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Risk Identification And Prioritization In 3000KL High Speed Diesel (HSD) Storage Tank; Site Fabrication And Erection Project Using Primavera Risk Analysis Software

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Abstract:

Risk management process contains identification, analysis and mitigation of risks to reduce future impacts on project. In this paper, sixty-nine risks associated with 3000 KL High Speed Diesel (HSD) storage tank site fabrication and erection project located at Pune, Maharashtra, India has been identified and classified in eight categories i.e. Political risks, Legal or Contractual risks, Execution or Operational or Construction risks, Management risks, Technical risks, Financial risks, Social risks and Environmental risks. With the help of Probability Impact technique and use of Primavera Risk Analysis Software, risks are classified in to high priority, medium priority and low priority risks. This analysis is useful for Project Managers for decision making and to build risk response plan to reduce impact of these risks on project schedule and cost.

Keywords: Risk Management, High Speed Diesel (HSD), Project Management Life Cycle, Risk Register, Risk Scoring, Probability- Impact Technique

1. Introduction:

Risk is uncertainty in the project which can affect project in positive manner or in negative manner. Project risks can be classified as Individual Project Risk and Entire Project Risk. Individual project risks involve uncertainties impacting specific activities associated with project. Entire project risks are the uncertainties can hamper complete project. To avoid future implications of risk on project, proper precautions needed.
According to PMBOK edition 6, risk management plan includes following steps.

- Risk Identification
- Qualitative Risk Analysis
- Quantitative Risk Analysis
- Plan Risk Response
- Analyze Results after Mitigation
- Apply Contingency Reserves

Risk identification is the first step in risk management plan in which identification and documentation of risks associated with project is carried out. This documentation further used in analysis and mitigation process.

2. Review of Literature:

Ebrahim Jokar et al. (2021) worked on **'Assessing and Prioritizing Risks in Public-Private Partnership (PPP) Projects Using the Integration of Fuzzy Multi-Criteria Decision-Making Methods'.** Public-Privet Partnership (PPP) projects mainly include infrastructural projects, which have many uncertainties' associated with it. These risks can cause delay in project timeline, increased in cost and loss of material. Hence it has been stated in this paper that to avoid this PPP method should be used. Risks are classified in categories such as economic and financing, constructional, operational, legal, political, government risks and other risks which have greatest impact on the project. In this paper, impact of these risks on cost, schedule and performance of the project has been identified. The results of quantitative risk analysis by FAHP method shows that the risk which impacts highest is economic and financing risk

to PPP freeway project which is followed by construction risk, operational risk, legal risk, political risk, other risk and government risk.

Paúl Urgilés et al. (2019) worked on **'Methods for quantitative risks analysis of cost and deadline overruns in complex projects'.** In this study quantitative risk analysis has been performed on actual hydroelectric project in Republic of Ecuador by stochastic simulation. Results of this analysis are the probabilities of risk events that may occur during execution of this project which can cause delay in project schedule and increases project cost. During study it has been found that, hydroelectric projects are completed with cost overrun up to 99% and schedule overrun up to 44%. Proper management and identification & mitigation of risks can improve project efficiency and profitability of project. After performing quantitative risk assessment, identifying risks associated with the project and allocating risk responses to hydrostatic project it has been observed that cost overrun of 6.4% with 95% probability of occurrence and Schedule overrun of 13.4% with 95% probability of occurrence associated with this project. Also, stochastic simulation results in identifying activities which case failure in meeting project schedule and cost.

Mohamed Nabawy et al. (2021) worked on '**Achieving efficiency in quantitative risk analysis process – Application on infrastructure projects'.** In this research the main aim is to suggest efficient way of performing quantitative risk analysis of Infrastructure Projects. Infrastructure Projects are critical and one mistake can lead shareholders in to huge loss, it is better to perform quantitative risk analysis of these projects in effective and efficient way by considering realistic approaches. For this study, sewage networks, water networks, irrigation networks, and district cooling networks of Cairo festival city project has been considered. This project case study has been selected for quantitative analysis because of its highly aggressive work environment which increases probability of risks in the project. To identify schedule risks, quantitative risk analysis has been performed and it has been observed that Monte Carlo Analysis helps managers to allocate deviations in activities or tasks while sensitivity analysis helps to identify activities due to which delivery of infrastructure project can be failed. In this paper it has been concluded that, for aggressive and complex infrastructure projects having very harsh internal and external environment benefits more by performing quantitative risk analysis.

3. Research Methodology:

The main purpose of this study is to identify risk involved in fabrication and erection project of HSD storage tanks and with the help of Probability – Impact technique, categorize risks in to high priority risks, medium priority risks and low priority risks to get idea of entire project risks.

Project Title	Design, engineering, manufacturing and site operations management of 3000 KL fixed roof, flat bottom HSD Storage tank (2 Nos.).
Research Objective	To identify risks associated with site fabrication & erection work of 3000 KL HSD storage tank.
Project Location	Chakan Village, Pune, Maharashtra, India
Project Battery Limit	From Inlet Nozzle to Outlet Nozzle of Tank
Project Schedule	From 3rd January, 2022 to 26th May, 2022
Project Cost	Rs. 2,44,10,122.00

Table 1: Project Specifications

The research has been carried out by considering contractor's point of view in which activities like detail design, drawing preparation, fabrication drawing preparation, supply of raw materials, tools & tackles, manpower, consumables required for fabrication and erection works of project are considered in contractor's scope.

For High Speed Diesel (HSD) storage tanks fabrication and erection project risks associated can be categorized as Political risks, Legal or Contractual risks, Financial or Economic risks, Management risks, Technical risks, Execution or Operational or Construction risks, Social risks and Environmental risks

Total sixty-nine risks are identified for this project and are classified as follows,

3.1. Risk Identification:

Sr. No.	Risk Category	Risks
1.	Political Risks	Change in ruling government
		Change in government policies
		Change in government rules and regulation
		Obstruction in project work due to local politics
		Lack of political willingness
		Delay in statutory approvals from government authorities
		Changes in global politics
2.	Social Risks	Unskilled labour
		Distance of site from accommodation of staff & labour
		Difficulties faced by staff and labours in satisfying daily needs
		Cultural faiths of staff and labours
		Labour protest and strikes
3.	Legal / Contractual Risks	Delay in receipt of Purchase Order from client
		Disagreements in contract with client at preliminary stage
		Ambiguities in contract with client
		Amendment in labour laws
		Delay in Third Party approval
		Disagreements in contract with sub-contractor/ vendor
		Legal disputes during execution stage
4.	Management Risks	Lack of understanding of project scope
		Error in identification of required resources
		Error in project team selection
		Incapability of responsible authority
		Lack of coordination within organization
		Miscommunication within project team
		Lack of realistic planning
		Lack of support from top management of organization
		Error in project scheduling
		Internal disputes in organization
		Improper supply chain management
Sr. No.	Risk Category	Risks
5.	Technical Risks	Delay in detail engineering
		Delay in preparation of fabrication drawings
		delay in receipt of drawings on site
		Error in design in preliminary stage
		Identification of design error during execution stage
		Using traditional technologies at work site
		Changes in design at preliminary stage
		Changes in design during execution stage

		Reuse of previously design formats
6.	Execution / Operational / Construction Risks	Delay in receipt of raw material
		Delay in receipt of required tools and tackles at site
		Interruption in work due to failure of electricity
		Unavailability of work front due to other ongoing work
		Unavailability of enough space to for material handling and moving
		Poor quality of civil and electrical work
		Failure of tools and tackles in between of work
		Minor accidents at work site
		Poor site management
		Receipt low quality material at site
		Receipt of wrong material at site
		Non-compliance of quality requirements
		Major accidents at work site
		Transportation damage
		Threat of theft of raw materials, tools & tackle at site
7.	Economic / Financial Risks	Change in global trade policy
		Insufficient project funding
		Change in credit system
		Change in tariff barriers
		Inflation risk
		Fluctuations in interest rates
		Fluctuations in prices of raw materials
		Error in estimation of project budget
		Significant change in labour daily wages
		Penalties due to delay in project
		Delay in payment from client
		Insurance related to staff, labours and goods
8.	Environment Risks	Severe natural calamities
		Bad Weather conditions
		Non-compliance of environmental norms

Table 2: Risk Identification and Categorization

For prioritizing, commonly used technique is Probability- Impact matrix. Probability- Impact matrix gives idea about probability of occurrence of that risk and quantum of impact on project.

3.2. Risk Scoring:

According to risk scoring, probability of risk to be happen if it is up to 10%, then it is considered as very low, if it is from 10% to 30% then it is said to be low, if it is from 30% to 50 % it is said to be medium, if it is from 50% to 70% then it is said to be high and if it is more than 70 % then it can be said that probability of risk is very high.

Probability Scale

Very Low	Low	Medium	High	Very High
Up to 10%	10% to 30%	30% to 50%	50% to 70%	70% or higher

Impact Scales and Types

	Very Low	Low	Medium	High	Very High
Schedule*	Up to 5	5 to 10	10 to 20	20 to 40	40 or higher
Cost*	Up to Rs.30,000.00	Rs.30,000.00 to Rs.75,000.00	Rs.75,000.00 to Rs.150,000.00	Rs.150,000.00 to Rs.600,000.00	Rs.600,000.00 or higher

* means impact is used in scoring

Probability and Impact Scoring (PID)
Risk Score is based on: **Highest Impact**

	Impact Very Low	Low	Medium	High	Very High
Very High	5	9	18	36	72
High	4	7	14	28	56
Medium	3	5	10	20	40
Low	2	3	6	12	24
Very Low	1	1	2	4	8

Key

Up to 5	5 to 23	23 or higher

Figure 1: Risk Scoring

Similarly, in case of impact of risk on schedule, if schedule delays up to 5 days then impact will be very low, if delay is between 5 to 10 days then impact will be low, if delay is between 10 to 20 then impact will be medium, if delay is between 20 to 40 days then impact will be high and if schedule delay is more than 40 days then impact of risk is very high.

Impact in case of cost, if cost is impacted up to Rs 30,000.00 then impact will be very low, if cost is impacted between Rs 30,000.00 to Rs 75,000.00 then impact is low, if cost is impacted between Rs 75,000.00 to Rs 1,50,000.00 then impact is medium, if cost is impacted between Rs 1,50,000.00 to Rs 6,00,000.00, then cost impact is very high and if cost impacted is above Rs 6,00,000.00 then cost impact is considered as very high.

Based on it risks can be classified as high priority risks, medium priority risk and low priority risks. According to risk scoring if risk score is up to 5 then risk can be classified as low priority risk, if risk score is from 5 to 23 then risk is classified as medium priority risk and if risk score is more than 23 then its priority will be very high.

3.3. Risk Prioritization:

Risk matrix shows relation between probability of risk to be happened and its impact on project schedule and project cost. In given matrix, risks indicated in red zone have very high risk score and can have very high impact on project. Risks such as lack of understanding of project, identification of design error at the time of execution and changes in design at the time of execution lie in red zone. Hence these risks need to be mitigated first. These risks are said to be compliant risks as it is necessary to work on these risks to reduce probability of these risks.

	Very Low	Low	Medium	High	Very High
Very High					
High					
Medium			RISK31 - Using Traditional Technologies at work Site, RISK44 - Receipt Low Quality Material at Site, RISK45 - Receipt of Wrong Material at Site, RISK48 - Threat of Theft of Raw Materials, Tools & Tackle at Site		
Low	RISK26 - Delay in Detail Engineering, RISK27 - Delay in Preparation of Fabrication Drawings, RISK28 - Delay in Receipt of Drawings on Site, RISK29 - Error in Design in Preliminary Stage, RISK51 - Change in Credit System, RISK54 - Fluctuations in Interest Rates	RISK8 - Delay in Receipt of Purchase Order from Client, RISK9 - Disagreements in Contract with Client at Preliminary Stage, RISK10 - Ambiquities in Contract with Client, RISK12 - Delay in Third Party Approval (CCOE Approval), RISK13 - Disagreements in Contract with Sub-contractor/ Vendor, RISK20 - Miscommunication within Project team, RISK22 - Lack of Support from Top Management of Organization, RISK32 - Changes in Design at Preliminary Stage, RISK36 - Delay in Receipt of required Tools and Tackles at Site, RISK37 - Interruption in work due to Failure of Electricity, RISK38 - Unavailability of Work front due to other ongoing work, RISK39 - Unavailability of Enough	RISK3 - Change in Government Rules and Regulation, RISK6 - Delay in Statutory Approvals from Government Authorities, RISK16 - Error in Identification of required resources, RISK17 - Error in Project Team Selection, RISK18 - Incapability of Responsible Authority, RISK19 - Lack of Coordination within Organization, RISK24 - Internal Disputes in Organization, RISK34 - Reuse Previous Design Formats, RISK35 - Delay in Receipt of Raw Material, RISK41 - Failure of Tools and tackles in between of work, RISK43 - Poor Site Management, RISK50 - Insufficient Project Funding, RISK52 - Change in Tariff Barriers, RISK55 - Fluctuations in Prices of Raw	RISK4 - Obstruction in Project Work due to Local Politics, RISK14 - Legal Disputes during Execution Stage, RISK21 - Lack of Realistic Planning, RISK23 - Error in Project Scheduling, RISK25 - Improper Supply Chain Management	RISK15 - Lack of understanding of Project Scope, RISK30 - Identification of Design Error During Execution Stage, RISK33 - Changes in Design During Execution Stage

Figure 2 (A): Risk Prioritization

Similarly, risks involved in yellow zone are partially compliant risks. It means these risks need to be mitigated but it has less impact on project schedule and project cost than compliant risks. Risks involved in green zone are non-compliant risks which has very low impact on project cost and project schedule. These risks can be mitigated or eliminated but if these risks remain in project, there will not be major impact on the project.

	Very Low	Low	Medium	High	Very High
Low		Space to for Material Handling and Moving, RISK40 - Poor Quality of Civil and Electrical Work, RISK42 - Minor Accidents at Work Site, RISK46 - Non-compliance of Quality Requirements, RISK53 - Inflation risk, RISK62 - Difficulties Faced by Staff and labours in satisfying daily needs, RISK66 - Bad Weather Conditions, RISK68 - Non-compliance of Environmental Norms	Materials, RISK56 - Error in estimation of Project Budget, RISK58 - Penalties due to Delay in Project, RISK59 - Insurance related to Staff, Labours and Goods, RISK60 - Unskilled Labour, RISK61 - Distance of Site from Accommodation of Staff & Labour, RISK64 - Labour Protest and Strikes, RISK65 - Severe Natural Calamities, RISK69 - Transportation Damage, RISK70 - Delay in payment from client		
Very Low	RISK7 - Changes in Global Politics	RISK11 - Amendment in Labour Laws, RISK49 - Change in Global Trade Policy, RISK63 - Cultural Faiths of Staff and labours	RISK5 - Lack of Political Willingness, RISK57 - Significant Change In Labour Daily Wages	RISK2 - Change in Government Policies, RISK47 - Major Accidents at Work Site	

Figure 2 (B): Risk Prioritization

4. Conclusion:

In case of construction projects like site fabrication and erection of High Speed Diesel (HSD) storage tank, it is necessary to conduct risk assessment in planning stage of project life cycle to reduce future impact on project schedule and cost. In given project total sixty-nine risks are identified and classified in eight categories i.e. Political risks, Legal or Contractual risks, Execution or Operational or Construction risks, Management, risks, Technical risks, Financial risks, Social risks and Environmental risks.

Among sixty-nine risks based on risk score, it has been found that three risks i.e. lack of understanding of project, identification of design error at the time of execution and changes in design at the time of execution lie in red zone, thirty-two risks are lying on yellow zone and thirty-three risks are lying on green zone. Risks lying on red zone are high priority risks and should be addressed immediately. Risks in yellow zone are medium priority risks and can be mitigated after addressing high priority risks and risks in green zone are low priority risks and have very less impact on project schedule and cost. This analysis will help in decision making and building risk responses to increase profitability of project.

References:

- Ahmed M. K., Ibrahim M., Ysory A., (2018). Special Studies in Management of Construction Project Risks, Risk Concept, Plan Building, Risk Quantitative and Qualitative Analysis, Risk Response Strategies, Alexandria Engineering Journal 57, 3179–3187.
- American Petroleum Institute. (2012). Standard for Design and Fabrication of Welded Steel Tank for Oil Storage (API 650), 11th Edition.
- Behrad B., Shahram S. S., (2020). Qualitative and Quantitative Project Risk Assessment Using a Hybrid Pmbok Model Developed Under Uncertainty Conditions, Heliyon 6 E03097.
- Bureau of Indian Standards. (2002). Criteria for Earthquake Resistant Design of Structures (IS 1893)
- Bureau of Indian Standards. (2003). Code of Practice for Design Loads (Other Than Earthquake) For Building and Structures (IS 875-1987).
- Bureau of Indian Standards. (2006). Code of Practice for Design, Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tank (IS 803-1976).
- Chaitali S. P., Suman S. J., Jalinder R. P., (2015). Risk Management In Infrastructure Projects In India, International Journal Of Innovative Research In Advanced Engineering (Ijirae) Issn: 2349-2163 Issue 4, Volume 2.
- Ebrahim J., Babak A., Alireza L., (2021). Assessing and Prioritizing Risks in Public-Private Partnership (Ppp) Projects Using the Integration of Fuzzy Multi-Criteria Decision-Making Methods, Operations Research Perspectives 8 100190.
- Lionel Galway, (2004). Quantitative Risk Analysis for Project Management, Wr-112-Rc.
- Martin H., Andrea B., Frantisek S. & Jiri T., (2019). Project Management During the Industry 4.0 Implementation with Risk Factor Analysis, 29th International Conference On Flexible Automation and Intelligent Manufacturing (Faim2019), Limerick, Ireland.
- Mohamed A. A., (2018). Risk Analysis Related to Costing and Scheduling of Construction Projects, International Conference On Industrial Engineering and Operations Management Bandung, Indonesia.
- Mohamed N., Laila M. K., (2020). A Systematic Review of Quantitative Risk Analysis in Construction of Mega Projects, Ain Shams Engineering Journal 11 1403–1410.
- Mohamed N., Laila M. K., (2021). Achieving Efficiency in Quantitative Risk Analysis Process – Application On Infrastructure Projects, Ain Shams Engineering Journal 12 2303–2311.
- Othman M. N., Potty N. S., (2014). Case Study Analysis for The Successful Completion and Sustainable Construction of Infrastructure Projects, Wit Transactions On Ecology and The Environment, Vol 181.
- Paúl U., Juan C., Miguel A. S., (2019). Methods for Quantitative Risks Analysis of Cost and Deadline Overruns in Complex

Projects, 8th Manufacturing Engineering Society International Conference, Procedia Manufacturing 41 658–665.

- Project Management Institute. (2017). A Guide to The Project Management Body of Knowledge, Sixth Edition.