EVALUATION OF RISK FACORS INFLUENCING BUILDING CONSTRUCTION

C H Sabarinath[1], Jinta John[2], Jenson Jose[3]

[1]*PG Student St Joseph's College of Engineering and Technology, Palai, Kerala.*
[2] *Assistant professor St Joseph's College of Engineering and Technology, Palai, Kerala.*
[3] *Assistant professor St Joseph's College of Engineering and Technology, Palai, Kerala.*

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Abstract - *Risk management is the identification, assessment of risk and measures to overcome risks. Risk existing in building construction is more as compared to other construction projects. Risk management in building construction could help to reduce the possible risk of accidents. This study focuses on the risk management in commercial building construction. Four main objectives of this study were to identify risk factors, identify risk frequency and impact, categorize risk and identify measures to manage these risks. Extensive literature survey followed by a questionnaire survey served as the main source of data.. Based on a probability of occurrence and severity of impacts on the project objectives, this paper identifies major risk factors influencing building construction. This research proposes Relative Importance Index (RII) and Technique for the Order Preference by Similarity to ideal Solution (TOPSIS) methodology based on Multi Criteria Decision Making analysis to prioritize and assess the risks.*

Key Words: **Building Construction Projects, MCDM analysis, Risks, Severity of impacts, RII, TOPSIS.**

1. INTRODUCTION

The risk management can be defined as the process to identifying, analyzing, and responding to project risks in order to improve opportunities and reduce threats affecting the objectives of the project. The first step of risk management is risk identification and therefore the next steps are often risk analysis, risk prioritization, and selecting appropriate strategy for handling risks. Building projects are highly risky due to the amount of investment put in for them which shows the necessity of identification of risk drivers, the level of each risk effect, intensity of the influence of the danger on the project, and therefore the probability of every risk. Finally, the appropriate action should be selected by project managers to reduce the loss of projects where the Cost, time, and quality are the main elements which should be concerned.

In this paper, by using RII and fuzzy technique (TOPSIS), it tried to evaluate, identify and prioritize project risks in the Project Life Cycle of construction projects and consequently help managers in decision-making.

1.1 Risk Management Process

Risk management contains the rundown of organized utilization of the executive's strategies, cycles and methods to the undertakings of building up the specific circumstance, recognizing, dissecting, evaluating, treating, checking and conveying risks. Risk management process (RMP) is the fundamental standard of comprehension and overseeing chances in an undertaking. It comprises of the fundamental stages: recognizable proof, appraisal and examination, and reaction. All means in RMP ought to be incorporated when managing chances, to productively execute the cycle in the task. Numerous varieties of RMP are accessible in writing, yet most ordinarily depicted systems comprise of those referenced advances. In certain models there is one more advance added, and most of sources recognize it as risk observation and reviewing. For the future use end goal of this paper the model of RMP could be utilized.

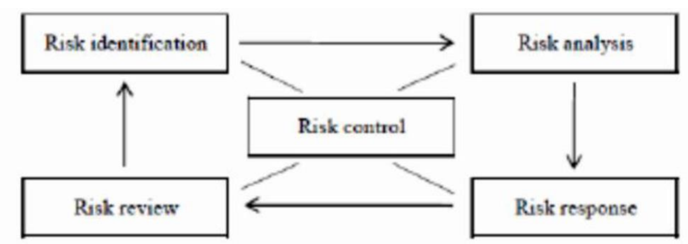

Fig 1 Risk Management Process

1.2 Purpose

Risk management is a core part of conducting a construction project. Within research and academic literature, there are numerous theories that suggest how to successfully identify, assess, and mitigate risks within the construction industry. There are still research studies showing that even though risk management works in theory, it often fails to be successful in reality. Moreover, this study shows that the techniques proposed in literatures are very rarely utilized in reality.

The purpose of this paper to describe and analyse risk management in a project based organization within the construction industry. My thesis aims to provide a better view of how risk management is used in practice but also what underlying factors that can affect risk management processes. The study will include both the ideas and views of the developer and the constructor; as well as their separate and joint processes facilitating risk management.

Since most of the larger construction companies have similar processes, the conclusions from this study will hopefully be applicable and helpful to other organizations as well.

2. LITERATURE REVIEW

Few journals that I referred to determine the risk factors affecting the building construction are given as follows: **(Azadeh et al.2015)** In this paper AHP is suggested as a method which is better than all other existing classical MCDM methods, which is a wrong concept. **(Fatemeh Nouban et al.2019)** This paper studies the risks that directly affect the aim of the project including the time, cost and quality. **(Sameer et al.2015)** This study tries to highlight the most critical risks that construction projects face .The associated most effective response methods to be employed is also determined. **(Sameh Monir El-Sayegh 2007)** This study identifies and assesses the significant risks in the UAE construction industry. **(Thomas kozhy et al.2017)** This study focuses on the risk management in medium-sized commercial building construction. **(Ali Assari et al.2009)** In this paper the parameters that affect sustainable development in heritage area and relationship with public point of view are studied. **(Perry et al1985)** This paper clearly depicts the concept of risk management within the context of management construction projects. **(Abadir M 2011)** The paper aims in assessing whether the processes, practices and tools under each of PMBOK are being applied by Ethiopian contractors. **(Edwards et al.1998)** As per the paper the literature on construction and project risk management published during the period from 1960 to 1997 was reviewed and analyzed to identify rising trends and practice. **(J Zeng et al.2007)** Modified fuzzy techniques together with AHP were used to determine the risks arising from complicated construction situations. **(S A Assaf et al.2006)** Studied the causes of delays in construction in Eastern Province of Saudi Arabia. **(E Kazimieras et al.2009)** The paper presents risk assessment of construction by applying TOPSIS grey and COPRAS-G. **(U-Habiba et al.2009)** The critical evaluation of the literature to determine the risks by MCDM –DSS tools were done as per this paper.**(M Algahtanya et al.2016)** This paper presents a new risk management model that can minimize client decision making, and enable the client to utilize facility, thereby improving project quality and performance. **(S Gardezi et al 2013)** The main purpose of this study is to identify the delays that result in time extension factors for project completion. **(J Zak et al.2014)** The paper presents the first stage of the MCDM/A-based two-stage procedure resulting in the selection of the most desirable location of the logistics center.

3. RESEARCH METHODOLOGY

3.1 DATA COLLECTION

Data was collected through structured questionnaire, and Google form survey with experts working under the various departments related to the construction works. A five point Likert scale was selected for completing the questionnaire survey. The journals related to risk management in commercial building construction was found through Google scholar and risk factors were listed out after read. To find the factors that are relevant to Kerala's situation, discussions were conducted from construction industry.

3.2 FINDING THE RISK FACTOR USING RII

For the questionnaire survey, electronic questionnaire survey that's Google forms where used due to the rapid spread of pandemic. Questionnaire in the form of Google form was prepared & send it to far respondents. From the literature studied 97 risks has been developed to frame the questionnaire. Questionnaire which showed a Cronbach alpha value of 9.27 was selected for the survey and the survey was conducted through Google form.

Finally top 20 risks were analyzed by using relative importance index and table1, 2, 3 below shows the identified risks for commercial, residential and institutional buildings

The RII is calculated using the relative frequencies obtained from the frequency analysis done through IBM SPSS for all the 3 types.

The RII can be calculated using the equation given below

$$\text{Relative Important index (RII)} = \frac{\sum_{i=1}^{5} an}{A \; x \; N}.$$

Where a = the weight assigned to each responses, n = likelihood / consequence of each response, N = total number of responses, A = the highest number in likert scale.

3.3 EVALUATION OF RISKS USING RII

Here top 20 risks analyzed found from the questionnaire survey and their risk factors were found out using the equation given above for all the 3 types of buildings

Table 1 RII for commercial buildings

No	Identified risk	Risk factor
1	Economic stability	0.793
2	Damage to equipment	0.792
3	Political climate change	0.781
4	Suitability of materials	0.780
5	Contractors experience	0.774
6	Equipment and material theft	0.771
7	Damage to structures	0.769
8	Increase in material price	0.768
9	Insufficient resource availability	0.765
10	Productivity of labour	0.760
11	Exchange rate fluctuations	0.757
12	Epidemic risk	0.755
13	Poor site management and supervision	0.753
14	Quality of workmanship	0.751
15	Inexperienced workers	0.749
16	Requirements of permit and their approval	0.748
17	Regulations (safety/labour)	0.745
18	Windstorms	0.740
19	Change in material specification	0.738
20	Poor communication with other parties	0.736

Table 2 RII for institutional buildings

No	Identified risk	Risk factor
1	Shortage of materials	0.8083
2	Improper budgeting	0.8000
3	Epidemic risk	0.7791
4	Poor planning	0.7790
5	Lack of proper inventory	0.7750
6	Inadequate construction technology	0.7749
7	Poor construction quality	0.7666
8	Poor maintanence	0.7625
9	Budget constraints	0.7620
10	Lack of long term investments	0.7583
11	Increase in material cost	0.7541
12	Change in law and regulations	0.7500
13	inexperienced workers	0.7496
14	Flooding	0.7485
15	Not following building codes	0.7458
16	Construction occupational safety	0.7443
17	Delay in project approval	0.7432
18	Increase in labour cost	0.7429
19	Quality of workmanship	0.7422
20	Economic stability	0.7416

3.4 MUTLI CRITERIA DECISION MAKING METHODOLOGY

Decision making is an important factor to achieve a successful completion of any project. MCDM is related with structuring and planning problems involving multiple criteria leading to a particular decision.. In this paper MCDM works as a part of analysis of complex decisions in construction works which involves some disputes as well as multiple criteria. This methodology can be interrelated with quantitative analysis which can be considered as a statistical method.

Table 3 RII for residential buildings

No	Identified risk	Risk factor
1	Financial funding problems by owner	0.773
2	Delay /Shortage in availability of labour, material, equipment	0.751
3	Owner interference	0.746
4	Low productivity of labour, equipment	0.742
5	Inflation of prices beyond expectation	0.737
6	Poor communication with the client	0.711
7	Delayed payment on contract	0.733
8	Epidemic risk	0.731
9	Tsunami	0.729
10	Unrealistic client's requirements	0.728
11	Complexity of work	0.725
12	Unexpected subsurface condition	0.724
13	Delay in sanction from Govt. for building permits and infrastructure	0.721
14	Inaccurate estimate	0.720
15	Design errors made by designer	0.715
16	Defective work	0.711
17	Poor coordination with contractors documents	0.710
18	Attitude of workers	0.706
19	Error made in tender documents	0.704
20	Change in scope of work	0.703

3.5 STUDIES ON TOPSIS AND ITS ANALYSIS

Literature study proposed that several MCDM approaches like AHP, ELECTRE, VIKOR, GREY to evaluate the complex decisions. But these methods cannot be used if the ideal alternatives are unknown. Techniques for Order of Preference by Similarity to Ideal Solution (TOPSIS) method assumes that each criterion has a tendency of increasing or decreasing utility which leads to a easily define the positive and negative ideal solution. It is a simple mathematical approach and try to achieve the closer to the ideal solution. The positive ideal solution is the solutions that lower the risks and better the performance and the negative ideal solution is that with higher risks and low performance.

3.6 SELECTION OF CRITERIA FOR TOPSIS

As per Simos procedure in TOPSIS approach criteria and subset were identified. There are five impacts taken as criteria based on the likert scale. Selected criteria were arranged in ascending order depend upon their position as from very low impact too very high impact.

3.7 EVALUATION OF RISKS USING TOPSIS

Identified risks were analyzed and evaluated using mathematical steps involved in TOPSIS. This analysis helps to determine positive ideal solution, negative ideal solution and closeness coefficient values. Using closeness coefficient values, risks were prioritized.

In this research, questionnaire method used for Collecting primary data was prepared based on literature Reviewed. It had five options (index) ranked 1-5 for the raised Questions that could be found as follows: VLI=very low impact LI=low impact MI= Moderate impact HI= High impact VHI=Very high impact.

4. TOPSIS (Technique for Order-Preference by Similarity to Ideal Solution)

TOPSIS is one of the used Multi criteria Decision Making techniques, which is very simple and easy to understand and implement, so that it is used when the user must adhere with a much simpler weighting approach (Ball & Korukoğlu, 2009).

It was first introduced by Hwang and Yoon in 1981 .As per this technique, the best alternative would be the one that is nearest to the positive ideal solution and farthest from the negative ideal solution (Asgharpour, 1999; Benitez et al., 2007).

The positive ideal solution is a solution that increases the benefit criteria and reduces the cost criteria, whereas the negative Ideal solution increases the cost criteria and decrease the benefit criteria.TOPSIS method can be used both for normal numbers as well as fuzzy numbers.

4.1 STEPS OF TOPSIS

Step 1: Find out the normalized value

Convert a decision matrix into dimensionless matrix

Rij = xij / √Σ X ij 2 ni=1 i= 1,….n

Step 2: Obtain a weighted normalized value

Wij = rij * weightage

Step 3: determine best performance and worst performance

S+ = {higher 1, 2, 3, 4,5} higher the worse

S- = {lower 1, 2, 3, 4, 5} lower the better

Step 4: determine positive and negative ideal solution

Dij+ = √Σ (S+ ni=1 – weighted normalized)2

Dij- = √Σ (S– ni=1 – weighted normalized)2

Step 5: Closeness Coefficient Value **Cci = Dij- /(Dij+ + Dij-)**

Step 6: Rank the alternatives in descending order with closeness coefficient value.

Table 1 presents the result of questionnaire

$$nij = \frac{\text{rij}}{\sqrt{\sum_{i=1}(\text{rij})^2}}$$

Table 2 provides the first process on the result of questionnaire by multiply each cell by itself and second process each cell should divided to square root.

N11= (2*2/√76) =0.458,

N12= (1*1/√691) =0.038

N13= (14*14/√4106) =3.058

N14= (16*16/√6505) =3.174

N15= (16*16/√2483) = 2483

Table 3: the matrix of weight that were calculated

$$W_{n,n} = \frac{\text{SQRT}}{\text{SUM (SQRT)}}$$

W_{11} = (8.132/233.42)=0.03483.

W_{22} = (26.281/233.42)=0.11259.

W_{33} = (64.071/233.42) = 0.27448.

W_{44} = (85.118/233.42) = 0.36465.

W_{55} = (49.818/233.42) = 0.21342.

$$\begin{bmatrix} 0.03483 & 0 & 0 & 0 & 0 \\ 0 & 0.11259 & 0 & 0 & 0 \\ 0 & 0 & 0.27448 & 0 & 0 \\ 0 & 0 & 0 & 0.36465 & 0 \\ 0 & 0 & 0 & 0 & 0.21342 \end{bmatrix}$$

Table 3 represents the matrix of multiply of tables 2 by matrix 3.

Table 4 presents the max and min of each column in Table 3.

Table 5 represents the forth step in TOPSIS method (it has five parts)-distance between max point and each point and the distance between min point and each points.

Table 1 Results of questionnaire for commercial building.

No	Very Low Impact	Low Impact	Moderate Impact	High Impact	Very High Impact
1	2	1	14	16	16
2	1	2	13	19	15
3	1	4	15	17	13
4	1	3	12	22	12
5	2	7	12	18	11
6	2	4	10	22	11
7	0	10	15	16	19
8	1	7	17	13	12
9	3	8	13	16	10
10	3	7	11	21	8
11	1	8	12	19	9
12	3	5	11	19	10
13	2	4	15	20	9
14	1	5	18	19	8
15	2	6	10	22	10
16	2	3	12	22	10
17	1	3	16	19	9
18	0	10	13	18	5
19	3	5	20	11	11
20	2	5	21	17	5

Table 2: Each cell of table 1 are multiplied with itself and they are divide by the square root of sum of each column.

No	Very low impact	Low impact	Moderate impact	high impact	Very high impact
1	0.458	0.038	3.058	3.174	5.137
2	0.114	0.152	2.637	4.475	4.515
3	0.114	0.608	3.511	3.583	3.391
4	0.114	0.342	2.247	6.000	2.889
5	0.458	1.864	2.247	4.017	2.428
6	0.458	0.608	1.560	6.000	2.428
7	0	3.804	3.511	3.174	7.244
8	0.114	1.864	4.510	2.095	2.889
9	1.032	2.434	2.637	3.174	2.006
10	1.032	1.864	1.888	5.467	1.284
11	0.114	2.434	2.247	4.475	1.625
12	1.032	0.951	1.888	4.475	2.006
13	0.458	0.608	3.511	4.959	1.625
14	0.114	0.951	5.056	4.475	1.284
15	0.458	1.369	1.560	6.000	2.006
16	0.458	0.342	2.247	6.000	2.006
17	0.114	0.342	3.995	4.475	1.625
18	0	3.804	2.637	4.017	0.501
19	1.032	0.951	6.242	1.500	2.428
20	0.458	0.951	6.882	3.583	0.501
Sqrt	8.132	26.28	64.071	85.11	49.81
Sqrt /sum(sqrt)	0.03483	0.11259	0.27448	0.36465	0.21342

Table 3: Multiply the weights with table 2.

NO	VLI	LI	MI	HI	VHI
1	0.0159	0.00427	0.83935	1.15739	1.09633
2	0.0039	0.01711	0.72780	1.63180	0.96359
3	0.0039	0.06845	0.96369	1.30654	0.72370
4	0.0039	0.03850	0.61675	2.18790	0.61657
5	0.0159	0.20985	0.61675	1.46479	0.51818
6	0.0159	0.06845	0.42818	2.18790	0.51818
7	0	0.42829	0.96369	1.15739	1.54601
8	0.0039	0.20986	1.23790	0.76394	0.61657
9	0.0359	0.27404	0.72380	1.15739	0.42812
10	0.0359	0.20986	0.51821	1.99354	0.27403
11	0.0039	0.27404	0.61675	1.63180	0.34680
12	0.0359	0.10707	0.51821	1.63180	0.42812
13	0.0159	0.06845	0.96369	1.80829	0.34680
14	0.0039	0.10707	1.38777	1.63180	0.27403
15	0.0159	0.15413	0.42818	2.18790	0.42812
16	0.0159	0.03850	0.61675	2.18790	0.42812
17	0.0039	0.03850	1.09654	1.63180	0.34680
18	0	0.42899	0.72780	1.46479	0.10692
19	0.0359	0.10707	1.71330	0.54697	0.51818
20	0.0159	0.10707	1.88897	1.30654	0.10692

Table 4 minimum and maximum of each column

V_j^+	0.0159	0.42829	1.88897	2.18790	1.54601
V_j^-	0	0.00427	0.42818	0.54697	0.10692

Table 5: The value of P_i the distance between a_i and the ideal solution.

NO	Si^+	Si^-	$Si^+ + Si^-$	P_i	Rank	P_i in order	rank
1	1.595	1.376	2.971	0.463	9	0.186	20
2	1.471	1.414	2.886	0.490	5	0.293	19
3	1.561	1.117	2.678	0.417	12	0.346	18
4	1.623	1.728	3.352	0.515	2	0.353	17
5	1.860	1.043	2.904	0.359	16	0.359	16
6	1.822	0.416	2.238	0.186	20	0.377	15
7	1.384	1.705	3.090	0.551	1	0.386	14
8	1.833	1.002	2.836	0.353	17	0.407	13
9	1.921	0.709	2.720	0.293	19	0.417	12
10	1.892	1.473	3.366	0.437	11	0.437	11
11	1.841	1.158	2.999	0.386	14	0.449	10
12	1.881	1.140	3.022	0.377	15	0.463	9
13	1.602	1.392	2.995	0.464	8	0.464	8
14	1.510	1.461	2.972	0.491	4	0.474	7
15	1.859	1.678	3.538	0.474	7	0.489	6
16	1.737	1.683	3.420	0.491	3	0.490	5
17	1.589	1.297	2.886	0.449	10	0.492	4
18	1.985	1.054	3.040	0.346	18	0.495	3
19	1.970	1.353	3.324	0.407	13	0.515	2
20	1.717	1.649	3.364	0.489	6	0.551	1

The ones with higher weight are the major risks which are ranked from 1 to 20 based on their weights for commercial buildings. Similar calculations were done for both the institutional and residential buildings and the major risks occurring during construction are ranked as above.

Table 6: Results of questionnaire for Institutional building.

No	Very Low Impact	Low Impact	Moderate Impact	High Impact	Very High Impact
1	1	1	7	25	14
2	1	1	10	21	15
3	1	6	10	11	20
4	2	1	15	12	18
5	7	3	8	26	9
6	0	5	9	21	13
7	0	5	15	16	13
8	2	3	11	22	10
9	3	4	10	23	10
10	3	3	11	15	16
11	1	5	13	17	12
12	0	6	15	12	15
13	2	5	11	15	15
14	2	6	7	20	13
15	2	5	11	16	14
16	2	4	11	19	12
17	1	4	15	15	13
18	1	2	17	17	11
19	2	9	6	14	17
20	1	5	13	17	12

Table 7: Each cell of table 1 are multiplied with itself and they are divide by the square root of sum of each column.

No	Very low impact	Low impact	Moderate impact	high impact	Very high impact
1	0.099	0.048	0.941	7.683	3.160
2	0.099	0.048	1.920	5.421	3.628
3	0.099	1.754	1.920	1.487	6.449
4	0.396	0.048	4.321	1.770	5.224
5	4.851	0.438	1.229	8.310	1.306
6	0	1.218	1.555	5.421	5.725
7	0	1.218	4.321	3.147	2.725
8	0.396	0.438	2.323	5.950	1.612
9	0.891	0.779	1.920	6.503	1.612
10	0.891	0.438	2.323	2.766	4.127
11	0.099	1.218	3.245	3.553	2.321
12	0	1.754	4.321	1.770	3.628
13	0.396	1.218	2.323	2.766	3.628
14	0.396	1.754	0.941	4.917	2.725
15	0.396	1.218	2.323	3.147	3.160
16	0.396	0.779	2.323	4.438	2.321
17	0.099	0.779	4.321	2.766	2.725
18	0.099	0.194	5.550	3.553	1.951
19	0.396	3.947	0.691	2.409	4.660
20	0.099	1.218	3.245	3.553	2.321
Sqrt	10.098	21.723	52.056	81.33	62.00
Sqrt/sum(sqrt)	0.0444	0.0956	0.2291	0.3579	0.2728

Table 8: Multiply the weights with table 2.

NO	VLI	LI	MI	HI	VHI
1	0.0043	0.0004	0.2155	2.7497	0.8620
2	0.0043	0.0004	0.4398	1.9401	0.9897
3	0.0043	0.1676	0.4398	0.5321	1.7592
4	0.0175	0.0004	0.9899	0.6334	1.4251
5	0.2153	0.0418	0.2815	2.9741	0.3562
6	0	0.1164	0.3562	1.9401	0.7433
7	0	0.1164	0.9899	1.1263	0.7433
8	0.0175	0.0418	0.5321	2.1295	0.4397
9	0.0395	0.0744	0.4398	2.3274	0.4397
10	0.0395	0.0418	0.5321	0.9899	1.1258
11	0.0043	0.1164	0.7434	1.2716	0.6331
12	0	0.1676	0.9899	0.6334	0.9897
13	0.0175	0.1164	0.5321	0.9899	0.9897
14	0.0175	0.1676	0.2155	1.7597	0.7433
15	0.0175	0.1164	0.5321	1.1263	0.8620
16	0.0175	0.0744	0.5321	1.5883	0.6331
17	0.0043	0.0744	0.9899	0.9899	0.7433
18	0.0043	0.0185	1.2715	1.2716	0.5322
19	0.0175	0.3773	0.1583	0.8621	1.2712
20	0.0043	0.1164	0.7434	1.2716	0.6331

Table 9: Minimum and Maximum of each column

V_j^+	0.21538	0.37733	1.27150	2.97414	1.75928
V_j^-	0	0.00045	0.28156	0.53219	0.35627

Table 10: The value of P_i the distance between a_i and the ideal solution.

NO	Si^+	Si^-	$Si^+ + Si^-$	P_i	Rank	P_i in order	rank
1	1.469	2.275	3.744	0.392	7	0.266	1
2	1.659	1.552	3.211	0.483	2	0.272	2
3	2.597	1.421	4.018	0.353	10	0.279	3
4	2.418	1.286	3.705	0.347	11	0.290	4
5	1.749	2.459	4.209	0.415	5	0.293	5
6	1.747	1.466	3.214	0.456	4	0.300	6
7	2.154	1.009	3.163	0.318	12	0.301	7
8	1.775	1.619	3.395	0.477	3	0.307	8
9	1.724	1.806	3.530	0.488	1	0.318	9
10	2.242	0.931	3.174	0.293	16	0.347	10
11	2.135	0.922	3.057	0.301	14	0.353	11
12	2.498	0.970	3.468	0.279	18	0.365	12
13	2.276	0.829	3.105	0.266	20	0.368	13
14	1.924	1.299	3.224	0.403	6	0.392	14
15	2.207	0.827	3.035	0.272	19	0.403	15
16	1.966	1.122	3.089	0.365	9	0.415	16
17	2.277	0.930	3.208	0.290	17	0.456	17
18	2.139	1.248	3.388	0.368	8	0.477	18
19	2.444	1.050	3.495	0.300	15	0.483	19
20	2.073	0.922	2.995	0.307	13	0.488	20

The ones with higher weight are the major risks which are ranked from 1 to 20 based on their weights for Institutional building.

Table 11: Results of questionnaire for Residential building.

No	Very Low Impact	Low Impact	Moderate Impact	High Impact	Very High Impact
1	2	3	10	18	13
2	1	3	13	17	11
3	1	3	12	20	9
4	1	4	13	16	11
5	1	5	12	16	11
6	2	9	7	14	13
7	1	1	13	17	11
8	1	2	14	17	10
9	4	2	12	15	12
10	3	3	13	14	12
11	1	3	18	13	16
12	4	5	11	9	16
13	1	3	14	17	9
14	1	3	7	21	10
15	2	5	12	17	9
16	0	8	14	13	10
17	2	4	12	21	6
18	3	3	15	15	9
19	2	4	15	16	8
20	3	5	11	17	9

Table 12: Each cell of table 1 is multiplied with itself and they are dividing by the square root of sum of each column.

No	Very low impact	Low impact	Moderate impact	high impact	Very high impact
1	0.426	0.465	1.768	4.421	3.309
2	0.106	0.465	2.988	3.944	2.369
3	0.106	0.465	2.546	5.459	1.586
4	0.106	0.827	2.988	3.493	2.369
5	0.106	1.292	2.546	3.493	2.369
6	0.426	4.188	0.866	2.674	3.309
7	0.106	0.051	2.988	3.944	2.369
8	0.106	0.206	3.465	3.944	1.958
9	1.705	0.206	2.546	3.070	2.819
10	0.959	0.465	2.988	2.674	2.819
11	0.106	0.465	5.729	2.306	5.012
12	1.705	1.292	2.139	1.105	5.012
13	0.106	0.465	3.465	3.944	1.586
14	0.106	0.465	0.866	6.018	1.958
15	0.426	1.292	2.596	3.944	1.586
16	0	3.309	3.465	2.306	1.958
17	0.426	1.292	2.546	6.018	0.704
18	0.959	0.465	3.978	3.070	1.586
19	0.426	1.292	3.978	3.493	1.253
20	0.959	1.292	2.139	3.944	1.586
Sqrt	12.141	20.259	56.54	63.302	47.517
Sqrt/sum(sqrt)	0.0607	0.1014	0.2830	0.3168	0.2378

Table 13: Multiply the weights with table 2.

NO	VLI	LI	MI	HI	VHI
1	5.172	9.420	99.962	279.858	157.223
2	1.286	9.420	168.941	249.663	112.567
3	1.286	9.420	143.95	345.565	75.361
4	1.286	16.754	168.941	221.113	112.567
5	1.286	26.174	143.95	221.113	112.567
6	5.172	84.844	48.963	169.269	157.233

7	1.286	1.033	168.941	249.663	112.567
8	1.286	4.173	195.911	249.663	93.038
9	20.700	4.173	143.95	194.337	133.950
10	11.643	9.420	168.941	169.269	133.950
11	1.286	9.420	323.917	145.97	238.155
12	20.700	26.174	120.939	69.948	238.155
13	1.286	9.420	195.911	249.663	75.361
14	1.286	9.420	48.963	380.951	93.038
15	5.172	26.174	143.95	249.663	75.361
16	0	67.037	195.91	145.97	93.038
17	5.172	26.174	143.95	380.951	33.45
18	11.643	9.420	224.916	194.337	75.361
19	5.172	26.174	224.916	221.113	59.538
20	11.643	26.174	120.939	249.663	75.361

Table 14: Minimum and Maximum of each column

V_j^+	20.700	84.844	323.844	380.951	238.155
V_j^-	0	1.033	48.96	69.948	59.538

Table 15: The value of P_i the distance between a_i and the ideal solution.

NO	Si^+	Si^-	Si^++Si^-	P_i	Rank	P_i in order	rank
1	269.89	237.31	507.21	0.467	6	0.313	1
2	251.18	222.65	473.83	0.469	4	0.341	2
3	257.30	292.07	549.38	0.468	5	0.372	3
4	265.23	200.76	466.00	0.430	12	0.372	4
5	281.92	187.93	469.86	0.399	14	0.374	5
6	356.64	162.66	519.31	0.313	20	0.397	6
7	253.82	222.50	476.32	0.467	7	0.399	7
8	248.12	234.57	482.69	0.485	2	0.423	8
9	290.96	174.56	465.52	0.374	16	0.430	9
10	292.32	173.21	465.54	0.372	17	0.438	10
11	268.58	334.05	602.64	0.445	10	0.445	11
12	375.75	195.30	571.07	0.341	19	0.460	12
13	257.07	232.83	489.90	0.475	3	0.467	13
14	320.16	312.91	633.08	0.494	1	0.467	14
15	282.25	207.60	489.86	0.423	13	0.467	15
16	305.44	181.34	486.79	0.372	18	0.468	16
17	278.94	327.23	605.34	0.460	9	0.469	17
18	277.10	216.53	493.64	0.438	11	0.475	18
19	266.14	233.38	499.53	0.467	8	0.485	19
20	297.13	196.20	493.33	0.397	15	0.494	20

The ones with higher weight are the major risks which are ranked from 1 to 20 based on their weights for Residential building.

Table 16: Risks ranked as per weight for commercial building.

NO	RISK FACTOR	WEIGHTS IN ORDER	RANK
1	Equipment and material theft	0.186	1
2	Exchange rate fluctuations	0.293	2
3	Windstorms	0.346	3
4	Increase in material price	0.353	4
5	Contractors experience	0.359	5
6	Epidemic risk	0.377	6

7	Regulations (safety/labour)	0.386	7
8	Requirements of permit and their approval	0.407	8
9	Political climate change	0.417	9
10	Productivity of labour	0.437	10
11	Regulations (safety/labour)	0.449	11
12	Economic stability	0.463	12
13	Poor site management and supervision	0.464	13
14	Inexperienced workers	0.474	14
15	Poor communication	0.489	15
16	Insufficient resource availability	0.490	16
17	Damage to equipment	0.492	17
18	Suitability of materials	0.495	18
19	Change in material specification	0.515	19
20	Damage to structures	0.551	20

Table 17: Risks ranked as per weight for institutional buildings.

NO	RISK FACTOR	WEIGHTS IN ORDER	RANK
1	Inexperienced workers	0.266	1
2	Not following building codes	0.272	2
3	Change in law and regulations	0.279	3
4	Delay in project approval	0.290	4
5	Lack of long term investments	0.293	5
6	Quality of workmanship	0.300	6
7	Increase in material cost	0.301	7
8	Economic stability	0.307	8
9	Poor construction quality	0.318	9
10	Poor planning	0.347	10
11	Epidemic risk	0.353	11
12	Construction occupational safety	0.365	12
13	Increase in labour cost	0.368	13
14	Shortage of materials	0.392	14
15	flooding	0.403	15
16	Lack of proper inventory	0.415	16
17	Inadequate construction technology	0.456	17
18	Poor maintenance	0.477	18
19	Improper budgeting	0.483	19
20	Budget constraints	0.488	20

Table18: Risks ranked as per weight for residential buildings.

NO	RISK FACTOR	WEIGHTS IN ORDER	RANK
1	Poor communication with client	0.313	1
2	Unexpected sub surface condition	0.341	2
3	Unrealistic clients requirements	0.372	3
4	Defective work	0.372	4
5	tsunami	0.374	5
6	Change in scope of work	0.397	6

7	Inflation of prices beyond expectation	0.399	7
8	Design errors made by the designer	0.423	8
9	Low productivity of labour ,equipment	0.430	9
10	Attitude of workers	0.438	10
11	Complexity of work	0.445	11
12	Poor coordination with contractors documents	0.460	12
13	Financial funding problems by owners	0.467	13
14	Delayed payment on contract	0.467	14
15	Error made in tender documents	0.467	15
16	Delay /Shortage in availability of labour, material, equipment	0.468	16
17	Owner interference	0.469	17
18	Epidemic risk	0.475	18
19	Delay in sanction from Govt. for building permits and infrastructure	0.485	19
20	Inaccurate estimate	0.494	20

5. CONCLUSIONS

The first step for emergency preparedness and maintaining a safe workplace is defining and analyzing risks. Although all risks should be addressed, resource limitations usually do not allow this to happen at one time. Risk identification and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to occur and least likely to cause major problems can be considered later.

Based on methods used to communicate risk at construction sites, it was revealed that site meetings, posters and informal communication are used to communicate risk. It was also revealed that safety committees and gang supervisors play a major role in communicating health and safety risks. Based on factors influencing risk management, the study reveals that poor communication, insufficient resource availability, damage to equipment, suitability of materials, change in material specification and damage to structures are the major risk factors that are to be considered in case of commercial building and lack of proper inventory, inadequate construction technology, poor maintenance, improper budgeting and budget constraints are the main factors affecting institutional buildings. For residential buildings Error made in tender documents, delay /Shortage in availability of labour, material, equipment, Owner interference, epidemic risk, Delay in sanction from Govt. for building permits and infrastructure and Inaccurate estimate are the major risk factors found out.

Thus the main 'mantra' is that every job on the construction site must be carried out with at-most care and responsibility so that no one is harmed anyway. During such a pandemic situation, the availability of jobs for fresher's is very low, so if they try to be an entrepreneur and begin a new firm ,they must know the hidden factors and risks awaiting them in the construction sector, the role of this paper comes there, by understanding the contents of this paper one could easily identify the risks factors influencing each type of construction and work risk free in a sustainable environment.

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