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Research Article

A Study On Risk Management Practices In Construction Projects In India

Mr. Nagarajan Muthukrishnan
Ph.D. (Part-Time) Research Scholar[*] (First Author)
Alagappa Institute of Management
Alagappa University, Karaikudi – 630 003

Dr. R. Ganapathi
Assistant Professor[**] (Second Author)
Directorate of Distance Education
Alagappa University, Karaikudi – 630 003

ABSTRACT

Risk is quite common event in all business whereas, it is significant in construction projects why because it is involving various activities in several stages and may be in simultaneous, therefore it may be unpredictable. To anticipate and manage those risks, Risk Management Practice is an effective weapon to limit its negative impacts and unwarranted consequences. This Research paper aims to study the risks and risk management practice adapted in the construction project through various roles from top management to worker level. The questionnaire survey has been prepared and responses were collected with a sample of 132 Professionals / respondents across India. The respondents are requested to provide their opinion based on their expertise through their present & past project experiences. The Construction professionals from various industrial sectors have participated in through online survey. Sixty (60) Major risk captured in this study and ranked within the category also overall ranks of the risks. The results shows (Design error[1]) the top ranked in Technical risk, (Pandemic Additional Expenses[1]) the top ranked financial risk, (Unsafe incidents & accidents during erection[1]) the top ranked construction risk, (Logistic accidents during transit lifting[1]) the top ranked procurement risk, (Breach of contract[1]) top ranked Legal risk, (Theft of Materials[1]) the top ranked other risk in construction projects. Opportunity Action Plan appears most adapted &Tender Contingencies estimation seems the least adapted in construction projects for Risk Management Practice. Procurement risk (27%), Other Risk (21%), Legal risk (20%) is most highly rated risk and Technical risk (17%), Financial Risk (15%) moderately rated by the respondents. The result also indicates the awareness level of risk management is high at middle management level (62%), average at Top Management level (28%) and low level at workers level (10%). Risk management practice has high impacts on Project performance in Quality (60%), timeline (43%) and delivery (49%) and medium impact on cost (45%) in the construction project. Risk Management practice has high impacts on project delivery in time (57%) and medium impacts in cost (73%) & delivery (55%) in the construction projects. The Two-Way ANOVA between the role of respondents and the experience level of respondents significantly shows variance ratio (F value) is 5.150 and 1.393 respectively. However, the above results are limited to the 132 respondents & indicative interpretation of their responses.

Keywords: Risk Management, Construction Projects, RMP, Enterprise risk, insolvency

1.Introduction

Risk Management is an essential process in construction project. Since, risk is common in any type of construction project. Risk Management practice will be the Tangible solution to identify the risk involved in the construction project, mitigate the risk by avoiding, eliminating or diluting it consequences. Technical Risk are inevitable due to lack of feasibility &involvement of various interfacing contractors or teams involved in a same location working individually or in a group to construct the project and commissioning it for revenue operations. Financial risks of the construction project may lead the companies into insolvency issues in case it is not addressed on time. Commercial risk of the construction project will impact the profitability of the firm. Environment risk & Political risk of the construction project is crucial to eliminate or avoid in case the event happen after the construction phase. Contractual risks can be avoided through contract, Technical risks can be eliminated through design, logistic and transit risk can be mitigated by action or treatment plans like insurance & selection of transit vehicles & lifting equipment's. Natural Disaster, Pandemic and force-majeure risk are incredible risk to manage at all times. The risk involves in all phase of any project. Risk Avoidance plan is absolutely necessary for the construction projects. Risk Elimination Plan is essential to identify the risk list and each risk to be addressed with Risk Treatment Plan to mitigate the risk or dilute its impacts. The Risk Management Practice will improve the performance of the construction projects in other hand it will helps the enterprise to avoid the insolvency and bankruptcy issues due to lack of funds during execution of the project. The risk management practice will leverage the profit margin in the contract price for the construction contractors. Scope, Time, Cost, quality, and delivery are the major factors where risk management plays a vital role to control it in an efficient way. The design errors, scope change, quantity change, time overruns, cost overruns, material cost fluctuation, price variation due to inflations, change in fuel rate, change in labour charges, force-majeure, acts of god, pandemic, disaster impacts, lack of availability of skilled labours, less awareness on contractual requirement, transit damages, political influence, environment& weather conditions, constructability difficulties, change of specification & ratings, defects, accidents are the important risk that commonly occurs on construction projects and companies.

Review of Literature

Chukwuemeka Patrick Ogbu (2011) carried out a comparative analysis on adaptation risk management practices between Multinationals and Indigenous Construction companies in Nigeria based on cross sectional survey with 11 international and 19 indigenous companies. Results shows the multinational corporates uses more risk management practices through the risk analysis methods& previous experiences data's than local companies in Nigeria.

Mehdi Tadayon, Mastura Jaafar and Ehsan Nasri (2012) were conducted an assessment on risk identification of large construction projects in Iran through questionnaire survey. They concluded the major are financial risk, construction and products risk considered in construction projects with reference to time & cost management in complex projects.

Roque Rabechini Junior and Marly Monteiro de Carvalho (2013) were empirically studied the impact of project risk management on project performance. They have investigated the degree of diffusion in risk management practices in Brazilian companies through methodical approach conducted in 415 projects at various level of complexity in multi-diversified industrial sector of brazil. Their result shows adaptation of risk management practice demonstrated positive significant impact in project success.

Alfredo Serpella, Ximena Ferrada, Rodolfo Howard and Larissa Rubio. (2014) were addressed the problems in risk management through modelling &knowledge-based approach and three-fold methodology. Their preliminary conclusion shows that risk management practice is ineffective due to lack of knowledge and they expect their application will improves the project performance & its functionality.

Adeleke, Bahaudin & Kamaruddeen (2015) were conducted a three-fold study, to identify antecedent factors to improve risk management in Nigerian construction industries. They were primarily analyzed the data with Partial Least Square Structural Equation Modelling and concluded that some of organizational factors will influence the constructional risk & effective risk management in Nigerian construction projects.

K. Jayasudha and B. Vidivelli (2016) were examined consciousness of the professionals in the construction industry to adopt planning techniques & tools in construction sites. Their result shows that the constructional professionals have low awareness on planning techniques & tools to adopt effectively to improve the project performances and need adequate trainings.

Pawel Szymanski (2017) has carried out the detailed assessment and study on risk in construction project throughout 5 groups: Preliminary design, Tender, Detailed design, Construction works, Financing the investment and concluded that it is essential to identify the risk and mitigate it in correct way rather than avoiding it and it is also necessary to determine all associated opportunity & hazards in the construction projects.

Mohammad Abazid and Husameddin Harb (2018) were conducted an immense study in risk management of construction projects in arab regions. They concluded that an integrated mechanism may be initiated based on a balanced inducement and risk distribution technique to contracting together with an improved practice methodology for risk management during entire project life cycle in which contractors may targeted to attain andsuitable possibility of excess margin.

Ahsan Nawaz, Ahsan Waqar, Syyed Adnan Raheel Shah, Muhammad Sajid and Muhammad Irslan Khalid (2019) were carried out a survey-based study in Pakistan to investigate the risk management practice in construction projects. They have collected 22 contracting enterprises data relevant to 100 diverse projects. Their result indicates higher degree of correlation between project success and effective risk management.

Shahid Iqbal, M. Nabeel Ehtisham, Syed Farqaleet K. Bukhari, Shahid Mahmood (2020) were carried out a survey with 215 responses from 100% background of construction industry. Their result indicates engineering management practice and risk management practices during planning phase of the project has influences in the project performance in Pakistan projects.

Nasser Alsaadi and Norhayatizakuan (2021) were examined the relationship between risk management and project performance in Oman through quantitative methods & survey. Their results revealed that risk management practices improved the construction project performance significantly and indicates the essentiality of hiring qualified project managers having skillset in practicing & possessing risk management with their knowledge.

3. Objectives of the Study

i. To study the major risks and Ranking the risk in category wise & overall rank of risk in construction projects through respondent responses.

ii. To identify the efficiency of risk management practice adapted in construction projects.

iii. To identify the risk management practice adopted, project performance, delivery, risk management awareness level, through simple percentage analysis and two-way ANOVA.

4. **Methodology**

This study carried out in construction enterprises executing projects in various region of India, respondents from various industry like Oil & Gas, Petrochemical, Metro railways, manufacturing, Building & Infrastructure, road & bridges construction, Cross country pipeline construction, Water & irrigation, Powers Plant & Substation constructional professional's has provided their response for questionnaire survey. The data collected from the respondent were analyzed and results of the response has been interpreted for an evaluation of risk management practice in industry & its impacts over construction projects provided in Tables and Figures.

5. Results & Findings

5.1 Summary

Table 1. Demographic Information of Respondents &Results

Profile of Respondents	**Number of Respondent**	**%Percentage of Respondent**
Type of Industry	**132**	**100%**
Petro-chemical, Oil & Gas	16	12%
Metro Rail, Railways	15	11%
Building & MEP Infrastructures	14	11%
Road & Bridge construction	17	13%
Manufacturing plants	17	13%
Cross-country Pipelines	21	16%
Water, irrigation projects	15	11%
Power Plant & substations	17	13%
Company which involved in multiple sector (Excluded)	*(1)*	*0.76%*
Role of Respondents	**132**	**100%**
Project Manager	33	25%
Construction Manager	30	23%
Planning Engineer	20	15%
Construction Engineer	26	20%
Supervisor	23	17%
Experience of Respondents	**132**	**100%**
0-5 Years	22	17%
5-10 years	23	17%
10-15 Years	32	24%
20-25 Years	35	27%
Above 25 Years	20	15%
Critical Risk Rated by Respondents	**132**	**100%**
Technical Risk	23	17%
Financial Risk	20	15%
Legal Risk	26	20%
Procurement Risk	35	27%
Other Risk	28	21%

Table 2. Ranking of Risk-Technical, Financial, Construction and Procurement

Risk Category	Type of Risk	Respondent Number	Response Percentage %	Rank within Category	Overall Rank
Technical	Design error	86	65%	1	8
	Rating change	76	58%	2	15
	Dimensional changes	76	58%	2	16
	Cost of substitute Items	74	56%	3	17
	Quantity change	72	55%	4	24
	Failure in interface	72	55%	4	25
	Scope Change	69	52%	5	28
	Integration failures	68	52%	6	30
	Specification Change	66	50%	7	35
Financial	Pandemic Additional expense	74	56%	1	18
	Liquidity Damages Penalty	68	52%	2	31
	Defect Liability cost change	67	51%	3	32
	Labour charge increase	65	49%	4	37
	Taxation revisions	64	48%	5	39
	Bonds & Guarantee cost change	52	39%	6	48
	Forex fluctuations	51	39%	7	49
	Consequential loss	50	38%	8	50
	Fixed Contract Price	49	37%	9	51
	Lack of cash flows	48	36%	10	52
	Change in Law	31	23%	11	56
	Material cost inflation	29	22%	12	57
	Force-Majeure	15	11%	13	58
Construction	Unsafe incidents & accidents during erection	95	72%	1	5
	Non-availability of Construction machineries	87	66%	2	7
	Unrealistic planning schedules	69	52%	3	29
	Lack of experienced professionals	67	51%	4	33
	Lifting & Erection failures	65	49%	5	38
	Act of God, Natural Disaster	63	48%	6	40
	Scarcity of skilled labours	61	46%	7	41
	Use of Improper tools & Plants	56	42%	8	46
	Material wastages	53	40%	9	47
	Constructability methods	43	33%	10	53
Procurement	Logistic accidents during transit lifting	104	79%	1	3
	Delay in replacement of defective product	90	68%	2	6
	Delayed in delivery of materials	78	59%	3	13
	Defective product delivery	77	58%	4	14
	Products or material Obsolete	73	55%	5	22
	Delay in placing orders	72	55%	6	26
	Shipping accidents during transit	61	46%	7	42
	Transit damage of products	60	45%	8	43
	Commodity price fluctuations	40	30%	9	54

Table 3. Ranking of Risk - Legal & Other Risks

Risk Category	Type of Risk	Respondent Number	Response Percentage %	Rank within Category	Overall Rank
Legal	Breach of contract clauses	112	85%	1	1
	Delay of payments with suppliers/ vendor	109	83%	2	2
	Consequential loss & Sequential loss	101	77%	3	4
	Breach of Intellectual Property	86	65%	4	9
	Delay of payments with customer	83	63%	5	10
	Bribery and corruptions	81	61%	6	12
	Labour non-compliance	74	56%	7	19
	Dispute resolution	9	7%	8	59
	Litigation & Arbitration	4	3%	9	60
Other Risk	Theft of materials	83	63%	1	11
	Localization & labour issues	74	56%	2	20
	Injuries to workers due to accidents	74	56%	2	21
	Enforced Cancellation of contract	73	55%	3	23
	New government regimes & policies	71	54%	4	27
	Rehabilitation & settlements	67	51%	5	34
	Political Issues	66	50%	6	36
	Geographical Issues	59	45%	7	44
	Geotechnical Issues	57	43%	8	45
	Social Issues	34	26%	9	55

Table 4. Implementation rate of Risk Management Practice

Risk Management Practice	**Respondent Response**	**Implementation %Percentage**
Effective use of Risk register	60	45%
Tender Contingencies Estimation	31	23%
Mitigation cost Analysis	67	51%
Risk Elimination Plan	59	45%
Risk Treatment Plan	62	47%
Risk Absorption log	61	46%
Opportunity Register Log	64	48%
Opportunity Action Plan	72	55%
Risk Monitoring Log	61	46%
Change order log	65	49%
Contract Price Adjustment Log	57	43%

Table 5. Risk Management Practice Impacts on Project Performance

Project Performance	**Low**	**Medium**	**High**	**Very High**	**Total**	**Respondent%**
Quality	0	14	**79**	39	132	100%
Cost	4	**59**	52	17	132	100%
Delivery	2	43	**65**	22	132	100%
Timeline	10	40	**57**	25	132	100%

Table 6. Impacts of Risk Treatment to improve Project Performance

Project Delivery	**High**	**Medium**	**Low**	**Total**	**Respondent%**
Time	75	41	16	132	100%
Cost	31	96	5	132	100%

Delivery	46	72	14	132	100%

Table 7. Risk Management Practice Impacts on Project Performance

Project Delivery	**High**	**Low**	**Medium**	**Total**	**Respondent%**
Normal Scenario	110	1	21	132	100%
Pandemic Scenario	3	105	24	132	100%

Table 8. Risk Management Awareness Level

Score Rating level	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Awareness Level %**
Top Management	0	3	8	26	0	0	0	0	0	0	37	28%
Middle Management	0	0	0	0	22	36	24	0	0	0	82	62%
Worker Level	0	0	0	0	0	0	0	7	5	1	13	10%
No of Respondent's											132	100%

Table 9. Cross Tabulation of Role of Respondents and Experience level

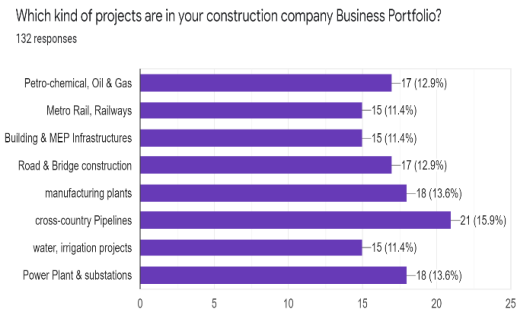
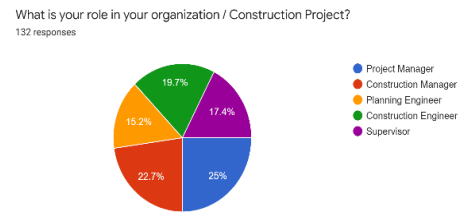
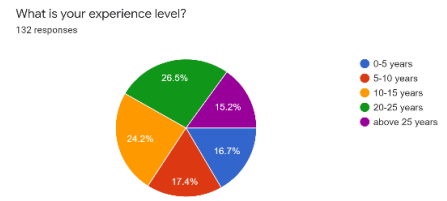
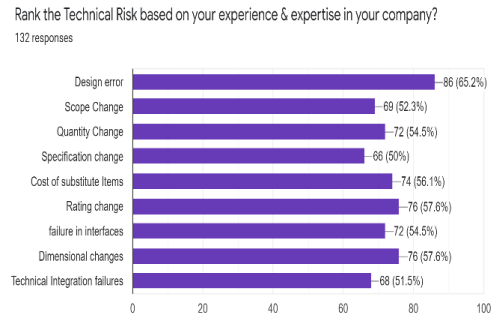
	Experience level of Respondents					
Role of Respondent	**0-5 Years**	**5-10 Years**	**10-15 Years**	**20-25 Years**	**Above 25 Years**	**Total**
Project Manager	6	7	7	6	7	33
Construction Manager	5	4	12	9	0	30
Planning Engineer	3	4	4	6	3	20
Construction Engineer	4	4	8	5	5	26
Supervisor	4	4	1	9	5	23
Number of Respondent	22	23	32	35	20	132

Table10. Tabulation of Two-Way ANALYSIS OF VARIANCE (ANOVA)

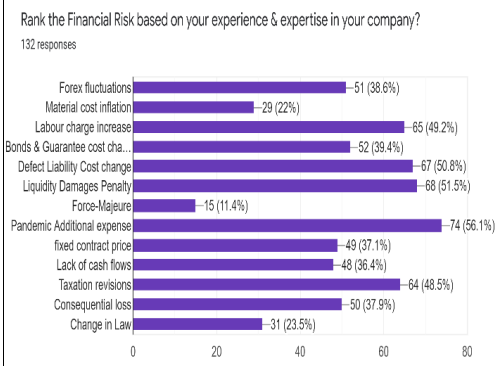
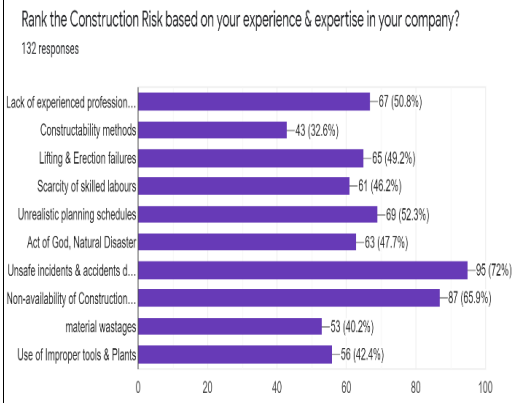
Source of Variation	**Degrees of Freedom (df)**	**Sum of Squares (SS)**	**Mean Sum of Squares (MSS)**	**Variance Ratio F= Greater Variance / Smaller variance**
Between the Variables	4	21.84	5.46	5.150
Within the Variables	24	35.44	1.48	1.393
Error level	96	101.76	1.06	
Total	124	159.04		

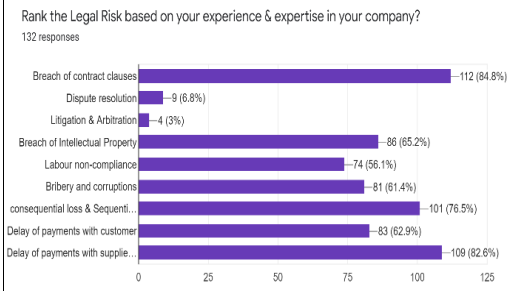
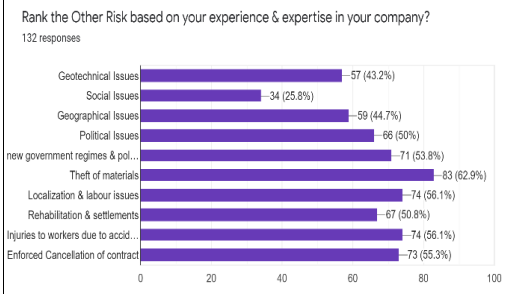
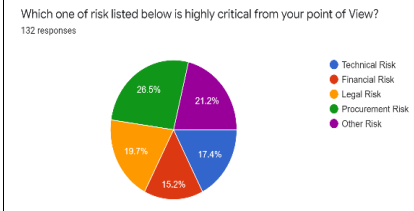
SURVEY QUESTIONNAIRE & RESPONSES

RISK MANAGEMENT PRACTICE IN CONSTRUCTION PROJECTS

1.	Which kind of projects are in your construction company Business Portfolio? □ Petro-chemical, Oil & Gas □ Metro Rail, Railways □ Building & MEP Infrastructures □ Road & Bridge construction □ Manufacturing plants □ Cross-country Pipelines □ Water, irrigation projects □ Power Plant & substations	
2.	What is your role in your organization / Construction Project? □Project Manager □Construction Manager □Planning Engineer □ Construction Engineer □Supervisor	
3.	What is your experience level? □ 0-5 years □ 5-10 years □ 10-15 years □ 20-25 years □ above 25 years	
4.	Rank the Technical Risk based on your experience & expertise in your company? □ Design error □ Scope Change □Quantity Change □ Specification change □ Cost of substitute Items □Rating change □ failure in interfaces □ Dimensional changes □ Technical Integration failures	
5	Rate Which level of your company employees have awareness of risk & risk management practice? □Top Management (0-4) □Mid-level Management (5-7) □Workers Level (8-10)	

SURVEY QUESTIONNAIRE

RISK MANAGEMENT PRACTICE IN CONSTRUCTION PROJECTS		
6.	Rank the Financial Risk based on your experience & expertise in your company? □ Forex fluctuations □ Material cost inflation □ Labour charge increase □ Bonds & Guarantee cost change □ Defect Liability Cost change □ Liquidity Damages Penalty □ Force-Majeure □ Pandemic Additional expense □ fixed contract price □ Lack of cash flows □ Taxation revisions □ Consequential loss □ Change in Law	
7.	Rank the Construction Risk based on your experience & expertise in your company? □Lack of experienced professionals □ Constructability methods □ Lifting & Erection failures □ Scarcity of skilled Labours □Unrealistic planning schedules □ Act of God, Natural Disaster □Unsafe incidents & accidents during erection □Non-availability of Construction machineries □ Material wastages □Use of Improper tools & Plants	
8.	Rank the Procurement Risk based on your experience & expertise in your company? □ Delay in placing orders □ Commodity price fluctuations □ Delayed in delivery of materials □ Transit damage of products □ Logistic accidents during transit lifting □ Shipping accidents during transit □Defective product delivery □ Delay in replacement of defective product □ Products or material Obsolete	

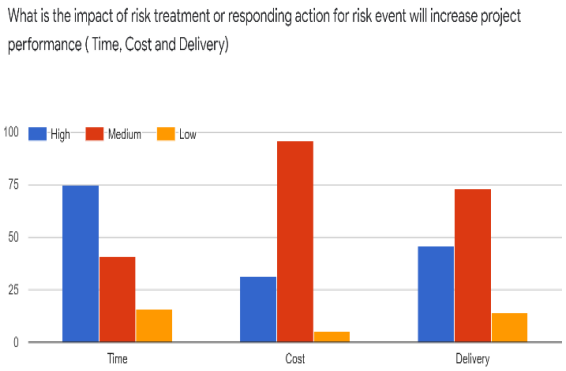
SURVEY QUESTIONNAIRE		
RISK MANAGEMENT PRACTICE IN CONSTRUCTION PROJECTS		
9.	Rank the Legal Risk based on your experience & expertise in your company? □ Breach of contract clauses □ Dispute resolution □ Litigation & Arbitration □ Breach of Intellectual Property □ Labour non-compliance □ Bribery and corruptions □ Consequential loss & Sequential loss □Delay of payments with customer □Delay of payments with vendor/ Suppliers	
10.	Rank the Other Risk based on your experience & expertise in your company? □Geotechnical Issues □ Social Issues □ Geographical Issues □ Political Issues □ New government regimes & policies □ Theft of materials □ Localization & Labour issues □ Rehabilitation & settlements □ Injuries to workers due to accidents □ Enforced Cancellation of contract	
11.	What are the risk management practice your company has implemented to track, reduce & dilute the risk impacts? □ Effective use of Risk register □ Tender Contingencies Estimation □ Mitigation cost Analysis Risk □ Elimination Plan Risk Treatment/ Dilution Plan □ Risk Absorption log □ Opportunity Register Log □ Opportunity Action Plan □ Risk Monitoring Log □ Change order log □ Contract Price Adjustment Log	
12.	Which one of risk listed below is highly critical from your point of View? □ Technical Risk □Financial Risk □Legal Risk □ Procurement Risk □Other Risk	

SURVEY QUESTIONNAIRE

RISK MANAGEMENT PRACTICE IN CONSTRUCTION PROJECTS

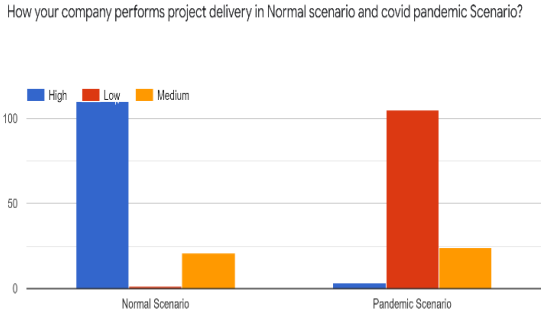
13. What is the impact of risk treatment or responding action for risk event will increase project performance (Time, Cost and Delivery)?

Attribute	High	Medium	Low
Time			
Cost			
Delivery			



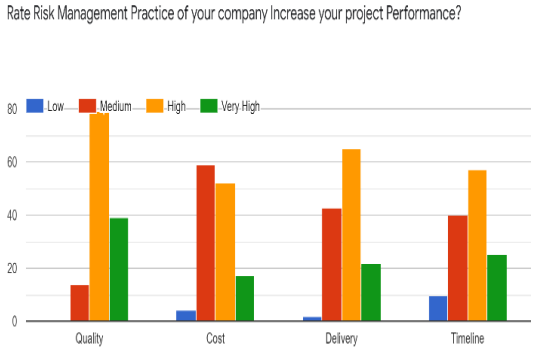
14. How your company performs project delivery in Normal scenario and covid pandemic Scenario?

Attribute	High	Low	Medium
Normal Scenario			
Pandemic Scenario			



15 Rate Risk Management Practice of your company Increase your project Performance?

Attribute	Low	Medium	High	Very High
Quality				
Cost				
Delivery				
Timeline				



6. Conclusion:

There are 60 risk captured in this study and the response has been analyzed and ranked within the category also overall ranks of the risks were interpreted from respondent response. The results shows (Design error[1]) the top ranked in Technical risk, (Pandemic Additional Expenses[1]) the top ranked financial risk, (Unsafe incidents & accidents during erection[1]) the top ranked construction risk, (Logistic accidents during transit lifting[1]) the top ranked procurement risk, (Breach of contract[1]) top ranked Legal risk, (Theft of Materials[1]) the top ranked other risk in construction projects. Opportunity Action Plan appears most adapted & Tender Contingencies estimation seems the least adapted in construction projects for Risk Management Practice. Procurement risk (27%), Other Risk (21%), Legal risk (20%) is most highly rated risk and Technical risk (17%), Financial Risk (15%) moderately rated by the respondents.

The result also indicates the awareness level of risk management is high at middle management level (62%), average at Top Management level (28%) and low level at workers level (10%).Risk management practice has high impacts on Project performance in Quality (60%), timeline (43%) and delivery (49%) and medium impact on cost (45%) in the construction project. Risk Management practice has high impacts on project delivery in time (57%) and medium impacts in cost (73%) & delivery (55%) in the construction projects. The Two-Way ANOVA between the role of respondents and the experience level of respondents significantly shows variance ratio (F value) is 5.150 and 1.393 respectively. However, the above results are limited to the 132 respondents &indicative interpretation of their responses, it may vary with various samples& Method of analysis which may be an eye opener for the further scope of research.

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