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Risk Management in Oil and Gas (EPC) Industry

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Abstract: ***The five most important risk factors identified in the design phase are 1] scope uncertainty, 2] failed management and planning, 3] changes in errors and omissions, 4] inadequate projectS team structure, 5] inadequate quality requirements. The top five risk factors determined by the procurement category are 1] Inadequate online resources and equipment, 2] Distribution of suppliers, 3] Uncertainty in design and style, codes, requirements and standards, 4] Defective items, and 5] Compromise. The 5 most important risk factors identified in the construction phase are 1] weak project capability, 2] excessive construction costs, 3] major construction delays, 4] strong project plan, and 5] poor safety management .This was initiated by the link between risk factors and the effects on price, quality and timing, as well as the potential for expensive, common, and high-quality outcomes.***
Keywords: Disaster risk management, risk management strategies, project risk management, oil and gas industry.

I. INTRODUCTION

A. General

The building sector in India could be the country's second largest economic segment after agriculture. It engages over 40 million individuals and also contributed almost 8.1 % to the national GDP found 2012-13. It's expected to possess contributed 7.8 % within 2013-14. Before the worldwide financial crisis in 2008, the market increased at more than ten % during 2005-07. After 2008, the growth moderated, with the market registering an average real development speed of 4.8 % throughout 2008-2014. Nevertheless, the business has become likely to recuperate with the development of a stable government at the centre and the thrust of its on infrastructure growth to revive financial development.

Infrastructure development is fuelling India's economic development over the past ten years or thereabouts. Increasing population, fast industrialisation and also urbanisation in addition to worldwide trade drive the need for constant investment in infrastructure growth. Recognizing these specifications, the Government programs to commit INR56.3 trillion within infrastructure throughout the Twelfth Five Year Plan [2012-17] and roughly 50 % of the investments are being contributed through the private sector. Looking at this leading potential chance in the infrastructure sector, the EPC market is likely to be gained

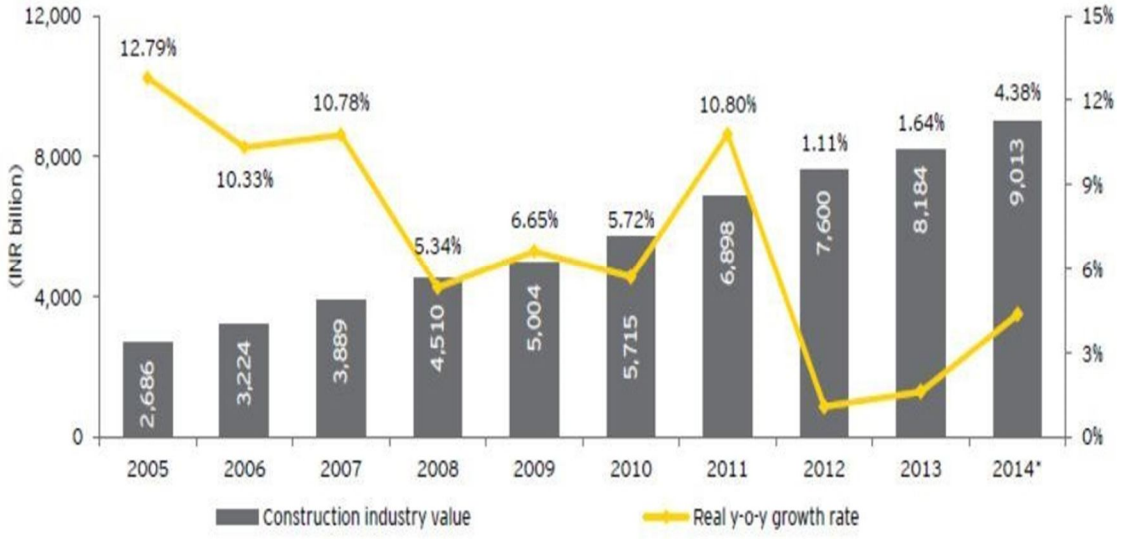


Fig1.1. construction growth trend in India

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B. Design-Bid-Build Contract

Design-bid-build also often known as Design-tender and is a standard strategy is a project delivery technique where the company or maybe owner contracts with individual entities because of the layout and building of a task.

There are three main sequential phases within the design–bid–build delivery method

1) The design phase
2) The bidding [or tender] phase
3) The construction phase

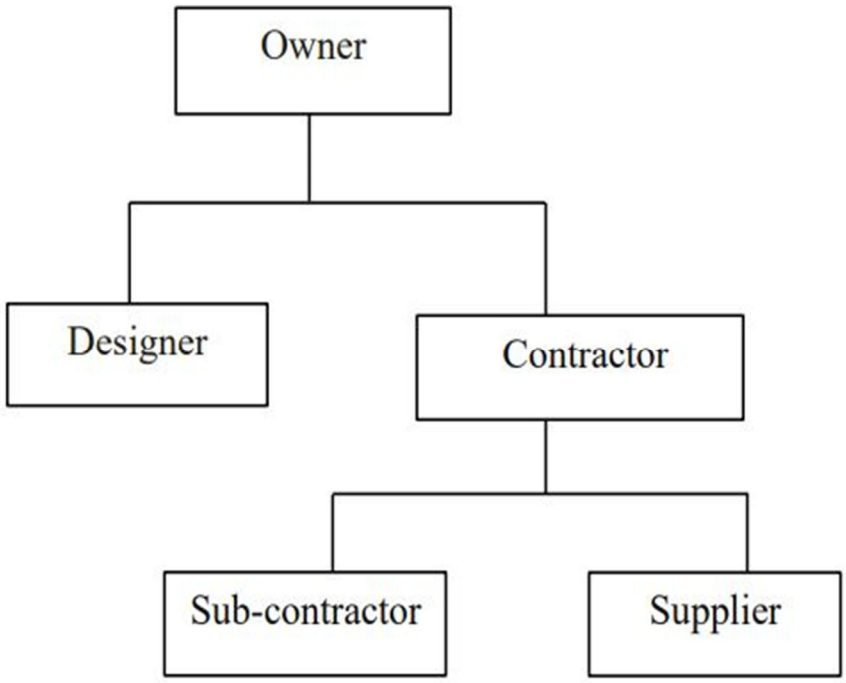


Fig 1.2: Traditional contract approach

C. Risk Management

Risk management is that the procedure of identification, evaluation and either mitigation or acceptance of hysteria in investment decision-making. Essentially, risk management happens anytime and an investor has to analyses and tries to quantify the possibility for losses in an asset and then takes the appropriate action [or maybe inaction] provided their investment goals and risk tolerance. Risk management covers all of the procedures involved in identifying, control, classification, evaluation and monitor in order taking steps to mitigate or even anticipate them.The management of danger isn't a linear process; quite it's the balancing of a selection of interwoven elements which communicate with one another and which must be in balance with each other. The control of one risk contains an effect on another. Management actions that are effective in controlling much more than one risk simultaneously could be achievable

The Risk management Process involves the following steps:-

1) Risk Identification
2) Risk Analysis
3) Risk control
4) Risk Monitor
5) Risk Evaluation
6) Risk management plan

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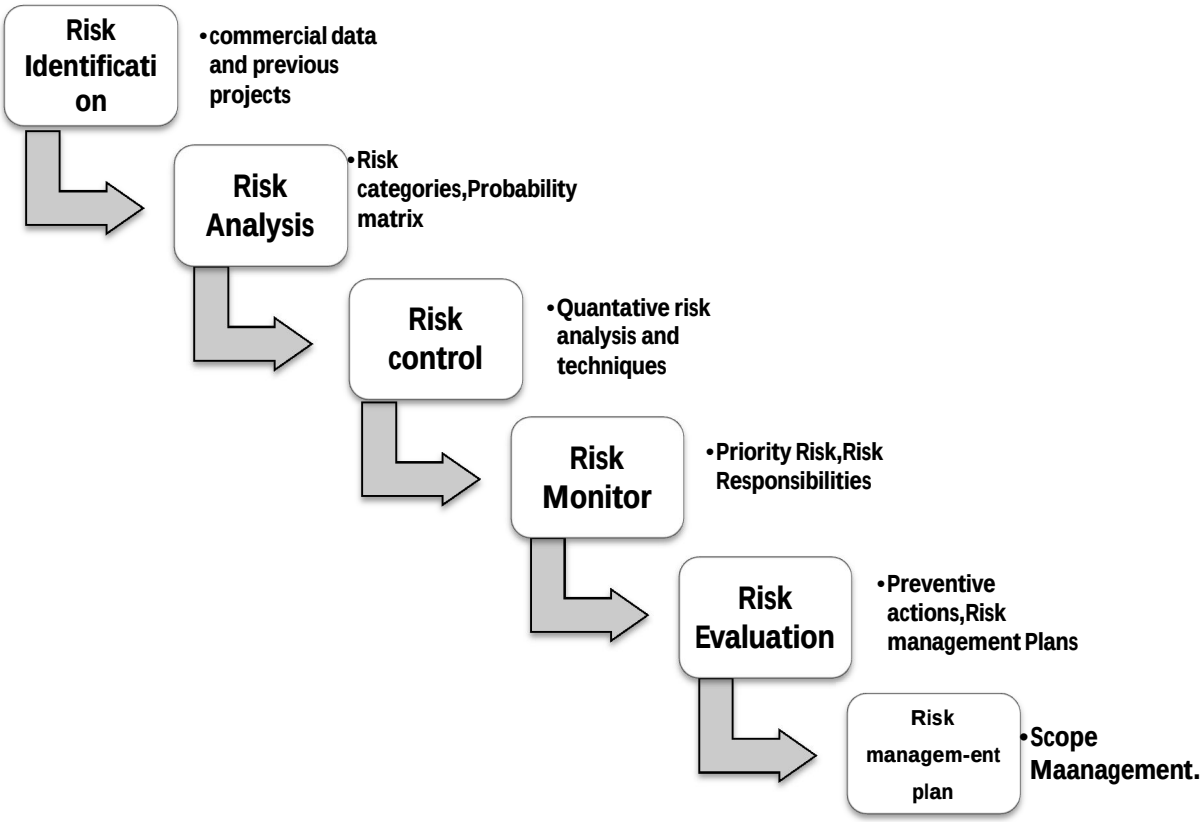


Fig.1.3 Risk management process cycle

D. Problem Statement

EPC oil and gas tasks in India are presently characterized by maximizing project complexity, various dimensions and intensified global movement. Therefore it's tough to satisfy the task objectives and issues in regards to timely completion, quality, costs, and earnings. Contracts are in essence resources for allocation of projects, risks and responsibilities. It's a principle of contracting the party who control risk must carry the risk.

While various and many research studies have been undertaken on risk management in numerous industries, including IT, producing and building sectors, there seems to be an absence of definitive methods for EPC tasks.

E. Scope Of The Study

The range of the research is restricted to oil and gas EPC tasks. The results from this research is beneficial to EPC contractors, owners, project managers, other stakeholders and project engineers to recognize the crucial and critical risk factors in the oil as well as gas EPC tasks and thereby leading them in developing as well as adopting needed effective and efficient project management methods to do EPC tasks on cost, schedule with quality that is good offering clients pleasure and security measures. My research is restricted to just cost, routine as well as quality No of respondents are much less as a result of time limitation. The following within this research study just risks in every stage are revealed and the responsible people because of this risks weren't studied.

F. Objective Of The Study

The overall objective of this research is:

1) To determine the various critical risks factors in oil & gas industry projects in India.
2) To suggest risk factors those're crucial and happening within the different phases in oil and gas EPC projects
3) To study and analyse the connection between the risk factors and influence on price, routine, and then quality of the entire venture.

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II. LITERATURE REVIEW

1) Mojtaba Karami et.al [1] [2020] The analysis examined the need to control danger within the petrochemical industry because of the horrific incidents of the latest accidents like India's Bhopal [with 4,000 killed], Ukraine's Chernobyl [with 38 killed], Flixborough , England [With twenty eight individuals killed] and also Italy's Seveso [with a gasoline mass produced from the blast 6 km long and one km wide] [Flixborough Vapor Cloud Explosion]. Recent events have drawn public focus on the chemical industry and a variety of risks involved within the petrochemical business, after which as an outcome have raised the demand for systematic safety evaluation of various tasks in the chemical business.
2) Mrrithunjay J, Michael Reagon et.al [2] [2020] There are various layers of protection find numerous levels of protection with regards to devices, these have a major goal and are triggered according to the importance. Machine Safety it's essentially the safeguards which are offered to the operator and the machine that are working on it. This's very important as there's an increased number of crashes happening as you work on machines. This paper works with the numerous kinds of guarding that're utilized for machines, the concepts of guarding, the necessity for Machine Safety Risk Assessment as well as its advantages. A machine plays a major part in the circumstances of a problem and an industry in anyone machine lead to the failure of the entire program. The use of technology is definitely observed in the situation on the printer guarding.
3) Ankush Suryabhan Harle et.al [3] [2020] Because of the inherent risks and also boosting complexity of contemporary construction projects, delays and also cost overruns have grown to be common information within the market. Researchers and practitioners used many methods to evaluate apportion and project delays delay duty of all the parties involved. Survey base delay analysis has been recognized as one of the most credible methods for examining construction waiting times. Despite the benefits of its, survey analysis is able to make results that are different based on the collected information size, it is able to be consider owner as well as contractor acceleration and systematically think about the effect of several baseline updates
4) A.Ansilin Mazhila et.al [[4] [2019]]In recent years, awareness of occupational safety and health risks among various people involved in the construction sector has increased further and accidents are still significantly higher than to most of the various other companies. Two main reasons have already been given to explain this high price for accidents in the construction industry: 1. the specific qualities of construction organizations and projects, and 2. the financial and financial problems of construction. implementing additional security measures in an expanding, competitive market. Kunal Sharma et single disaster is visible in a moment.
5) Kunal Sharma et.al [5] [2018] Jeopardy of damage always prevails with natural catastrophes, however when the organic disaster fuses with technical factors, the disappointment could end up as a possible purpose for mass destruction. The catastrophe risk reduction methods taken by responders might not be adequate as the typical procedure is facing unique disaster at a time is visible.
6) Dr . Prof .Ajit Patil et.al [6] [2018] High-rise structures also are known as “vertical cities”, having the potential to decongest conurbation . Indian cities are seeing immense demographic expansion because of migration from adjacent villages, resulting in urban sprawl, real estate need, rise in price of ground. Housing has created into an economy producing industry. The building projects are among the most crucial one which plays a crucial part in development of the nation. It's believed the High rise [or] multi storey structures would be the most crucial component of the building for the better development. Given this demand, while high rise residential structures.
7) Raoudha Ben Amor et.al [7] [2018] The petroleum supply chain is very inflexible & complicated. It appears as a major danger having a high impact on the national economic climate. The complexity results in the presence of different forms of danger that has be considered for when developing, operating and planning such a product. The primary objective of this paper is representing a literature review on the chance in the engine oil business and also in order to produce a typology of risk control. For starters, this content identifies main risks associated with each stage of the oil supply chain. Next, it concentrates an overview on the modelling strategies of the threat control.
8) Revathi et.al [8] [2017] this analysis evaluates existing laws, and also assesses the suitability of these procedures and regulations for building environment and workforce Additionally, it covers issues related to enforcing safety laws at construction sites. Therefore to be able to determine the safety problems and problems, an extensive security climate questionnaire survey was done with employees and sites of the building businesses by categorizing it into three levels namely; low-level, medium-level, and high-level. From the collected information, we recognize many factors which define .

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9) Olga Viktorovna et.al [9] [2017] The post substantiates the urgency of chance control in gas and oil companies in the present context. The primary threat management bodies and their capabilities are provided in the context of 1 of the Russian gas and oil companies. Depending on the systematization of risk sorts, the author distinguishes significant risks in oil & Gas Corporation. Among the external chances the author identifies the organizations of political, environmental, socioeconomic, and scientific technical risks. It's recommended carrying out analysis of internal chances inside the following groups: chances of manufacturing activity, chances of the assistance activity, risks in the reproductive sphere, risks in the sphere of circulation, and chances in the sphere of control.

10) Sundaram Haridos , et.al. [10] [2017] This document provides all risks, plus safety concerns and management practices in the oil and gas sector Use and production of possible threats Oil and gas wells can emit hydrogen sulfide and expose employees hydrogen sulfide gas The 3 best methods to avoid injury and death are: effective monitoring of hydrogen sulfide gas; good planning and training programs for employees.

III. METHODOLOGY

The framework being used for this primarily consists of 3 stages namely input, output and process. Input regarding to this particular study refers to objectives, scope of the research and literature review whereas process refers to the methodology being used to achieve the stated objectives. Output refers to the conclusions and recommendations that will be useful in identifying t critical risks and relation with the project performance variables [cost, quality and schedule].

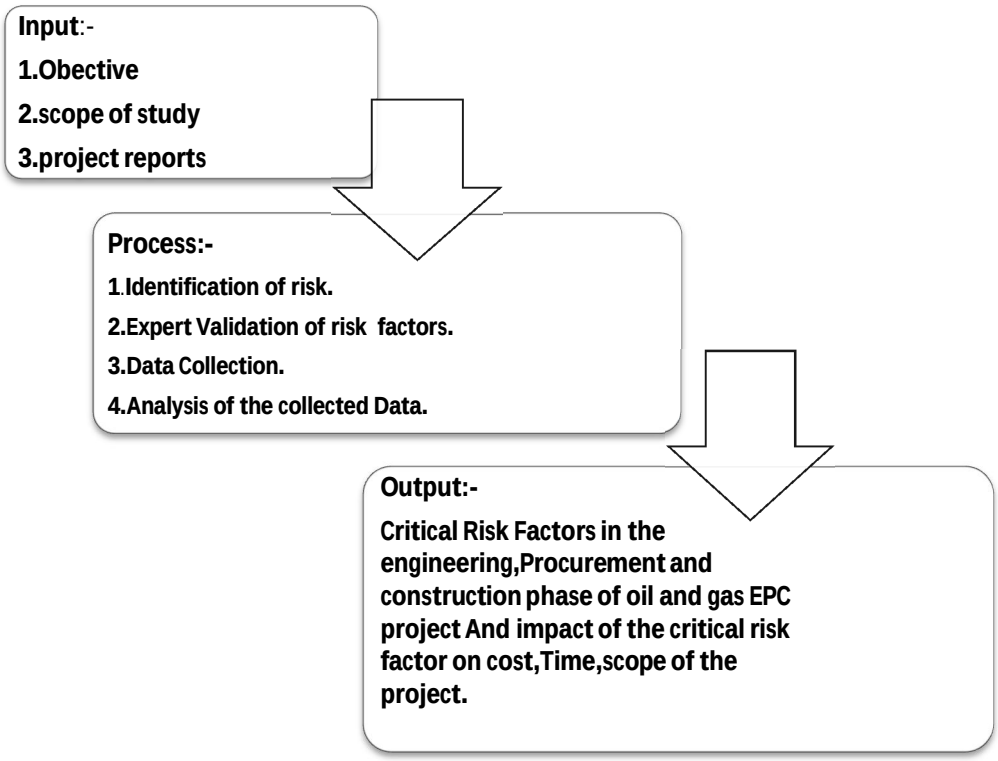


Fig no 3.1 Risk identification process

A. Questionnaire Design And Structure

Questionnaire survey was adopted for collection of data. Structured interviews with project managers, employees and other departmental specialist in the oil and gas industry field were performed after the main uncertainty factors that could be opportunities are identified using the information collected from the question and answer survey. The question and answer survey is developed using the risk factors that are determined in different phases of the project through the review of the different specialist in the industry.

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The questionnaire includes 3 parts

1) *Phase 1:* This section of questionnaire includes questions related with respondent and construction project profile.
2) *Phase 2:* This section of questionnaire comprised of questions related with identifying the critical risk factors in the oil and gas engineering procurement and construction phase of the projects.
3) *Phase 3:* This section of questionnaire covers the questions related to how these risk factors are affecting the project performance variables like schedule, cost and quality in the oil and gas EPC projects.

Part 1 of the questionnaire which is composed of questions regarding respondent gives the details regarding the respondent , for example age, experience, position, number of projects involved in, etc., whereas part two of the questionnaire gives all information with respect to perception and knowledge regarding risk management in oil and gas industry and part three of the questionnaire includes risk factors that will be aligned with likelihood scale, impact and the which will be get reviewed for determining the most crucial factors.

B. Expert Validity Of Contents

Identified risk factors from the literature were validated by the experts to find out whether the factors are practicable in the Indian oil and gas construction industry. This leads to adding or perhaps subtraction of factors beyond the factors identified in the literature review. Expert validation of the factors was carried out with 5 experts who're project managers with no less than ten years of experience. After the expert validation questionnaire was modified according to the necessary modifications as suggested by the experts and was used to gather the information from the respondents.

C. Questionnaire Distribution

After finalizing the risk factors from the expert validation, finalised questionnaire was distributed on the respondents. Criteria for the respondents are project engineers, the project or project manager's team involved in the oil and gas EPC project. Questionnaire was mainly distributed by face to face to ensure reliability of clear understanding and the data of the questionnaire for the respondent and in some cases questionnaire will be distributed through email.

D. Data Collection And Sample Selection

Primary data was collected through questionnaire survey and expert interviews. Secondary data will be collected from the literature [Journals, etc., reports, articles,] which helped in analysing the collected data with no bias. After the expert validation and finalizing the questionnaire, it was distributed to the respondents.

Data was mainly collected through questionnaire survey from the project engineers or perhaps the project managers who have experience in the oil and gas EPC projects in the portion of the India. Questionnaire survey was focused on questions dealing with identification of various risk factors and relation with project performance.

The data was mainly collected from oil and gas EPC construction projects in Some responses provinces in India. It focused on any representatives or project staff from the owner and contractor who're interested in the building projects. Questionnaire survey was carried out with project managers, engineers, contractors and consultants to get info about project's risks as well as the impact on cost, quality and schedule. Sample size of the questionnaire survey is fifty two.

E. Data Analysis

This section describes exactly how the collected data was analysed. The statistical analysis of results could be utilized to provide empirical support for a few generally accepted ideas on the issue.

The outcomes of the questionnaire survey were analysed to explore the participants' view on the risk factors and also the effect of those factors on the cost, quality and schedule of the oil and gas EPC construction projects. Nonparametric statistical techniques were used to analyse the research findings. Specifically as designed in questionnaire survey, my data is largely quantitative. On the conclusion of the data collection, the data was entered for analysis using SPSS 22. The Statistical Package for Social Science [SPSS] was used to deal with the statistical calculations. Several statistical methods have been used to analyse data to be able to discover the connection among variables. The methods as frequency distribution, descriptive statistics analysis and the Pearson correlation were used.

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F. Descriptive Statistics Analysis

Descriptive statistics are a pair of brief descriptive coefficients that summarizes a given data set, which may be a representation of the whole population or perhaps a sample. The measures used to refer to the data set are measures of central measures and tendency of dispersion or variability. Here mean and frequency distribution analysis are taken out. Mean is taken that is an indicator to report the central tendency to show the typical value in the distribution. The purpose of mean in this analysis is for ranking. Frequency will be the number of occurrences of a repeating event per time. It's accustomed determine the amount of times that particular variable occurred.

IV. RESULT AND DISCUSSION

A. Over View

This research defines that certain managers , employees have been interviewed in EPC oil and gas projects in India. Study has been conducted as mentioned in questionnaire and methodology part. The respondent levels in the surveyed projects are including project manager, project engineers, contract managers, site managers etc. Furthermore the questionnaire has four parts respondents profile, projects impact, risk factors, and information of risk factors on cost, Quality and Schedule.

B. Identification and Ranking of Risk Factors

The final list of risk factors in the form of survey questionnaires were distributed to the respondents of EPC oil and gas projects as mentioned before. Direct site visit, emailing or face to face interview were conducted to collect data. In order to determine the major risk factors in Engineering, Procurement and construction phase of the EPC oil and gas construction projects, the respondents were asked to rate the risk factors listed in the list. They were requested to judge two attributes of each risk: the frequency of likelihood [occurrence] and the degree of consequence [impact]. The respondents judged the frequency of likelihood [occurrence] through the five level judgement scale of frequently, likely, possible, unlikely and rarely. The similar scale was applied to the degree of consequences [impact] through the five level judgement scale of very high, high, medium, minor and negligible. Descriptive statistics and frequency distribution analysis were performed to rank the risk factors followed by the overall ranking according to the Engineering, Procurement and construction phases of the EPC oil and gas projects.

Descriptive Statistics of each phase are calculated

- Engineering phase.
- Procurement phase.
- Construction phase.

1) Descriptive Statistics of Engineering phase

Table 4.1 showing Descriptive Statistics of Engineering phase

Engineering Phase Risks	No.of Respondents	Risk index
"Scope uncertainty"	52	9.5
"Ineffective planning andmanagement	52	9.26
"Design changes and errors	52	8.77
"Inadequate project organization structure"	52	8.29
"Complex and delay in planning approvals and permit"	52	7.54
"License requirements"	52	5.04
"Unclear quality requirements"	52	8.03
"Inaccurate cost estimate	52	5.25
"Inadequate or lack of proper site information"	52	5.55
"Poor financial market"	52	5.26

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2) Descriptive Statistics of Procurement phase

Table 4.2showing Descriptive Statistics of Procurement phase

Procurement phase risk	No. of Respondents	Risk index
"Insufficient resources, equipment and material"	52	8.041203
"Material networking"	52	5.585636
"Unfamiliarity with required subcontractors and vendors"	52	6.337376
"Price fluctuations"	52	7.455636
"Import/export restrictions"	52	5.3845
"Supplier availability"	52	8.387591
""Poor quality materials"	52	7.772403
"Inappropriate procurement strategy"	52	5.131151
"Change in currency & tax rates"	52	4.1538
"Unfamiliarity with design, codes, standards and construction requirements"	52	8.100199

3) Descriptive Statistics of Construction Phase

Table 4.3 showing Descriptive Statistics of Construction Phase

Construction Phase risk	No. of Respondents	Risk index
"Incompetence of projectteam"	52	10.08
"Construction cost overrun"	52	9.83
"Construction time delay"	52	9.46
“Tight project schedule"	52	8.76
"Poor safety management"	52	8.40
"Accidents"	52	5.69
"Unavailability of labour"	52	5.37
"Poor competency of labour"	52	6.33
"Strikes or labour problem"	52	4.69
"Environmental risks"	52	4.92

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C. Descriptive Analysis For Impact Of Cost, Schedule And Quality

To understand the strength of relationship between risk factors and impact on cost, schedule and Using 52 questionnaires, SPSS 22 was applied to the actual implementation part of the questionnaires. For impact on cost, schedule and quality a scale was applied to the degree of impact through the five level judgement scale of very high, high, medium, minor and negligible. Descriptive statistics and were performed to find the means of the corresponding risk factors. The values obtained for the mean represents the impact level of the particular factor corresponding to cost, schedule and quality. The means of the risk factors corresponding to cost, schedule and quality were ranked accordingly in every phase. The top critical risks in every phase corresponding to the cost, schedule and quality were identified.

Based on the analysis risk mean value of all the factors were found. Similarly the correlation coefficients of all the risk factors are calculated and are tabulated as shown in the figure. This table represents the overall comparison of the total risk factors in each phase with their respective cost, schedule and quality correlation coefficients. This is done actually to find out the risk factor which is commonly affecting more than one phase.

1) In engineering phase the top 5 risks based on risk mean level, cost correlation coefficient values, schedule correlation coefficient values and quality correlation coefficient values are marked in yellow colour.
2) In procurement phase the top 5 risks based on risk mean level, cost correlation coefficient values, schedule correlation coefficient values and quality correlation coefficient values are marked in green colour
3) In construction phase the top 5 risks based on risk mean level, cost correlation coefficient values, schedule correlation coefficient values and quality correlation coefficient values are marked in orange colour

calculating risk index

likelihood	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	impact					

Risk	likelihood	Impact
1	1	4
2	1	4
3	1	4
4	0	0
5	2	8
6	0	0
7	1	4
8	1	4
9	0	0
10	0	0

Table no 4.4 likelihood risk matrix

D. Output of Qualitative Risk Assessment

Risks are classifies into levels that are different [high, low risk].The output and medium of quantitative risk evaluation is updated chance register including rank of risk factors, group of risks, list of immediate risks that need urgent implementation of remedy, list of danger for additional response and assessment.

1) Description of Likelihood of Risk

Risk Level	Description
5	Frequent
4	Probable
3	Occasional
2	Remote
1	Improbable

Table no. 4.5 Likelihood of risk

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2) Description of Consequences of Risk

Risk Category	Description
5	Very high
4	Major
3	Medium
2	Minor
1	Negligible

Table no. 4.6 consequences of risk

Risk management strategy includes responsibilities and roles, risk evaluation definition, risk category for low, high risk, moderate, the time and extreme risk and finances required to conduct project risk management. Outputs on the Risk managing plan are important inputs to risk control. Risk management program is able to include probabilistic evaluation of the task, probability of getting the price and time goals, prioritized listing of quantified risk, along with trends in quantitative threat analysis benefits.

V. CONCLUSION

The risk management process is most important used strategy to find and nullify or reduce the risk in the projects .We calculated all types of risk that will affect the project w.r.t time , cost , schedule and quality of the work. During this process we faced the risks which highly affect jujmm the field of engineering , procurement and construction phase of the oil and gas project This Project represents the research results obtained through questionnaire which is surveyed in the oil and gas industry projects. There are total five probable critical risks in every phase of EPC project were identified based on an extensive assessment of the likelihood of theirs of values and occurrence of consequence on project objectives. 15 out of total risk factors are found to be critically occurring risks in the oil and gas EPC projects.

1) Top Five Critical Risk Factors in the Engineering Phase

1] Scope uncertainty, 2] Ineffective planning and management, 3] Design changes and errors, 4] Inadequate project organization structure, 5] Unclear quality requirements.

2) Top Five Critical risk Factors in the Procurement Phase

1] Insufficient resources, equipment and material, 2] Supplier availability, 3] Unfamiliarity with design, codes, standards and requirements, 4] Defective materials and 5] Price fluctuations.

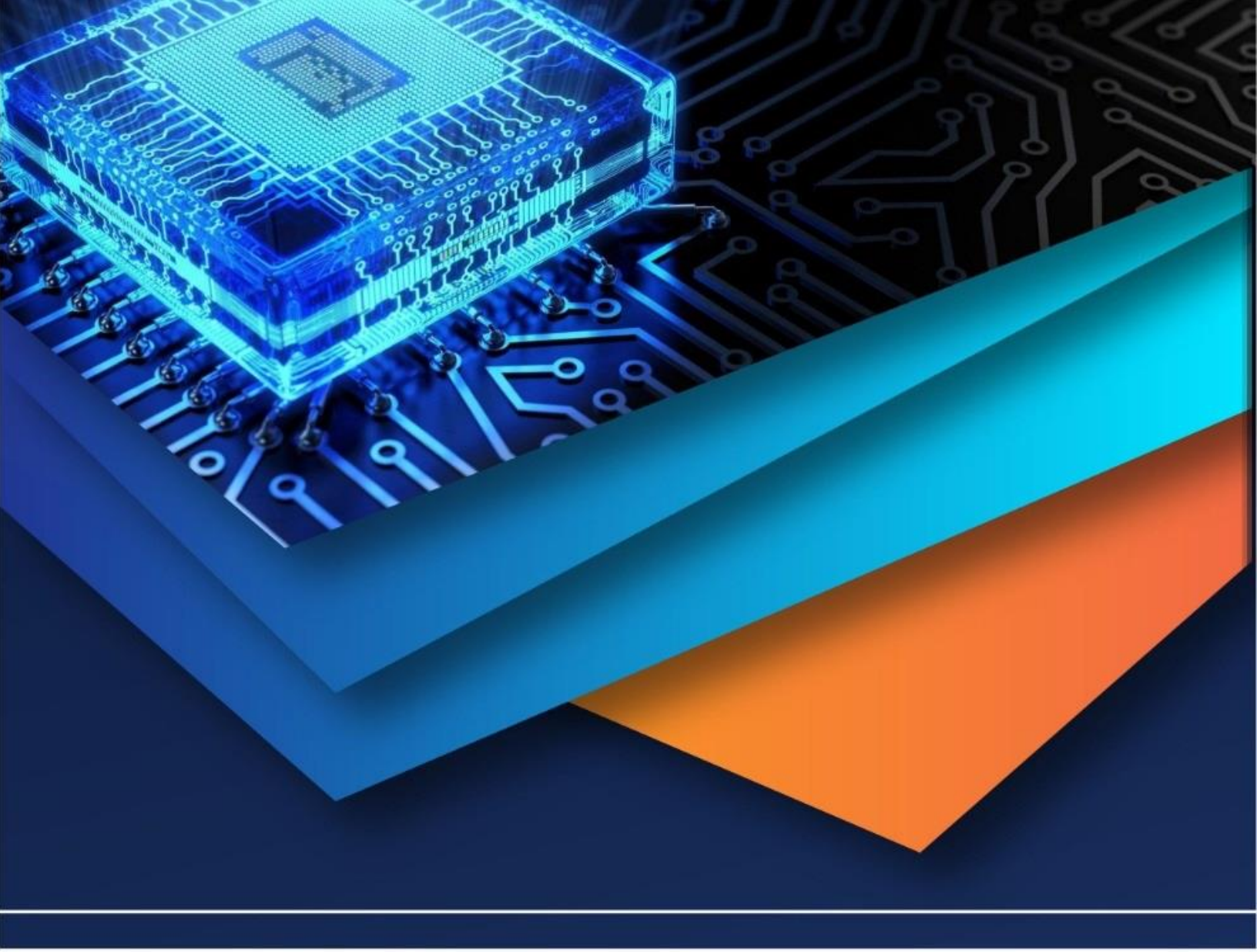
3) Top Five Critical Risk Factors In The Construction Phase Are

1] Incompetence of project team, 2] Construction cost overrun, 3] Construction time delay, 4] Tight project schedule and 5] Poor safety management.

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