A Review on Risks and Project Risks Management: Oil and Gas Industry

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Abstract—this paper is a literature reviews of risks and projects risk management for oil and gas industry. Overview of the oil and gas operations such as upstream and downstream activities forwarded and elaborated for further understanding. Literatures on risks, definition, types of risks forwarded in this paper to illustrate the importance of risks management. Poor risks management normally lead to project failures, hence project risks management discussion forwarded in this paper. Usually, project risks management for oil and gas industry will be centered towards upstream activities, if wrong decisions were made it might cause losses of trillion or billion or millions of USD. Hence, this paper is to highlights possible areas to be explored for oil and gas practitioners and academics to further enhance their operations, and eliminate losses due to poor project risks management.

Index Terms— risk, risk management, strategic risk management, project risk management

1 INTRODUCTION

THis paper is a literature review on risks and risks management for oil and gas industry. Oil and gas industry highly operated in a project based environment, whereby each tasks highly structured in such a way a single operation might involve several small projects in order to ensure the running of the operation will be less risky and more efficient. Efficiency of an oil and gas industry highly dependent on the success or the completion of several small project. According to [9] the success of a project depending on the ability of the management to manage risk prone changing environments within the framework of the project. Furthermore, project managers usually trying to minimize the uncertainty and risk; however, normally during the process project managers either underestimate or overestimate risks [21].

2 LITERATURE REVIEW

2.1 Overview Oil and Gas Operations

Oil and gas operations usually divided into two main activities which are upstream and downstream. Usually, the most critical operation and highly risky operation usually centered at the upstream activities. Below further overview of oil and gas activities.

2.1.1 Upstream and Downstream Activities in Oil and Gas Industry

Upstream activities are activities that happened before processing and refining of hydrocarbon. Those activities are exploration, conceptual development and production [30]. Normally, upstream exploration and production involved the highest investment for new product development due to exploration to discover reservoirs, production and operation, drilling and completion [13].

Downstream activities involves processes after oil were extracted and transported to crude oil terminals. Most of the activities involving processing and refining of the crude, petrochemical plants, logistic and retail transactions. Normally downstream activities require industrial plants, pipelines, and storage services [13], [30]. Table below illustrate the different between upstream and downstream in oil and gas industry.

TABLE 1:
UPSTREAM AND DOWNSTREAM ACTIVITIES IN OIL & GAS INDUSTRY

Upstream Activities
1. **Exploration**: analyzing and interpreting seismic data to determine the potential of hydrocarbon reserves; drilling of test wells.
2. **Conceptual Development:** performing screening studies to determine the most efficient and cost effective method to produce potential hydrocarbon sources. This would include selection of facilities (floating or moored structures), transport of hydrocarbon from field to customer (pipeline, floating storage and offloading (FSO) vessels), corrosion mitigation strategies, and safety aspects of the operations.
3. **Development**: project management of construction, detailed engineering, optimum well location, transport of facilities to location and commissioning of facilities.
4. **Production**: maintenance strategies, planning budgets, analysis of supply and demand, and retrofit work to maintain or meet new production targets.

Downstream Activities
1. Refining (gas processing and transmission)
2. Gas distribution
3. Retail
4. Petrochemicals

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2.2 Risks

[35] defined risk as a problem that might cause losses or might threaten the success of a project. Normally in a project, "risk" is a potential problem that will alleviate cost, schedule or technical success that will harm quality of the products and morale of employees [14].

Risk can be divided into two which are 'stake' and 'uncertainty', whereby as for 'stake' it will be evaluated whether it might lead to financial gain or loss, and for uncertainty it is highly dependent on time and situation [15].

2.3 Risk Management

Risk management can be defined as a strategic business process, whereby management have to assess whether the business activities are consistent with its stated strategic objectives and how risk management is linked to investment and growth decisions [15]. Most risk management studies concentrated towards prevention of failures and understanding on the causes of the failures and the reasons for the failures to occur. Risk management allows for reliability of project design due to formal method or procedures to approve any relevant project, and added value because it allows for high performance, efficient cost management, and meeting project deadlines [1], [31].

2.4 Project Management

Project management involves activities such as project planning, project execution and project monitoring [21], [28]. According to [5], 'The Iron Triangle' (cost, quality, and time) (Refer to Figure 1) for project management was developed by Oisen during 1950s, and it was used by the British Standard for project management definition.

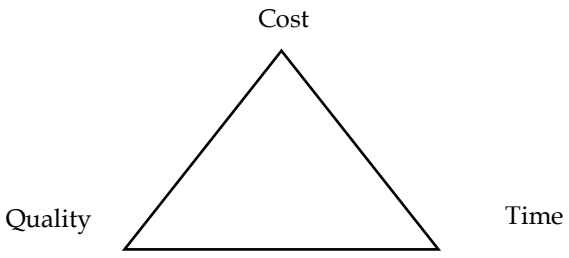

Figure 1: The Iron Triangle

Source: [5]

Project management define by British Standard for project management BS6079 11996 as the planning, monitoring and control of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time at specified cost, quality, and performance [5].

Further, [5] had posited that criteria for success comprised of the delivery stage (the process), and post-delivery stage (systems and benefits). Table 2, below depicts the components for square route to understanding success criteria.

TABLE 2
SQUARE ROUTE TO UNDERSTANDING SUCCESS CRITERIA

Iron Triangle	The Information System	Benefits Organization	Benefits Stakeholder/ Community
Cost Quality Time	Maintainability Reliability Validity Information-quality use	Improved efficiency Improved effectiveness Increased profits Strategic goals Organizational learning Reduced waste	Satisfied user Social and environmental input Professional learning, contractors profits Capital suppliers, content project team, economic impact to surrounding community

Source: [5]

2.5 Project Management Triangle

A review on project scope, costs, quality and scheduling forwarded for project management triangle.

2.5.1 Project Scope

In a study conducted by [33] project scope is identified as one of the criteria for the greatest problem under project definition. Further, [26] on government ICT project failures showed that complexity/size factors as one of the factors contributed to project delay or failures.

2.5.2 Project Cost

The cost is used as an indicator whether the project able to meet the schedule or able to complete on time. [25] proposed an earned readiness management (ERM) in scheduling, monitoring and evaluating a project in order to ensure success. [7] had integrated the calculation of expected completion probability by utilizing the Line of Balance Technique (LOB) with Program Evaluation and Review Technique (PERT), and Repetitive Project Evaluation and Review Technique (RPERT) to develop software for repetitive construction project with identical activities. Further in a study on factors for waste water construction cost variation or cost overrun in Egypt showed that the cost variation dependent on lowest bidding procurement method, additional work, bureaucracy in bidding or tendering method, wrong method of cost estimation, and funding issues are the most critical factors for cost variation, in addition other factors that lead to cost overrun includes inaccurate cost estimation, mode of payment and financing,

unexpected ground conditions, inflation and fluctuation in prices of raw materials [8].

2.5.3 Project Quality

In order to minimize failures, designers or project managers must have excellent knowledge on the causes of project failures that might be due to poor project design, process or outside of the system (users, environment) [29], [6], [31].

2.5.4 Project Scheduling

In a study conducted by [6], project delayed can be categorized by seven main factors which are consultants related factors, contractor related factors, design related factors, equipment related factors, external related factors, labors related factors, and materials related factors. In another study on project scheduling conducted by [11] the study applied project cards that integrate dynamic scheduling that comprise of baseline schedule, risk analysis and project control with new two components identified which is project authenticity and tracking authenticity.

According to [23], project management methodologies require software support systems, until late 1980s most project management tools were software packages designed for project scheduling such as PERT (Program evaluation and review technique), ADM (Arrow diagramming method) and PDM (Precedence diagramming method). Those three software able to formed the basis for planning and predicting, visibility and enabled management to control the program, assisted management to handle the uncertainties, provided facts for decision making, ability to determine manpower, material and capital requirements, and ability to provide structure for information reporting.

However, project leadership could not be replaced with computer software packages, but it can be used as a reference for decision making purposes. In addition, 95% of the project management software focuses on planning, scheduling, and controlling project should be created for the initiation of a project and also the closure of a project [23].

Further, in most project management researches nowadays, the used of 'soft' and 'hard' have been used quite extensively. Usually, 'soft' is referring to human factor, whereas 'hard' is referring to technical performance and efficiency (Pollack, 2004). The 'soft' part in project management is quite clear as it usually involves human behavior. However, it is quite difficult to make generalization for the 'hard' issues in project management.

TABLE 3

HARD VS. SOFT IN PROJECT MANAGEMENT

Hard	Soft
Hard end project: technical performance and efficiency [18] (to reduce uncertainty)(Closed system approach such as Systems Engineering, System Analysis and System Dynamics)	**Soft end project:** goals that value relationships, culture and meaning [18] (to reduce ambiguity)
Hard Skills: contracting, business finance, integrated cost and schedule control, measuring of work performance, monitoring of quality, and conduction of risk analysis [20].	**Soft Skills:** negotiation, change management, understanding and dealing with needs of peers, staffs and managers [20].
Hard Issues: time, cost, quality to measure project success [16]	**Soft Issues:** community perception, safety, environmental impacts, legal acceptability, political, and social impact [22].

For examples, project failures due to poor selection of vendors or suppliers at the expense of business profits are detrimental to any businesses [8], [29], can be combination between 'hard' and 'soft' elements in project management.

2.5 Project Risk Management

Project risk management involved identification, assessment, and prioritization of risks through coordination and economic application of resources in minimizing, monitoring and controlling the probability consequences of unfortunate events that will maximize the success of a project. In project risk management there are five critical factors to be considered which are planning risks, risks identification, qualitative risk analysis, quantitative risk analysis, and monitoring risks [12], [32], [24].

2.6 Potential Risks in Oil and Gas Projects

2.6.1 Reasons for Poor Project Results

In a study by [27], it was found that large oil and gas construction project cost overruns and losses on labor productivity in Canada were due to management deficiency in managing scope, time, cost, quality, productivity, tools, scaffold, equipment, materials, and lack of leadership. In another study by [19], there are 20 reasons that might lead to poor project results, schedule and cost overruns for Canadian oil sand projects, as listed below:

1. Lack of experienced owner and contractor sources.
2. Overall quality of owner and contractor management capabilities.
3. Ineffective organizational and alliance structures for mega projects.
4. Inappropriate delegation of owner responsibilities to contractors.
5. Lack of clear definition of lines of authority and management responsibilities.
6. Lack of discipline and ineffective control of project scope.
7. Complexities of major expansions to existing operat-

ing plants.
8. Customization of owner specification requirements,
9. Level of project definition and proximity not well understood.
10. Lack of familiarity with the climate, safety requirements, environmental constraints, governmental regulations, construction practices.
11. Scarcity of qualified craft workers, high labor costs, inconsistent productivity.
12. Many completing mega-projects affecting resources and labor availability.
13. Ineffective contractual arrangements and lucrative contracting environment.
14. Ineffective material management plans and premature field mobilization.
15. Inappropriate management influence of cost estimates to meet economic hurdles and ignoring project reality.
16. Ineffective project control systems and project development practices.
17. Lack of discipline and consistent application of project code of accounts to allow effective control and collection of actual costs.
18. Lack of owner front-end estimating capability and project control personnel.
19. Lack of appropriate risk analysis expertise.
20. Lack of owner historical project systems and databases on the location of the project conditions.

2.6.2 Possible Sources for Uncertainty

According to [10], possible sources of uncertainty for oil and gas industry might be due to several sources as listed below:

1. Poor estimates of time and cost.
2. Lack of a clear specification of project requirements.
3. Ambiguous guidelines about managerial processes.
4. Lack of knowledge of the number and types of factors influencing the project.
5. Lack of knowledge about the interdependencies among activities in the project.
6. Unknown events within the project environment.
7. Variability in project design and logistics.
8. Project scope changes.
9. Varying direction of objectives and priorities.

2.6.3 Potential Risks

For oil and gas operations in either Canada or other northern countries the potential risks as shown on Table 4, and those risks are related to environment or weather which is beyond normal human being control [3]. However, mitigation plan can be secured to reduce the damage from those risks.

TABLE 4
POTENTIAL RISKS IN OIL & GAS PROJECTS

Potential Risk	Items
Exploration	1. Subsidence. 2. Wave loading. 3. Loss of surface water access. 4. Delays due to species migration.
Production	1. Early season delays. 2. Pad damage. 3. Loss of surface water access. 4. Production interruption. 5. Ice road decreased trader's travels.
Transport and terminals	1. Ice load variation. 2. Damage to coastal facilities. 3. Shipment interruptions. 4. Improved for reduced shipping lanes or seasons.
Pipelines	1. Thaw subsidence and frost jacking. 2. Wildfires.
Refining and processes	1. Loss of access of water. 2. Flooding. 3. Loss of peak cooling capacity.
Neighboring communities	1. Loss of species and habitat. 2. Water. 3. Storm impacts on key infrastructures.

Source: [3].

3 Discussion

3.1 Methods to Avoid Project Failures

There are few methods that can be used to avoid project failures which are Failure Mode and Effect Analysis (FMEA), for bottom up analysis, and Hazard and Operability Analysis (HAZAOP) and What if checklist for top bottom analysis [31]. According to [31], in designing a product or project, few methods can be used to minimize the failures of a product or project design by performing Fault Tree Analysis (FTA) for top down analysis, and Failure Mode and Effect Analysis (FMEA) for bottom up analysis. In addition, Hazard and Operability analysis (HAZOP) and What if checklist, also needed to reduce or minimize the causes of failures. However, new method TRIZ is introduced that forces users to take much more proactive approach in identifying causes of problems, in order to allow to 'invent the failure' and then to re-transform the invented failure into a means of preventing the failures in the future.

[7] had integrated the calculation of expected completion probability by utilizing the Line of Balance Technique (LOB) with Program Evaluation and Review Technique (PERT), and Repetitive Project Evaluation and Review Technique (RPERT) to develop software for repetitive construction project with identical activities. Further in a study on factors for waste water construction cost variation or cost overrun in Egypt showed that the cost variation dependent on lowest bidding procurement method, additional work, bureaucracy in bidding or tendering method, wrong method of cost estimation, and funding issues are the most critical factors for cost varia-

tion, in addition other factors that lead to cost overrun includes inaccurate cost estimation, mode of payment and financing, unexpected ground conditions, inflation and fluctuation in prices of raw materials [8].

However, for a study on ballast water treatment it discusses the holistic assessment that includes environment (manufacturing, operation, end of life), social aspects (workers, users, local community, society), exposure assessment, and effects assessment [34] to eliminate project failures.

3.2 Theories Related to Project Risk Management

According to [2], Resource Based View or Resource Based Theory originated from economic disciplines, however the application of the theories has extended towards management, sociological, information management and knowledge management. From the analyses conducted by them from compilation of various literatures on Resource Based Theory, about 73.8 percent in the area of general management and strategy from 1992 to 1994, and 57.7 percent in year 1998 to 2000. The latest analyses of theories indicated that it had evolved from economic towards management fields such as marketing, organizational studies, production operation and management [2]. Other than that, according to [17] resource based theory focuses on: 1. performance differences between firms highly dependent on the measure whether the firm owns unique inputs and capabilities, 2. the level of the resources whether at reputation level or dealer loyalty, 3. Acceptable proxies for firm resources (R&D capabilities or management proclivities), and 4. New IO game theoretical approach (3 forces: 1. Own assets, 2. Competitors assets, 3. Constraints from broader industry and public policy environment).

Further, according to [4], Resource Based View is actually a strategic management theory that has been used extensively by managers in project management. It is used to examine how resources can increase competitive advantage by being able to create added value than rivals and simultaneously gained higher return from investments According to [24] a project management is equivalent to temporary organization. From the research, they proposed that 'action' is not necessarily the consequence of decision, whereby a decision can be made after the action in order to legitimate the earlier action. Action might supersede decision when 1. Time is crucial; 2. Task, 3. Team, and 4. Transition [24].

[32] had discussed integrated reliability theory towards logistics park construction project risk control in order to avoid risk and increase the reliability of the project with a minimum total investment. At decision stage the factors identified are function orientation, location and investment decision. As for construction preparation, the factors that considered as important risk will be land acquisition, survey and design, tendering and bidding, and financing and preparation. For construction phase the factors identified are construction, facilities installation and commissions, contract management, equipment and material management, security management, and supervision. Final phase, which is the handout and operation consisted of acceptance and handover, merchant and operation management.

Both theories are quite relevant to be used in project risk management.

4 IMPLICATIONS

4.1 Industry

The Oil & Gas Industry had identified few sources of risks and actually, those risk can be divided into controllable vs. non-controllable risk or hard risk vs. soft risk. By clustering those risks or issues, potential mitigation plans can be initiated in order to eliminate as much risks as possible.

4.2 Future Research

More extensive theories, models and management methods should be applied or adopted for Oil & Gas research due to its complicated risks factor and business nature. By doing so, more contribution towards the industry could be generated in enhancing efficiency, increasing quality, and reducing cost and time.

5 CONCLUSION

Project risk management yet to be studied extensively, and not much study has been conducted in the Oil and Gas Sector, as such this review provides risk factors for Oil and Gas project.

In addition, project risk management allows the identification, assessment, and prioritization of risks through coordination and economic application of resources in minimizing, monitoring and controlling the probability consequences of unfortunate events that hopefully, will maximize the success of a project.

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