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Analyze Monte Carlo Simulation Applications for Project Management

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Abstract: Risks have an important impact on construction comes in terms of its primary objectives. Construction comes that are tortuous in nature, uncertainty and risks within the same will develop from completely different sources. The record of the development trade isn't acceptable in terms of header up with risks incomes. Risk management is a process which consists of identification of risks, assessment with qualitatively and quantitatively, response with a suitable method for handling risks, and then control the risks by monitoring. This study proposes to use the risk management technique which has well - documented procedures for the one stop resolution all kinds of hazards possibly to occur throughout any construction project.
Keywords: Risk, Risk Management, Construction Projects, Risk Management Process, Monte Carlo Simulation

I. INTRODUCTION

Risk may be outlined because the event that negatively affects the project objectives like time and schedule, cost, quality of labor. Risk Management is that the method of distinguishing the potential risk related to risk and responding to those risks. Risk in any project may be a various rather than fate. According to the characteristic of the development trade, that has high uncertainty, thus it'll occur several risks throughout the development section and our operational building? Risk in construction has been the article of attention owing to time and price over-runs related to construction comes. Risk is a gift all told the activities during a project; it's solely the quantity that varies from one activity to a different. . Risks and uncertainties inherent within the industrial area unit quite the other industries. Many industries became a lot of proactive regarding exploitation risk management techniques in project. However, with relevancy the development trade, constant isn't used normally. Risk is an integral component of any project. Risk is a gift all told comes regardless of their size or sector. No project is totally free from risks. If risks are not properly analyses and strategies are not trained to deal with them, the project is likely to lead to failures.

II.OBJECTIVES

The main objectives of this study include the following:

A. To identify the causes of risk in construction projects.
B. To identify the approaches for solving the problems regarding risk.
C. To minimize the effect of risk in construction project

III. METHODOLOGY

In this paper, general focus has been created on the danger factors. The target of this study is to spot the foremost reason behind risk within the construction project and access the relative importance of those causes, from the aspects of construction contractors and consultants. The study was performed on the idea of form, divided into two main components. Half one associated with general info for each the corporate and respondent. Each contractor and consultants were more requested to answer the queries bearing on their expertise in the housing industry. Half two includes the list of known causes of risk in the housing industry on the idea of form distributed arbitrarily to contractors & consultants operating in the construction comes, response were collected. The data gotten inside the survey were poor down by Relative Importance Index (RII) technique. During this paper, general focus has been created with the overall ideas of risk management. Risk identification has been through with the study of literature. A form was developed when the known factors poignant risk. Risk assessments are often through with the help of qualitative and measure. Risk response can be planned with the idea of the result of the study. Risk management is that the last step within the method of risk management.

A. Relative Importance Index (RII)

Assess the relative significance among risks, previous literature work study suggests establishing a risk significance index by calculating a significance score for each risk. For Calculating the significance score, multiply the probability of occurrence by the degree of Impact. The significance score for each risk assessed by each respondent can be obtained through the model

$$S^i_j = A^i_j * B^i_j$$

Where S^i_j = Significance score assessed by respondent j for risk i

A^i_j = Occurrence of risk i, assessed by respondent j

B^i_j = degree of impact of risk I, assessed by respondent j.

By averaging scores from every one of the reactions, it is conceivable to get a normal importance score for each hazard, and this normal score is known as the hazard record score and is utilized for positioning the dangers. The model for the figuring of hazard list score can be characterized as

$$R_s^i = \sum_j^T = 1\ S^i_j / T$$

Where R_s^i = index score for risk i

S^i_j = Significance score assessed by respondent j for risk i

T= total number of responses

B. Applicability of Test Results to Construction Industry-

Monte Carlo simulation produces distributions of possible outcome values. Monte Carlo simulation provides a number of advantages over deterministic, or "single-point estimate" analysis: Probabilistic Results.

IV. CONCEPT OF RISK ANALYSIS AND MANAGEMENT

Risk management could be a method that identifies the project risks, analyses them, and confirm the actions to avert the threats on any project. All steps within the risk management method ought to be enclosed to handle risks, so as to implement the method of the project. Thanks to the character of construction comes, risk management could be an important method.

Risk associated with construction industry can be broadly categorized into:

S.NO	RISK CATEGORIZED		
1.	Technical Risks:	2. Construction Risks:	3.Physical Risks
	Inadequate specification	Labour productivity	Damage to structure
	Incomplete design	Rush bidding	Supplies of defective materials
	Unknown site conditions	Site condition	Labour injuries
	Investigation Change in scope	Equipment failures	Varied labor and equipment
	Construction procedures	Design changes	
	Labor shortages	Difference in actual and contract executed quantities	6. Management Risks
	Errors in design drawing	Lower quality of work	Ambiguous planning due to project complexity
	Material shortage	Labour productivity	Resource management
	Industrial disputes		Changes in management ways
	Incompetence of transportation facilities		Information unavailability
			Poor communication between parties involved
4.	Organizational Risks	5. Financial Risks	7. Political Risks
	Contractual	Monopolizing of materials due to closure and other unexpected	Change of government
	Relations	Low market demand	Change of government policy
	Contractor's	Exchange rate fluctuation	Attitudes of participants
	Experience	Payment delays	7. Environmental Risks
	Attitudes of participants	Un managed cash flow	Weather implications
	Inexperienced work	Change in bank formalities and	Natural Disasters

		lenders	
		Insurances risks	Any adverse impact on project due to climatic conditions
			Any impact on the environment due to the project
			Any impact on the environment due to the project
			Fire
8.	Logistics Risks	9. Design Risks	
	Unavailable labour, materials and equipment	Not coordinated design	
	Undefined scope of working	Inaccurate quantities	
	High competition in bids	Lack of consistency between bill of quantities,	
	Inaccurate project program	Awarding the design to unqualified designers	
		Rush Design	

V. RESULT AND DISCUSSIION

INTERVIEW NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	MEAN(m)	SD(s)	C.O.V=(s/m)
Technical Risk																					
Inadequate specification	0.8	0.48	0.48	0.36	0.64	0.64	0.6	0.6	0.64	0.64	0.48	0.64	0.64	0.64	0.64	0.64	0.64	10.28	0.604	0.113	0.187
Incomplete design	0.8	0.48	0.48	0.36	0.64	0.64	0.6	0.6	0.64	0.64	0.48	0.64	0.64	0.64	0.64	0.64	0.64	10.28	0.604	0.113	0.187
Unknown site conditions	0.8	0.36	0.36	0.36	0.64	0.64	0.6	0.6	0.64	0.64	0.48	0.64	0.48	0.64	0.6	0.8	0.64	10	0.588	0.113	0.192
Investigation Change in scope	0.8	0.36	0.36	0.36	0.64	0.64	0.6	0.6	0.64	0.64	0.64	0.64	0.64	0.64	0.48	0.64	0.48	9.88	0.581	0.226	0.389
Construction procedures	0.6	0.48	0.48	0.36	0.64	0.64	0.6	0.6	0.64	0.64	0.64	0.48	0.64	0.64	0.48	0.64	0.48	9.76	0.574	0.084	0.147
Labor shortages	0.8	0.64	0.64	0.64	0.48	0.8	0.5	0.6	0.8	0.64	0.64	0.48	0.8	0.48	0.48	0.64	0.64	10.72	0.630	0.113	0.179
Errors in design drawing	0.8	0.64	0.64	0.64	0.64	0.64	0.6	1	0.64	0.64	0.64	0.64	0.8	0.64	0.64	0.64	0.64	11.56	0.68	0.113	0.166
Material shortage	0.6	0.64	0.64	0.64	0.64	0.64	0.6	0.8	0.64	0.8	0.64	0.48	0.64	0.64	0.48	0.64	0.48	10.68	0.628	0.084	0.135
Industrial disputes	0.48	0.64	0.64	0.64	0.64	0.64	0.6	0.6	0.64	0.6	0.64	0.48	0.64	0.64	0.36	0.48	0.48	9.92	0.583	0	0
Incompetence of transportation facilities	0.48	0.64	0.64	0.48	0.64	0.48	0.6	0.6	0.64	0.6	0.64	0.64	0.64	0.64	0.36	0.36	0.48	9.64	0.567	0	0
Labor shortages	0.6	0.64	0.64	0.64	0.48	0.6	0.5	0.6	0.8	0.64	0.64	0.64	0.8	0.36	0.48	0.64	0.64	10.36	0.609	0.028	0.046
Construction Risks																					
Labour productivity	0.8	0.36	0.36	0.48	0.64	0.48	0.6	0.6	0.36	0.64	0.48	0.64	0.64	0.36	0.48	0.48	0.48	8.96	0.527	0.226	0.429
Rush bidding	0.8	0.36	0.36	0.48	0.64	0.48	0.6	0.6	0.36	0.64	0.48	0.64	0.64	0.36	0.64	0.64	0.48	9.28	0.545	0.226	0.414
Site condition	0.8	0.36	0.36	0.48	0.64	0.48	0.6	0.6	0.64	0.64	0.64	0.64	0.64	0.36	0.64	0.64	0.48	9.72	0.571	0.226	0.395
Equipment	0.8	0.3	0.3	0.4	0.6	0.4	0.	0.	0.6	0.6	0.6	0.6	0.6	0.4	0.64	0.8	0.6	10.1	0.597	0.113	0.189

failures		6	6	8	4	8	6	6	4	4	4	4	4	8			4	6			
Design changes	0.8	0.48	0.48	0.48	0.48	0.48	0.5	0.8	0.64	0.8	0.64	0.64	0.64	0.48	0.8	0.48	0.64	10.24	0.602	0.113	0.187
Difference in actual and contract executed quantities	0.8	0.64	0.64	0.48	0.48	0.36	0.5	0.8	0.64	1	0.36	0.64	0.64	0.48	0.48	0.48	0.48	9.88	0.581	0.226	0.389
Lower quality of work	0.8	0.64	0.64	0.48	0.64	0.64	0.6	0.8	0.64	0.64	0.36	0.64	0.64	0.48	0.8	0.8	0.48	10.76	0.632	0.226	0.357
Physical Risks																					
Damage to structure	0.48	0.64	0.64	0.64	0.36	0.64	0.4	0.6	0.48	0.64	0.64	0.64	0.64	0.64	0.8	0.8	0.64	10.32	0.607	0.113	0.186
Supplies of defective materials	0.48	0.64	0.64	0.64	0.48	0.64	0.5	0.6	0.48	0.64	0.64	0.64	0.8	0.64	0.8	0.8	0.64	10.72	0.630	0.113	0.179
Labour injuries	0.48	0.64	0.64	0.36	0.36	0.64	0.4	0.6	0.48	0.64	0.64	0.64	0.64	0.64	0.8	0.8	0.64	10.04	0.590	0.113	0.191
Varied labor and equipment	0.48	0.64	0.64	0.64	0.36	0.64	0.4	0.6	0.48	0.8	0.64	0.36	0.8	0.64	0.8	0.8	0.64	10.36	0.609	0.113	0.185
Financial Risks																					
Monopolizing of materials due to closure and other unexpected	0.36	0.64	0.64	0.64	0.64	0.64	0.6	0.6	0.64	0.64	0.48	0.48	0.64	0.64	0.48	0.48	0.64	9.96	0.585	6.78	11.586
Low market demand	0.36	0.64	0.64	0.64	0.64	0.64	0.6	0.5	0.64	0.64	0.48	0.48	0.64	0.64	0.48	0.64	0.64	9.96	0.585	6.78	11.586
Exchange rate fluctuation	0.36	0.64	0.64	0.64	0.64	0.64	0.6	0.6	0.64	0.64	0.48	0.48	0.48	0.64	0.48	0.64	0.48	9.8	0.576	6.67	11.579
Payment delays	0.36	0.64	0.64	0.64	0.8	0.64	0.8	0.5	0.8	1	0.48	0.64	0.36	0.64	0.36	0.48	0.48	10.24	0.602	6.98	11.598
Unmanaged cash flow	0.36	0.64	0.64	0.64	0.8	0.64	0.8	1	0.8	1	0.48	0.64	0.64	0.48	0.36	0.36	0.48	10.76	0.632	7.35	11.618
Change in bank formalities and lenders	0.36	0.64	0.64	0.64	0.64	0.64	0.6	1	0.64	0.64	0.64	0.36	0.64	0.64	0.48	0.36	0.48	10.08	0.592	6.87	11.591
Insurances risks	0.36	0.64	0.64	0.64	0.64	1	0.6	0.8	1	0.64	0.64	0.36	0.6	0.48	0.64	0.64	0.48	10.84	0.637	7.410	11.621
Financial failure of the contractor	0.36	0.64	0.64	0.8	1	0.8	1	0.8	1	0.64	0.64	0.64	0.8	0.48	0.64	0.48	0.64	12	0.705	8.23	11.660
Inexperience when pricing tender	0.36	0.64	0.64	0.8	0.64	1	0.6	0.8	0.64	0.64	0.64	0.64	0.64	0.48	0.64	0.64	0.48	10.96	0.644	7.49	11.625
Loss due to fluctuation of interest rate	0.36	0.64	0.64	0.8	0.64	0.8	0.6	0.8	0.64	0.64	0.64	0.64	0.64	0.48	0.64	0.64	0.48	10.76	0.632	7.35	11.618
Management Risks																					
Ambiguous planning due to project complexity	0.48	0.36	0.36	0.6	0.64	0.48	0.6	0.6	0.64	0.48	0.48	0.64	0.48	0.36	0.64	0.48	0.64	9.04	0.531	6.052	11.382
Resource management	0.48	0.36	0.36	0.6	0.64	0.36	0.6	0.6	0.64	0.36	0.64	0.8	0.8	0.36	0.48	0.36	0.48	9	0.529	6.02	11.37
Changes in	0.4	0.3	0.3	0.6	0.6	0.4	0.	0.	0.6	0.3	0.6	1	0.4	0.6	0.48	0.3	0.4	9.28	0.545	6.22	11.39

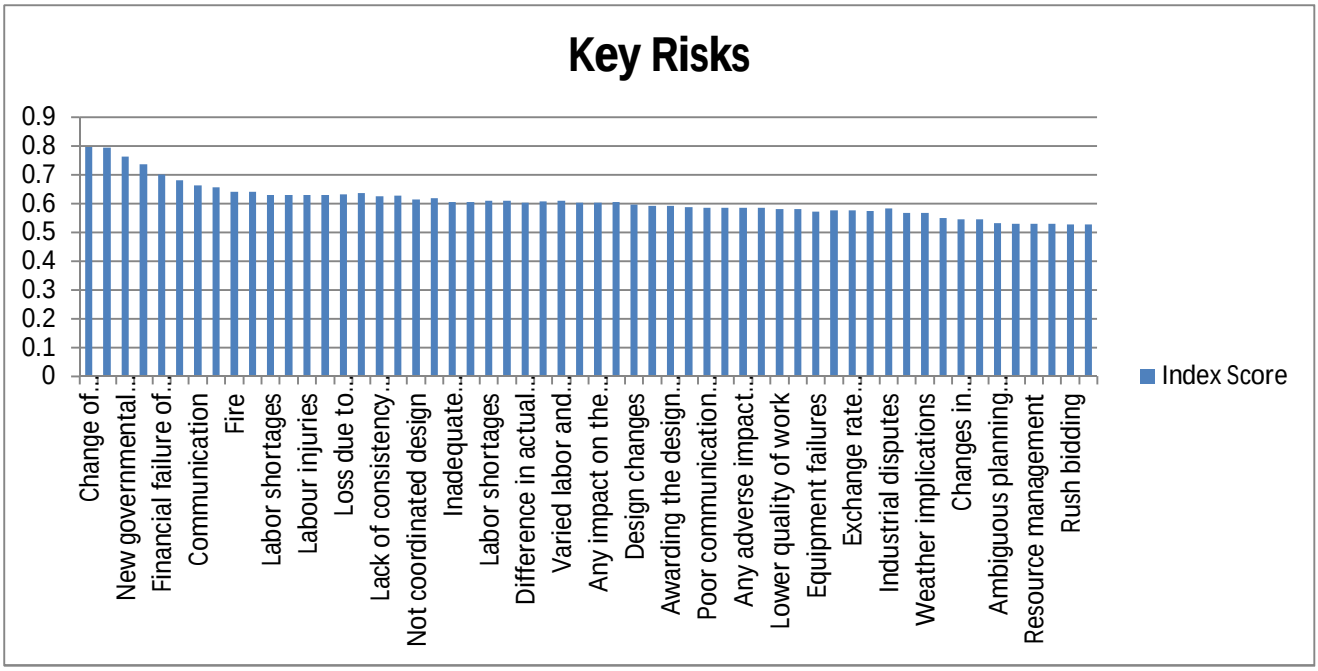
management ways	8	6	6		4	8	6	6	4	6	4		8	4		6	8				
Information unavailability	0.48	0.36	0.36	0.36	0.64	0.48	0.6	0.6	0.48	0.64	0.48	1	0.48	0.64	0.48	0.36	0.48	9	0.529	6.02	11.37
Poor communication between parties involved	0.48	0.36	0.36	0.48	0.64	0.48	0.6	0.6	1	0.64	1	0.8	0.48	0.64	0.48	0.36	0.48	9.96	0.585	6.70	11.44
Political Risks																					
Change of government	0.8	0.8	0.8	1	0.8	0.8	0.8	0.8	1	0.8	0.8	1	0.6	0.64	0.8	0.64	0.64	13.52	0.795	0.11	0.14
Change of government policy	0.8	0.8	0.8	1	0.8	0.8	0.8	0.8	1	0.8	0.8	1	0.64	0.64	0.8	0.64	0.64	13.56	0.797	0.11	0.14
Attitudes of participants	0.8	0.8	0.8	1	0.6	0.8	0.6	0.8	1	0.8	0.8	0.36	0.48	0.8	0.8	0.64	0.64	12.52	0.736	0.11	0.15
New governmental acts or legislations	0.8	0.8	0.8	1	0.6	0.8	0.6	0.8	1	0.8	0.8	0.64	0.8	0.64	0.8	0.64	0.64	12.96	0.762	0.11	0.14
Communication	0.8	0.64	0.64	1	0.8	0.36	0.8	0.5	0.64	0.64	0.64	0.64	0.48	0.64	0.8	0.64	0.64	11.28	0.663	0.11	0.17
Environmental Risks																					
Weather implications	0.64	0.64	0.64	0.8	0.64	0.48	0.6	0.5	0.48	0.64	0.48	0.64	0.48	0.64	0.48	0.36	0.48	9.64	0.567	0.11	0.19
Natural Disasters	0.64	0.64	0.64	0.8	0.64	0.48	0.6	0.5	0.48	0.64	0.48	0.64	0.48	0.64	0.48	0.36	0.64	9.8	0.576	0	0
Any adverse impact on project due to climatic conditions	0.64	0.64	0.64	0.8	0.64	0.48	0.6	0.6	0.64	0.6	0.48	0.64	0.48	0.8	0.48	0.36	0.36	9.96	0.585	0.19	0.33
Any impact on the environment due to the project	0.64	0.64	0.64	0.8	0.64	0.48	0.6	0.6	0.64	0.6	0.64	0.64	0.48	0.8	0.48	0.36	0.48	10.24	0.602	0.11	0.18
Any impact on the environment due to the project	0.64	0.64	0.64	0.8	0.64	0.48	0.6	0.6	0.64	0.8	0.64	0.64	0.48	0.64	0.48	0.36	0.48	10.28	0.604	0.11	0.18
Fire	0.64	0.64	0.64	0.6	0.64	0.8	0.6	0.5	0.6	0.64	1	0.64	0.8	0.64	0.48	0.36	0.64	10.88	0.64	0	0
Logistics Risks																					
Unavailable labour, materials and equipment	0.48	0.36	0.36	0.64	0.36	0.64	0.4	0.5	0.64	0.64	0.64	0.64	0.64	0.64	0.48	0.48	0.48	8.96	0.527	0	0
Undefined scope of working	0.48	0.36	0.36	0.8	0.36	0.64	0.4	0.5	0.64	0.64	0.64	0.64	0.64	0.64	0.48	0.48	0.36	9	0.529	0.08	0.160
High competition in bids	0.48	0.36	0.36	0.8	0.48	0.48	0.5	0.6	0.64	0.64	0.8	0.48	0.64	0.64	0.48	0.48	0.48	9.36	0.550	0	0
Inaccurate project program	0.48	0.36	0.36	0.8	0.36	0.48	0.4	0.6	0.64	0.64	0.8	0.48	0.64	0.64	0.48	0.48	0.64	9.28	0.545	0.11	0.20
Design Risks																					
Not	0.8	0.3	0.3	1	0.6	0.8	0.	0.	0.6	0.6	0.6	0.4	0.3	0.3	0.8	0.8	0.4	10.4	0.614	0.22	0.36

coordinated design		6	6		4		6	6	4	4	4	8	6	6			8	4			
Inaccurate quantities	0.8	0.36	0.36	0.64	0.64	0.8	0.6	0.6	0.64	0.64	0.64	0.64	0.36	0.48	0.8	0.8	0.64	10.52	0.618	0.11	0.18
Lack of consistency between bill of quantities,	0.8	0.36	0.36	0.64	0.64	0.64	0.6	0.6	0.64	0.64	0.64	0.64	0.64	0.48	0.8	0.8	0.64	10.64	0.625	0.11	0.18
Awarding the design to unqualified designers	0.8	0.36	0.36	0.64	0.64	0.64	0.6	0.4	0.48	0.64	0.64	0.64	0.64	0.36	0.8	0.8	0.64	10.08	0.592	0.11	0.19
Rush Design	0.8	0.64	0.64	0.64	0.48	1	0.5	0.6	0.48	1	0.64	0.64	0.64	0.48	0.8	0.8	0.36	11.16	0.656	0.31	0.47

Ranking of Risks

S.No	Risks	Index Score	Rank order
1	Change of government policy	0.797	1
2	Change of government	0.795	2
3	New governmental acts or legislations	0.762	3
4	Attitudes of participants	0.736	4
5	Financial failure of the contractor	0.7	5
6	Errors in design drawing	0.68	6
7	Communication	0.663	7
8	Rush Design	0.656	8
9	Fire	0.64	9
10	Inexperience when pricing tender	0.64	9
11	Labor shortages	0.63	10
12	Damage to structure	0.63	10
13	Labour injuries	0.63	10
14	Unmanaged cash flow	0.63	10
15	Loss due to fluctuation of interest rate	0.632	10
16	Insurances risks	0.637	10
17	Lack of consistency between bill of quantities	0.625	11
18	Material shortage	0.628	11
19	Not coordinated design	0.614	11
20	Inaccurate quantities	0.618	11
21	Inadequate specification	0.604	12
22	Incomplete design	0.604	12
23	Labor shortages	0.609	12
24	Labour productivity	0.609	12
25	Difference in actual and contract executed quantities	0.602	12
26	Supplies of defective materials	0.607	12
27	Varied labor and equipment	0.609	12
28	Payment delays	0.602	12
29	Any impact on the environment due to the project	0.602	12
30	Any impact on the environment due to the project	0.604	12
31	Design changes	0.597	13
32	Change in bank formalities and lenders	0.592	13
33	Awarding the design to unqualified designers	0.592	13
34	Unknown site conditions	0.588	14

35	Poor communication between parties involved	0.585	15
36	Monopolizing of materials due to closure and other unexpected	0.585	15
37	Any adverse impact on project due to climatic conditions	0.585	15
38	Low market demand	0.585	15
39	Lower quality of work	0.581	15
40	Investigation Change in scope	0.581	15
41	Equipment failures	0.571	16
42	Natural Disasters	0.576	16
43	Exchange rate fluctuation	0.576	16
44	Construction procedures	0.574	16
45	Industrial disputes	0.583	17
46	Incompetence of transportation facilities	0.567	18
47	Weather implications	0.567	18
48	High competition in bids	0.55	19
49	Changes in management ways	0.545	20
50	Inaccurate project program	0.545	20
51	Ambiguous planning due to project complexity	0.531	21
52	Information unavailability	0.529	22
53	Resource management	0.529	22
54	Undefined scope of working	0.529	22
55	Rush bidding	0.527	22
56	Unavailable labour, materials and equipment	0.527	22



VI. CONCLUSION

Risk management technique seldom utilized by the participants in the construction comes. The participants accustomed to handle the risks with a casual approach. This method isn't used due to less data and awareness among the development business. The danger management technique ought to be applied into any construction project at the initial stage of the project to induce most advantage of the technique. Hence, there's thriving have to be compelled to have a well-documented procedure

that ought to be a one stop answer to any or all hazards that are seeming to occur throughout the project life cycle. There ought to be the additional wholesome approach towards risk management rather than the current irregular approach towards the risks. This research examines the Monte Carlo simulation method and its uses in various fields, focusing primarily on its use in the field of project management. Monte Carlo simulation becomes more popular in project management, more creative studies will propose practical, applicable improvements to current practices and continue to contribute positively to the field. Monte Carlo simulation, once the Monte Carlo simulation technique is thoroughly explained and demonstrated, hands-on experience will allow project managers to realize that the statistical knowledge they are required to apply is quite minimal, and the tools are relatively easy to use once their project network and schedule have been created.

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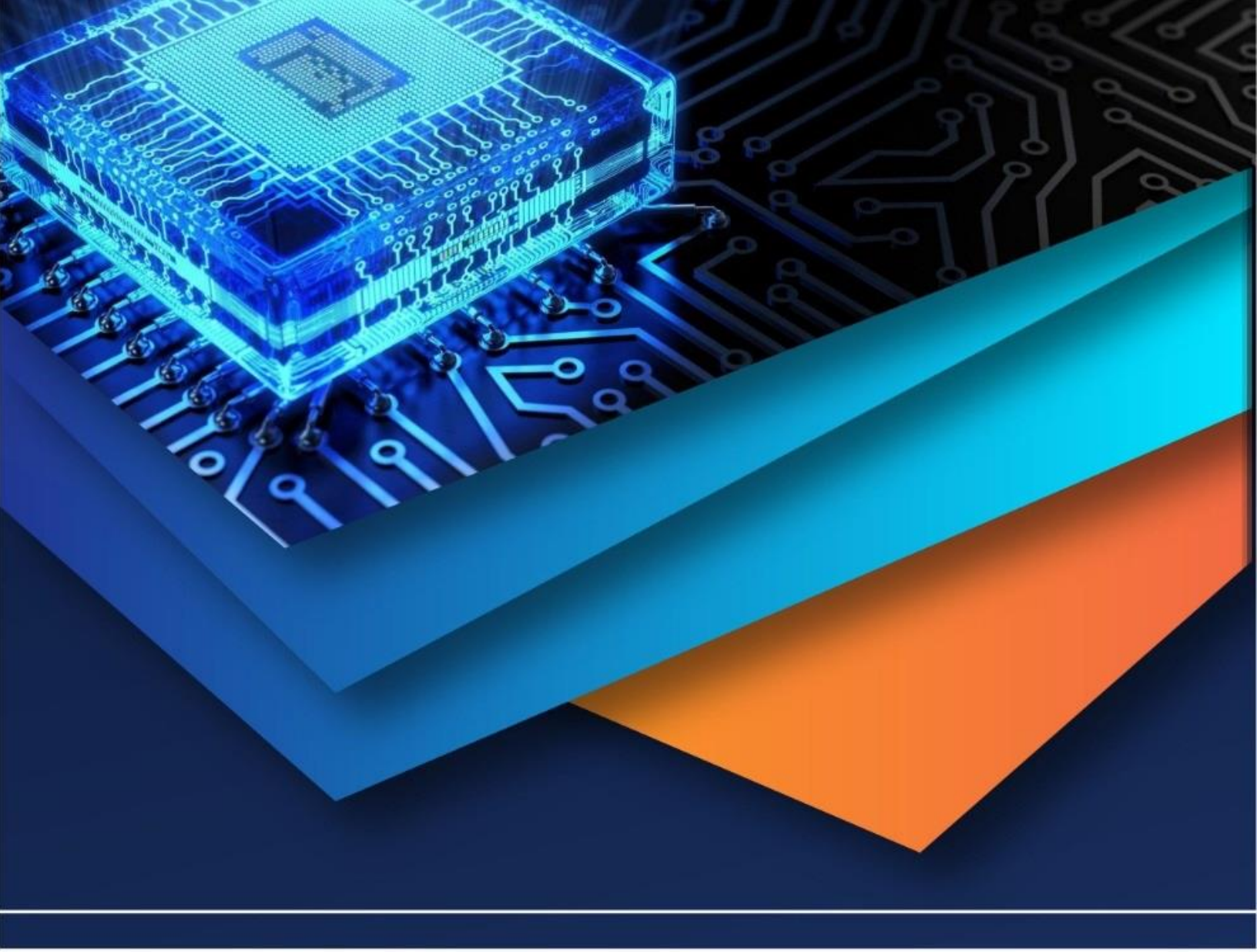

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