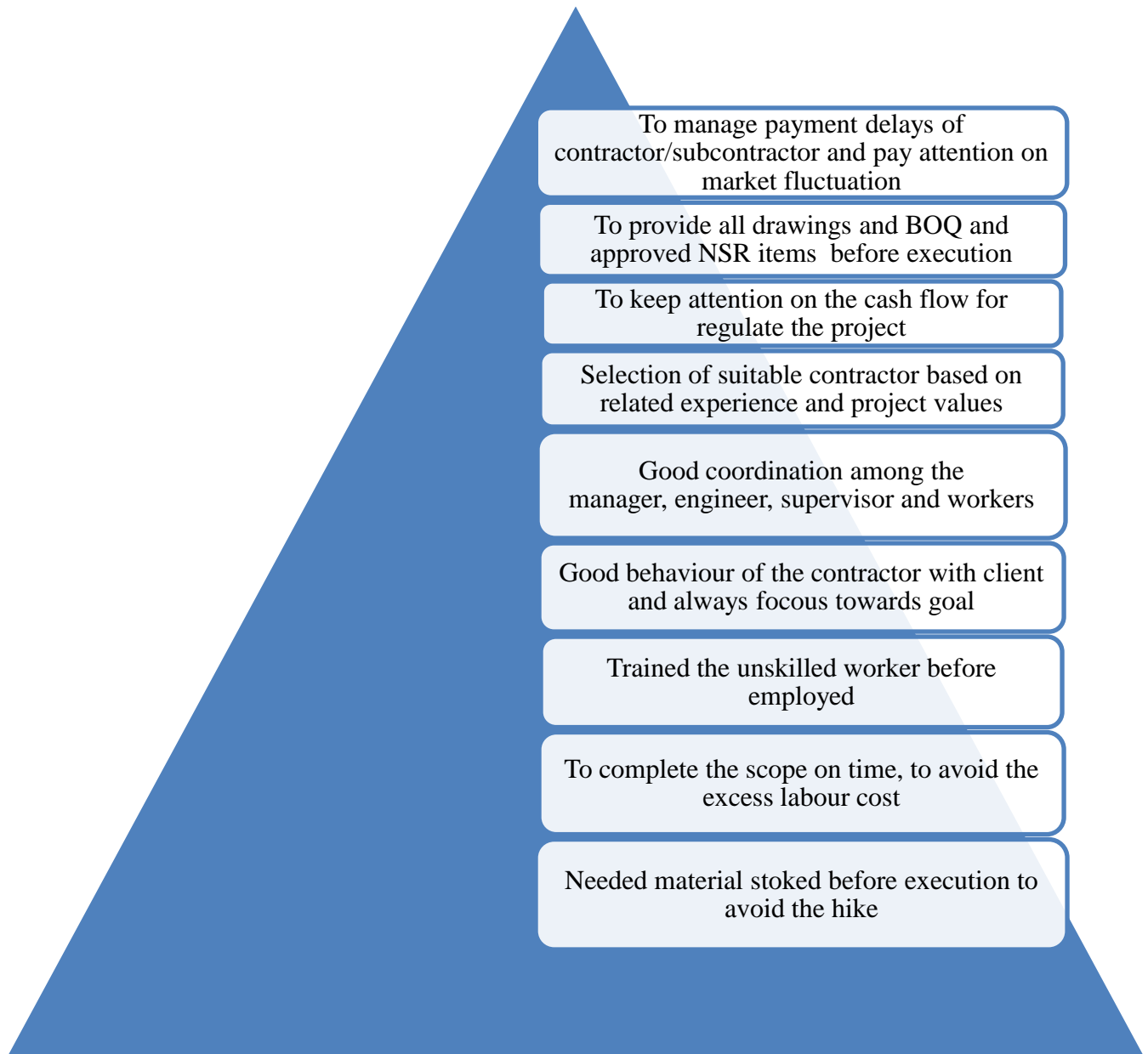
In this research thirty risk factors are established and subsequently Risk analysis sheets are circulated among the twenty project of a Construction company. To identifying the major risk factors faced in construction project by Relative index score method. Ranking the level of risk according to their risk index score and identify the risk mitigation which cause profit and success of project.

In this research, financial risk are the major risk in construction project and adversely affect the cost overruns ,

schedule time, delay and quality of work. For improvement of quality of work, manage schedule time and cost by applying risk assessment technique with immediate effect. It is very difficult to remove all the risks but this risk can be minimized by monitoring the construction project regularly. The aim of this research is also to implement their risk analysis tools. In this research, Pareto Analysis tool has been used to identify the major factors and focus on those risks that have adverse impact on the project. From this study,

found that twenty risks are responsible for negative impact in construction project associated to cost, time, delay and poor quality of work. If these 20 risks monitor on time, 80% risk manage in construction project

This results identify twenty major factors in which extreme risk factors are consider to mitigate the risk in construction project by adopting the recommended model below:



9.2 Future Scope of Research

The result of this research will help to construction project companies in India to understand how to identify the major risk and mitigate them to improve the poor quality of the works. This study also gives the importance of Pareto analysis for the risk management in construction project.

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